USDA United States Department of Agriculture

Cove-East Fork Virgin River Watershed Project
Kane and Washington County, Utah
Draft Plan-EIS Frequently Asked Questions (FAQs)

Unique Identification No.: EISX-005-53-049-1288324567 September 2026



Q: What is the Preferred Alternative?
A: The Preferred Alternative includes construction of a 6,000-acre-foot reservoir and dam with appurtenances, a recreation area, pipelines, and a booster pump station.

Q: What Alternatives were considered?
A: Several alternatives were considered during the planning process including alternative reservoir sites, alternative reservoir sizes, and non-structural measures (including water conservation). Three alternatives were carried forward for detailed analysis in the Watershed Plan Environmental Impact Statement: 1) A No Action Alternative (which includes existing and planned conservation measures), a 3,000-acre-foot reservoir, and a 6,000-acre-foot reservoir (the preferred alternative). Ten additional reservoir locations and/or sizes were eliminated from detailed study due to being infeasible, not meeting the project purpose and need, or being more environmentally impactful, dangerous, or costly.

Q: Where will the materials be sourced from?
A: Embankment materials for the proposed dam will be taken primarily from the reservoir basin. Three additional borrow pit sites will be used to supply riprap and gravel. Use of the borrow pit sites would result in a maximum of 5.7 acres of additional disturbance.

Q: Why is the project being proposed?
A: The project is being proposed to address annual water shortages experienced by local agricultural users served by the Glendale, Orderville, and Mt. Carmel irrigation companies. Additionally, Washington County is experiencing stressed Municipal and Industrial (M&I) water availability.

Q: Who benefits from the project?
A: The proposed project would provide the following long-term benefits:

- Increased water availability to local agricultural users in Kane and Washington Counties.
- Increased water availability to municipal users in Washington County.
- Increased water security for present and future residents in both Kane and Washington Counties.
- Added recreation opportunities for Kane County and the surrounding communities.

Q: What would the water be used for?
A: Water from the proposed reservoir would be made available to existing agricultural fields near Mt. Carmel and Hurricane, and for M&I uses in Washington County.

Q: How will the reservoir affect downstream flow?
A: The proposed reservoir would store excess water during high-flow periods and release it during low-flow periods to meet irrigation and water conservancy demands. Although the timing of flows would change, modeled flow alterations would be small compared to the natural seasonal variability of EFVR flows. Yearly monitoring would continue to be required to regulate flows on the EFVR.

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Q: When would water be diverted to the reservoir and released from the reservoir?
A: Water would be diverted from the East Fork Virgin River (EFVR) at the Orderville Diversion and delivered by pipeline to the proposed reservoir between November 1 and May 31, as required by the *Zion National Park Water Rights Settlement Agreement of 1996*. No diversions are allowed outside of this period. Releases from the reservoir would be timed to supplement low, natural flows. Water for Long Valley agricultural purposes would be released into existing and proposed irrigation pipelines during the summer months, when natural flows are lowest. Water committed to Washington County could be released any time during the year to meet demand but would most likely be during the summer months for agricultural needs and during the fall and winter months for M&I needs.

Q: How will the reservoir affect downstream habitat?
A: The EFVR riparian corridor is adapted to substantial natural variation in streamflow, including episodic flood events, spring runoff, and seasonal low flow periods. Modeled project-related changes in flow, depth, and width would remain small relative to the river's existing natural variability. As a result, the project is not expected to adversely affect existing downstream habitat.

Q: What measures will prevent non-native fish from entering the East Fork Virgin River?
A: The proposed reservoir intake would include a fish screen with a 1-inch maximum pore opening to prevent fish and debris from entering the pipeline to the Orderville Hydroelectric Power Plant. The hydroelectric facility utilizes two Turgo Impulse turbines, which focus water through small nozzles at high pressure and velocity into the turbines. The combination of the small nozzle size, high velocity, and sudden pressure drop would make it highly unlikely that any fish that might make it into the pipeline would survive. Additionally, prior to stocking the proposed reservoir with fish, a management plan will be developed to ensure that non-native fish species do not escape from the reservoir into the EFVR. The management plan would meet non-native stocking and control requirements.

Q: What is the likelihood of a dam failure and what protection would be in place for downstream properties?
A: The dam would be classified as a high-hazard structure to safeguard downstream infrastructure, and further detailed analyses would be conducted to include strategies for reducing the probability of a dam breach. However, like all dams, the risk of failure exists and would be mitigated by an Emergency Action Plan.

Q: What is the total project cost and benefits?
A: The total cost estimate for the preferred alternative is $39,730,000 with the NRCS contributing $24,889,000 and the sponsors contributing $14,841,000. The average annual benefit is projected to be $1,397,000, and the benefit-to-cost ratio is expected to be 1.03, which includes monetized and non-monetized benefits.

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Draft Watershed-Plan Environmental Impact Statement

for the Cove-East Fork Virgin River Watershed Project

Kane and Washington Counties, Utah
Unique Identification No.: EISX-005-53-049-1288324567



Lead Federal Agency
Natural Resources Conservation Service

Date
September, 2026

Sponsoring Organizations
Kane County Water Conservancy District and Washington County Water Conservancy District

In cooperation with
National Park Service, Utah Trust Lands Administration, Utah Public Lands Policy Coordinating Office, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Bureau of Land Management

Draft

Cove Reservoir Watershed and

Environmental Impact Statement

for the Cove-East Fork Virgin River Project

Kane and Washington Counties, Utah

Lead Agency: U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS)

Sponsoring Local Organization: Kane County Water Conservancy District; Washington County Water Conservancy District

Cooperating Agencies: National Park Service (Zion National Park), Utah Trust Lands Administration, Bureau of Land Management (BLM), U.S. Army Corps of Engineers (USACE), U.S. Environmental Protection Agency (EPA), and Utah Public Lands Policy and Coordinating Office

Congressional District: Utah Congressional District 2

Authority: This Watershed Plan and Environmental Impact Statement (Plan-EIS) for the Cove Reservoir Watershed has been prepared under the authority of the Watershed Protection and Flood Prevention Act of 1954 [Public Law 83-566 (PL 83-566) Stat. 666 as amended (and in accordance with the National Environmental Policy Act (NEPA) of 1969, PL 91-190, as amended (42 U.S.C. 4321 et seq.)). The Plan-EIS would be implemented under the PL 83-566 authorized purposes of agricultural water management, flood prevention, and public recreation.

This environmental document was initiated using the 40 CFR 1500-1508 (May 20, 2022) and 7 CFR 650 regulations. These regulations have recently been rescinded and replaced with U.S. Department of Agriculture (USDA) regulations found under 7 CFR 1b, published as a Final Rule in the Federal Register on April 3, 2026 (91 FR 17062). However, in a good-faith effort to fulfill NEPA's requirements, including Congressional timeline and considerations of fiscal restraints, the agency decided to continue to use 40 CFR 1500-1508 (July 31, 2023) and 1 CFR 650. This is permissible per the USDA policy guidance issued in the Final Rule's preamble. The Federal Register notice said: "if the NOI for an EIS [was] published more than 90 days prior to the publication of this final rule, the USDA subcomponent has discretion to continue applying the versions of NEPA regulations being applied before the publication of the NOI or to switch to applying 7 CFR 1b as published in this final rule."

Abstract: The Action Area for the Cove-East Fork Virgin River Project (Project) includes both Kane and Washington Counties. The proposed reservoir site Project is located near Orderville within the Upper Virgin Watershed in Kane County, Utah. Project implementation would enhance the reliability of agricultural water availability in the Orderville and Mt. Carmel areas of Kane County and the Hurricane area in Washington County, Utah.

Project development would also result in the creation of a public recreation opportunity at the proposed reservoir site and an increase of Municipal & Industrial (M&I) water to communities in Washington County. M&I water demand in the WCWCD service area is projected to exceed

existing capabilities as more municipal water providers join and receive water from the WCWCD system.

The need for this project is due to annual water shortages experienced by local agricultural users in the Orderville Mt. Carmel and Hurricane areas. Due to a difference in timing between the spring runoff within the watershed and the peak demand for agricultural water use, these users experience annual water shortages during the summer months. The NRCS preferred alternative (Alternative Two) for the Project is a 6,000-acre-foot reservoir. NRCS proposes constructing a 6,000-acre-foot reservoir and dam, along with principal and auxiliary spillways, recreational facilities, and necessary infrastructure. The dam would feature a 1,900-foot earthen embankment with a central clay core, at a maximum height of 90 feet. Two spillways would be installed. The total cost estimate for this alternative is $39,730,000 with NRCS contributing $24,889,000 and the Sponsors contributing $14,841,000. Water from the reservoir would be used by Orderville and Mt.

Carmel agricultural users in Kane County. Water would also be released downstream via the East Fork Virgin River for agricultural and M&I use in Washington County. The proposed action would comply with the Zion National Park Water Rights Settlement of 1996 (United States, Utah, Washington District, & Kane District).

Comments and Inquiries: Comments and inquiries must be received within 45 days of publication of the Notice of Availability (NOA) for the Draft Plan-EIS in the Federal Register (Regulations.gov). Submit comments and inquiries to: Ammon Boswell, Watershed Program Manager, USDA, NRCS, 1950 West Main Street, Tremonton, Utah, 84337; Telephone: (435) 459-1621; or email: ammon.boswell@usda.gov.

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Mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410;

Fax: (202) 690-7442; or

Email: program.intake@usda.gov.

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Ancestral Land Acknowledgement

NRCS, through the review of the National Park Service Native American Graves Protection and Repatriation Act Native American Consultation Database (NACD), the U.S. Department of Housing and Urban Development Tribal Directory Assessment Tool (TDAT), the Bureau of Indian Affairs (BIA) website, and the Utah Division of Indian Affairs (UDIA) website, and previous National Environmental Policy Act (NEPA) and National Historic Preservation Act (NHPA) consultations, identified 11 Federally Recognized Tribes. The Hopi Tribe, Kaibab Band of Paiute Indians of the Kaibab Indian Reservation, Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony, Moapa Band of Paiute Indians of the Moapa River Indian, Navajo Nation, Paiute Indian Tribe of Utah, Pueblo of Zuni, San Juan Southern Paiute Tribe of Arizona, Ute Indian Tribe of the Uintah & Ouray Reservation, Ute Mountain Ute Tribe, and White Mesa Ute Council have ancestral land, traditional use, and/or traditional cultural property claims within the project area and the immediate vicinities. Consultation with these 11 entities will continue throughout this plan's development. Refer to Appendix A for that correspondence.

WATERSHED PLAN AGREEMENT (TO BE INCLUDED IN FINAL PLAN–EIS)

Summary (Office of Management and Budget Fact Sheet)

Summary Watershed Plan-Environmental Impact Statement Document

For

Cove-East Fork Virgin River Watershed Project

Kane and Washington Counties Utah

Utah Congressional District 2

Authorization	Public Law 83-566 Stat. 666 as amended (16 U.S. Code Section 1001 et. Seq.) 1954
Sponsors	Kane County Water Conservancy District (KCWCD); Washington County Water Conservancy District (WCWCD)
Cooperating Agencies	National Park Service (Zion National Park); Utah Trust Lands Administration; Utah Public Lands Policy Coordinating Office; U.S. Army Corps of Engineers; U.S. Environmental Protection Agency; U.S. Bureau of Land Management
Purpose and Need	The project purpose is to sustain agriculture and improve recreation opportunities in Long Valley, Utah, and to provide agricultural and Municipal & Industrial (M&I) water to Washington County, Utah. There is an existing need to increase water availability during the summer irrigation months due to persistent water shortages and provide water for an additional water-based recreation site and the existing hydroelectric power plant
Description of the Preferred Alternative Plan	The Preferred Alternative would consist of developing a 6,000-acre-foot reservoir with appurtenances, a recreation area, pipelines, and a booster pump station. Water from the proposed reservoir would be made available to existing agricultural fields near Mt. Carmel and Hurricane, and for M&I uses in Washington County.
Resource Information	**Watershed Name:** East Fork Virgin River Watershed **Latitude and Longitude:** 37.2875 degrees/-112.628 degrees **Eight-digit Hydrologic Unit Number:** 15010008 **Climate and Topography:** July average high/low: 90/55 degrees Fahrenheit (F) January average high/low: 47/20 degrees F, Semi-desert, low hills, 5,449 feet above sea level, 16.81 inches average annual precipitation. **Watershed Size (Acres):** 152 square miles (97,449 acres)

Land Uses (Acres): Irrigated lands within the project area in Kane County: 1,100 acres.

Irrigated lands within the project area in Washington County: 770 acres

Private residences, out buildings, livestock grazing, and limited recreation opportunities are also present within the proposed project area.

Land Ownership:

Private: 99.92 percent

State–Local: 0.07 percent

Federal: 0.01 percent

Population and demographics (Kane County): 8,425 people

White—93.9 percent; African American—1.0 percent; American Indian—1.8 percent; Asian—0.9 percent; Native Hawaiian/Pacific Islander—0.1 percent; Hispanic/Latino—5.6 percent; Two or More Races—2.4 percent[1]

Relevant resource concerns that have been identified through scoping: East Fork Virgin River (EFVR) flow reductions, nonnative vegetation, recreation, traffic and other impacts associated with construction, soils, streambank erosion, water budget and water quality, rare fish and other aquatic species, endangered species, wild and scenic rivers (WSR), Areas of Critical Environmental Concern (ACEC), designated wilderness, Wilderness Study Areas (WSA), Research Natural Areas (RNA), climate variation, groundwater, wetlands, cultural resources and agricultural water efficiency improvements

Alternative Plans

Two Action Alternatives and a No Action Alternative are being considered in the Watershed Plan Environmental Impact Statement (Plan-EIS). After careful examination, 10 other potential alternative reservoir sites were considered and eliminated from detailed study as they were infeasible, did not adequately meet the purpose and need for the project, had a greater negative environmental impact, presented safety concerns, or were cost prohibitive. These sites are Swapp, Lower Swapp, Lower Lydia's Canyon, Upper Lydia's Canyon, Dry Wash, Orderville, Lower Muddy Creek, Upper Muddy Creek, Lower Stout Creek, and Upper Stout Creek Sites. A non-structural alternative was also considered; however, it would not meet the purpose and need of the Preferred Alternative and is not analyzed in detail in the Plan-EIS.

Alternative 1: No Action	Under the No Action Alternative, construction activities associated Alternative with the project would not occur, and the KCWCD and WCWCD would continue to operate and maintain their existing systems. The need for the project would still exist. The two Districts would address continuing agricultural water and M&I shortages as other sources of funding became available.
Alternative 2: 6,000-acre Alternative	Alternative 2 would consist of a 6,000-acre-foot reservoir and earthen dam, two pipelines, a booster pump station, an access road, principal and auxiliary spillways, recreational facilities, and all necessary infrastructure. Three borrow pits outside of the reservoir basin would supply materials for the dam construction. Embankment material would be taken from within the reservoir basin. The reservoir would be located near Orderville in western Kane County, Utah.
Alternative 3: 3,000-acre Alternative	Alternative 3 would consist of a 3,000-acre-foot reservoir and earthen dam, principal and auxiliary spillways, a recreation area, pipelines, and a booster pump station. Three borrow pits outside of the reservoir basin would supply materials for the dam construction. Embankment material would be taken from within the reservoir basin. The reservoir would be located at the same location as the 6,000-acre-foot reservoir near Orderville in western Kane County, Utah
Mitigation Measures	Implementation of the Preferred Alternative would comply with all applicable federal and state laws and regulations, as well as local zoning and building ordinances. Appropriate Best Management Practices (BMPs) would be used. Consultation between the Natural Resources Conservation Service (NRCS), Individual Tribal Nations, Utah State Historic Preservation Officer (SHPO) regarding compliance with Section 106 of the National Historic Preservation Act has occurred. Construction activities would be limited to the smallest extent practicable within the project area. Construction personnel would adhere to all state and NRCS fire prevention and suppression requirements. Disturbed areas (excluding the reservoir, dam, and borrow pit sites) would be restored to preconstruction conditions after construction completion. No ground disturbance would occur during or immediately following precipitation events or under any wet conditions that would create deep ruts. Disturbed areas would be recontoured. A Stormwater Pollution Prevention Plan that contains erosion and sediment control/pollutant prevention BMPs would be required and implemented. To resolve adverse effects to National Register of Historic Places (NRHP)–eligible sites, an inadvertent discovery plan will be prepared and supplied to construction crews, in addition to the preparation and execution of a Memorandum of Agreement.

The KCWCD would be responsible for compliance with applicable local, state, and federal regulations related to the use, handling, storing, transporting, and disposing of hazardous materials on non-federal lands.

All federal, state, and local laws/regulations pertaining to pollution and contamination of the environment would be followed to prevent pollution of surface water, groundwater, soil, and air with any hazardous materials.

Table S.1. Project Costs.

Project Costs	**Public Law 83-566 Funds**	**Other Funds**	**Total**
Construction	$20,320,000	$13,893,000	$34,213,000
Engineering	$4,200,000	$0	$4,200,000
Real Property Rights	$135,000	$705,000	$840,000
Project Administration	$233,000	$233,000	$467,000
Permits	$0	$10,000	$10,000
TOTAL COSTS	**$24,889,000**	**$14,841,000**	**$39,730,000**

Project Benefits

The primary benefit of implementing the proposed project would be improved availability and distribution of agricultural water for local agricultural users in Kane and Washington Counties. Additional water is needed to offset annual shortages that occur during the summer months primarily due to a lack of storage capability. Additionally, a reliable source of water supply would improve the effectiveness of fire protection systems. The project would further provide improved hydroelectric energy production for the town of Orderville. New recreation opportunities (camping, fishing, boating, day-use, etc.) would be made available. The reservoir and surrounding riparian zone would also provide limited habitat for waterfowl. Finally, the project would provide additional M&I water for Washington County.

Number of Direct Beneficiaries (Onsite–Offsite)	There are 110 agricultural users in Glendale, 144 in Orderville, 15 in Bench Lake, and 52 in Mt. Carmel that would benefit from the proposed action. In Washington County, approximately 2,800 agricultural users would benefit from the agricultural water supply and approximately 800 private residences in Washington County would benefit from the M&I water supply.
Describe Other Beneficial Effects in Physical Terms	The Preferred Alternative would have beneficial effects on irrigation water availability, water quality, riparian habitat, recreation, economy, and public health and safety.
Benefit to Cost Ratio	1.03
Net Economic Benefits	$38,000
Funding Schedule	2026–2029 (budget year plus 5): Federal Funds: $24,889,000 Non-Federal Funds: $14,841,000 Total: $39,730,000
Period of Analysis	The period of analysis is the time required for installation of the project plus the life of the project. All structural alternatives were evaluated with a period of analysis of 103 years (100-year project life plus 3 years for construction). The 2026 discount rate of 3.25 percent was used for economic cost and benefit calculations.
Project Life	The life of the project is estimated to be 100 years following 3 years of construction.
Environmental Impacts	Table S-2 lists the resources of concern and associated environmental consequences associated with the Preferred Alternative. Resources that would not be impacted by the Preferred Alternative are not listed on this table.

Table S.2. Environmental Impacts.

Resource Concern	Summary of Concern	Consequence
Soil Resources	Potential sediment yield within the new watershed and increased erosion potential during construction activities	Direct short-term impacts to erosion potential on disturbed areas during construction would occur. Impacts would be minimized through implementation of BMPs that would be installed during and after construction. The short-term impacts would be minor based on implementation of BMPs and restoration/stabilization of disturbed

Resource Concern	Summary of Concern	Consequence
		areas following project construction. Anticipated indirect, long-term benefits include reduced sediment deposition in developed areas and within EFVR that are no longer exposed to flooding.
Water Resources	Impacts to water resources from Construction and operation activities	The Preferred Alternative would have direct, positive benefits on water resources by making 2,148 acre-feet of existing water available for water users in Kane and Washington County annually. Minor downstream impacts to the EFVR would occur.
Water Quality	Impacts to surface water quality during project operation	Minor direct, and negative impacts to water quality would occur during construction while crossing the EFVR; however, long-term, beneficial impacts would occur through the capturing of sediment in the reservoir during flash flooding events.
Floodplain Management	Impacts on floodplain areas from construction activities	The Preferred Alternative would have long-term beneficial impacts on downstream flooding, and long-term minor impacts on floodplain management. The proposed reservoir would capture runoff produced by flash floods out of Cove Canyon, thereby decreasing the amount of water and sediment entering the river and reducing potential loss of riparian vegetation. However, the proposed dam would also create a new inundation area, causing potential changes to floodplains.
Waters of the U.S., Wetlands, and Special Aquatic Sites	Disturbance to jurisdictional Waters of the U.S. located within the study area	The Preferred Alternative would impact approximately 0.21 acres of aquatic features and 0.17 acres of wetlands.
Regional Water Resources	Compliance with KCWCD and WCWCD Water Conservation Plans	The Preferred Alternative would comply with Regional Water Resource Plans through supporting both Kane County and Washington County's Water Resource Plans.
Wild and Scenic Rivers	Impacts to the EFVR in Zion National Park (ZNP) from project operation activities	The Preferred Alternative would have no impacts on the WSR values of the EFVR within ZNP, as it would also adhere to the stipulations required in the ZNP Agreement (1996). Therefore, changes in

Resource Concern	Summary of Concern	Consequence
		flow in the EFVR through ZNP would be minor, particularly when the natural variation of the EFVR is approximately 100 times the range of effect from proposed reservoir releases (Alpha Engineering 2025). The NPS notified the NRCS that the NPS will not be completing a Section 7 analysis on this project.
Air Quality	Emissions and fugitive dust from construction activities	Construction activities and the use of the borrow sites would cause minor, short-term, and direct increases in emissions concentrated around the construction site. Construction activities would not violate air quality standards, and BMPs would be implemented.
Threatened and Endangered Species	Disturbance to Endangered Species Act-listed, BLM-listed, and state-listed species/habitat	The Preferred Alternative would have **No Effect** on the Western yellow billed cuckoo, desert tortoise, Suckley's cuckoo bumble bee, Jones cycladenia, Shivwits milk-vetch, Siler's pincushion cactus, and Ute ladies'-tresses. The Action Alternatives are **Not Likely to Jeopardize the Continued Existence** of the monarch butterfly or the California condor outside of ZNP. The Action Alternatives **May Affect, but Not Likely to Adversely Affect** the California condor (within ZNP), Mexican spotted owl, southwestern willow flycatcher, Virgin River chub, and woundfin. The Action Alternatives **May Affect, but Not Likely to Adversely Affect** designated critical habitat for the Mexican spotted owl, Virgin River chub, and woundfin. The Action Alternatives would have **No Effect** on designated critical habitat for the California condor or southwester willow flycatcher as none has been designated in the study area.
Migratory Birds	Disturbance to migratory bird habitat during construction	Construction disturbance would have minor, direct, and short-term impacts that would disturb suitable breeding/nesting or foraging habitat for migratory birds and foraging habitat for migratory birds. Conservation measures would be implemented to avoid and minimize impacts to these species and disturbed areas would be restored after

Resource Concern	Summary of Concern	Consequence
		construction completion. Potential impacts would be minor due to the ample surrounding habitat available. The Operation & Maintenance activities would have minor, beneficial, long-term impacts to migratory birds. The riparian habitat surrounding the reservoir would provide long-term habitat opportunities for migratory birds.
Bald and Golden Eagles	Disturbance to bald and golden eagle habitat during construction	Construction would cause temporary, minor impacts to bald and golden eagles; however, no significant loss of foraging grounds would be expected due to the availability of nearby suitable habitat. The new riparian area surrounding the reservoir would have long-term, beneficial impacts to bald and golden eagles by providing additional roosting opportunities.
Ecologically Critical Areas	Impacts to the Parunuweap Canyon WSA, Zion Wilderness, and Parunuweap RNA during operational activities	No direct or indirect impacts to designated wilderness, WSA's. or RNAs would occur under the Action Alternatives.
Invasive Species	Introduction of invasive plant and animal species during construction and operational activities.	The Preferred Alternative would have minor, temporary impacts on invasive species during and immediately following construction; however, BMPs would be implemented to prevent the spread or introduction of noxious weeds and invasive animals. A Post-Construction Rehabilitation Plan would be developed and include mechanisms for addressing weed establishment and treatment and the prevention of the establishment of invasive animals.
Fish and Wildlife	Disturbance to fish and wildlife species/habitat	Construction activities would cause temporary, minor impacts to fish and wildlife species, including Species of Greatest Conservation Need, due to an increase in human presence and noise. There is ample surrounding habitat, and therefore, long-term impacts are not anticipated. The creation of the riparian area surrounding the reservoir would have beneficial, long-term impacts by providing

Resource Concern	Summary of Concern	Consequence
		new additional habitat for wildlife. State e fish Species of Greatest Conservation Need, including the desert sucker, flannelmouth sucker, and Virgin spinedace are known to exist in the EFVR. Changes in water flow from implementation of Alternative 2 would be minor, particularly when the natural variation of EFVR flows are approximately 100 times the range of effect from proposed Cove Reservoir releases (Alpha Engineering 2025), and therefore these species and their habitat would not be impacted.
Riparian Areas	Impacts to downstream riparian areas from changes in water flow	The Preferred Alternative would have minor, positive impacts to riparian vegetation through the creation of additional riparian habitat at the reservoir site. No impacts to existing riparian habitat in the EFVR would occur.
Cultural Resources	Impacts on historic/cultural resources that are present within the study area	The Preferred Alternative would result in **Adverse Effect to Historic Properties**. Indirect effects to cultural resources could arise from the increase in human activity in the area.
Social Issues	Impacts on local social conditions from project implementation	**Population** The Preferred Alternative would have indirect, positive benefits to the population by providing an additional needed recreation area. **Demographics** The Preferred Alternative would have no impact on demographics. **Employment and Income** The Preferred Alternative would provide 67 short-term jobs, 9 long-term jobs, and water to support 430 acres of agricultural land. **Housing** An increased risk of flooding from dam failure would cause indirect impacts to up to 275 residential parcels. **Economy** The Preferred Alternative would have a direct, beneficial impacts on the economy by attracting more visitors and supporting an additional 430 acres of existing agricultural land.

Resource Concern	Summary of Concern	Consequence
Public Health and Safety	Increased risks to public safety from dam failure and increased risk for construction-related traffic while construction is occurring	Short-term, minor risks to public health and safety would occur during construction due to an increase in traffic. Long-term risks to approximately 10 to 15 people would occur with properties in the new inundation zone of the dam. Long-term benefits to public health and safety include the reduction of stress from reliable water and the increased effectiveness of the fire suppression systems.
Scenic Beauty	Changes to the visual character of the immediate area	Short-term visual impacts would occur from the presence of construction equipment. Direct, long-term impacts to scenic values would occur from the conversion of 235 acres of arid land to a reservoir.
Significant Scientific Resources	Impacts on paleontological resources from construction activities	No impacts to significant paleontological resources are expected. A paleontological monitor would be present during new surface-disturbing activities associated with the Mt. Carmel irrigation improvements. A preconstruction paleontological training course with the construction contractor would occur prior to construction.
Land Use	Changes to land use from project implementation	Approximately 253.4 acres of land would be converted from undeveloped to developed resulting in minor, long-term impacts to land use within the project area.

Major Conclusion

Implementation of the Preferred Alternative would meet the purpose and need of the project while providing the greatest economic benefits. No significant adverse impacts to the human environment are anticipated (See Chapter 5.0 of the Plan-EIS for a detailed analysis); however, impacts resulting from project implementation would be cumulative to other actions identified in Chapter 5.0 of the Plan-EIS. Adverse construction effects would be short-term (approximately 15 months) and partially offset by avoidance/minimization measures and implementation of BMPs. Improved water availability and distribution for agricultural purposes and M&I uses would result. Additional hydroelectric energy would be produced by the extended use of the existing Orderville hydroelectric power plant. The reservoir and associated facilities would provide a new recreation opportunity.

	The Preferred Alternative is the most environmentally friendly alternative and has the greatest net economic benefits of all alternatives analyzed. This alternative represents both the Preferred Alternative and the National Economic Efficiency (NEE) Alternative. No measurable long-term adverse impacts are anticipated, and long-term environmental, social, and economic benefits would be realized from implementation of the Preferred Alternative.
Areas of Controversy	The scoping process for the Plan-EIS resulted in the identification of several issues and concerns associated with the proposed project. These include project cost, reduced downstream flow, project economics, alternative reservoir sites, non-reservoir alternatives, dam safety, invasive species, WSR-status, rare species, cultural resources, water use, and climate variation.
Issues to be Resolved	None
Evidence of Unusual Congressional or Local Interest	There has been interest in the proposed project expressed by the public, government, and non-government entities. A total of 66 public documents containing 249 specific comments were submitted during the public scoping period. An additional 9 agency-specific comment documents containing 57 specific comments also were submitted during the public scoping.
Compliance	Is this report in compliance with executive orders, public laws, and other statues governing the formulation of water resource projects? Yes X No___

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1.0 WATERSHED PLANNING BACKGROUND

As the lead federal agency for this proposed project, the Natural Resources Conservation Service (NRCS) is proposing to provide funding for project measures associated with Agricultural Water Management (AWM), Municipal & Industrial (M&I) Water Supply, and Public Recreation in the Cove-East Fork of the Virgin River. A Watershed Plan-Environmental Impact Statement (Plan-EIS) is required for NRCS to comply with the requirements of the National Environmental Policy Act (NEPA) of 1969, 42 U.S. Code (USC) 4321 et seq. and its implementing regulations, as set forth in 7 Code of Federal Regulations (CFR) 650. This environmental document was initiated using the 40 CFR 1500-1508 (May 20, 2022) and 7 CFR 650 regulations. These regulations have recently been rescinded and replaced with U.S. Department of Agriculture (USDA) regulations found under 7 CFR 1b, published as a Final Rule in the Federal Register on April 3, 2026 (91 FR 17062). However, in a good-faith effort to fulfill NEPA's requirements, including Congressional timeline and considerations of fiscal restraints, the agency decided to continue to use 40 CFR 1500-1508 (July 31, 2023) and 1 CFR 650. This is permissible per the USDA policy guidance issued in the Final Rule's preamble. The Federal Register notice said: "if the NOI for an EIS [was] published more than 90 days prior to the publication of this final rule, the USDA subcomponent has discretion to continue applying the versions of NEPA regulations being applied before the publication of the NOI or to switch to applying 7 CFR 1b as published in this final rule."

This chapter describes the general and specific planning backgrounds for NRCS Watershed Programs, and this proposed project.

1.1 Authority

This Plan-EIS has been prepared under the guidance of the NRCS Watershed Program, which authorizes fundings to help urban and rural communities protect, improve, and develop land resources in watersheds up to 250,000 acres in size. The Watershed Program is authorized under provisions of the Watershed Protection and Flood Prevention Act of 1954 (Public Law [PL] 83-566) Stat. 666 as amended (16 USC Section 1001 et seq.).

1.2 Sponsor

The proposed project Sponsoring Local Organizations (SLOs) are the Kane County Water Conservancy District (KCWCD) and the Washington County Water Conservancy District (WCWCD).

1.3 Cooperating Agencies

Cooperating agencies for this project include the U.S. Environmental Protection Agency (EPA), National Park Service (NPS) through Zion National Park (ZNP), U.S. Army Corps of Engineers (USACE), the Bureau of Land Management (BLM), Utah Trust Lands Administration (UTLA), and the Utah Public Lands Policy Coordinating Office (PLPCO).

1.3.1 Environmental Protection Agency

The EPA accepted Cooperating Agency status in a letter dated October 29, 2021 (Appendix A). The EPA is involved in this proposed project through their responsibilities under Section 102(2)(C) of the NEPA and Section 309 of the Clean Air Act (CAA) of 1970.

1.3.2 National Park Service

The portion of the East Fork Virgin River (EFVR) that traverses ZNP is designated as a Wild and Scenic River (WSR) (National Wild and Scenic Rivers System, 2024). ZNP also maintains water rights on the EFVR. As a result, the NPS and ZNP have an interest in the proposed project and accepted Cooperating Agency status by memorandum dated April 18, 2022.

1.3.3 U.S. Army Corps of Engineers

The USACE has jurisdiction over waters of the U.S. (WOTUS) under the authority of Section 404 of the Clean Water Act of 1972 (CWA) and accepted Cooperating Agency status in a letter dated November 15, 2021 (Appendix A).

1.3.4 Bureau of Land Management

The BLM's involvement in this project is limited as no surface disturbance would occur on public lands, and no BLM permits would be required. However, the EFVR flows through the BLM–managed Parunuweap Canyon WSA. As a result, the BLM signed an MOU accepting Cooperating Agency status on August 16, 2022 (Appendix A).

1.3.5 Utah Trust Lands Administration

The UTLA manages lands located within the proposed project area. The UTLA is the steward of Utah's trust lands and is responsible for generating revenue from them for the benefit of public schools and other state institutions now and for future generations. The UTLA accepted Cooperating Agency status by email correspondence dated October 25, 2021 (Appendix A).

1.3.6 Utah Public Lands Policy Coordinating Office

The PLPCO is the State agency responsible for coordinating, promoting, and implementing Utah's public land priorities. The PLPCO requested Cooperating Agency status by memorandum dated October 20, 2021 (Appendix A) Refer to the Memorandum of Understanding (MOU) included in Appendix A for the roles and responsibilities of each individual agency.

1.4 Planning Area

1.4.1 Selected Watershed

The proposed Watershed Area developed for this Watershed Plan consists of a compilation of three Hydrologic Unit Code (HUC) 12s (Table 1-1 and Figure B-1) totaling 97,449 acres that are intersected by the project area in Kane County, Utah (Figure B-1, Appendix B). The Watershed Area is comprised of all direct tributary drainageways and land from which, after project installation, water and sediment could adversely affect any proposed structural measure as defined in the National Watershed Program Handbook, Title 390 Part 606.80 (NRCS, 2014a).

Table 1.1. HUC 12s in the Watershed Area

Name	Hydrologic Unit Code Number	Acres
Headwaters East Fork Virgin River	150100080201	33,414
Lydias Canyon-East Fork Virgin River	150100080203	40,747
Muddy Creek	150100080202	23,287
Total	-	**97,449**

1.4.2 Study Area

The project area for the proposed project is approximately 712.46 acres in size and is located in the Long Valley area between the cities of Glendale and Mt. Carmel, Utah. The project area includes all areas where ground or surface disturbance would occur as a result of project implementation. Surface-disturbing activities would include construction of a reservoir, access roads, pipelines, spillways, staging areas, and borrow pits. A detailed description of the proposed project is included in Section 4.2.2.1. Although no surface disturbance would occur beyond the project area as defined above, water would be made available to Washington County users for agricultural and M&I purposes.

The study area for the proposed project includes the project area and the downstream areas in Washington County. The study area includes all areas where environmental impacts could potentially occur as a result of project implementation. Downstream areas include where water would be released from the new reservoir to the Quail Creek Reservoir Diversion site approximately 50 river-miles downstream via the EFVR and Virgin River. Water would then be diverted from the river for agricultural use by the Hurricane Canal Company and M&I use in Washington County. Washington County is approximately 2,430 square miles with an estimated population of 207,943 (Utah Demographics, 2026). Primary communities include the cities of St. George, Washington, Hurricane, Santa Clara, Ivins, Toquerville, La Verkin, and Virgin. Refer to Figure C-1 in Appendix C for a figure of the project area versus the study area.

Project alternatives considered for detailed analysis (No Action and 3,000-Acre-Feet Reservoir Alternatives) encompass the same study area as described above; however, both alternatives would entail a reduced construction footprint or surface disturbance area compared to the Preferred Alternative (6,000-Acre-Feet Reservoir).

1.4.3 Area of Potential Effects for National Historic Preservation Act Section 106 Compliance

The Area of Potential Effect (APE) has been refined throughout the watershed planning process. In December 2019, the APE was defined as 791.68 acres (152.18 acres BLM, 70.33 acres UTLA, and 569.17 acres of private land), which included the proposed reservoir area, hydroelectric plant locations, six proposed borrow pits, a pipeline, and powerline/utility corridors. In January 2023, an addendum APE of 68.83 acres of private land was added to include the addition of the Mt. Carmel pipeline. In February 2024, an addendum APE of 13.72 acres was added to include the Esplin Borrow Pit Site. Refer to Appendix C-2 for figures of the APE.

In August 2024, the project extents were further refined, removing three of the six borrow pit sites (keeping the Tait, Esplin, and Lamb Pits). The NRCS defined the final Direct area of the APE, in consultation with the EPA, USACE, BLM, NPS and applicable tribes as 712.46 acres, consisting of 0.23 acres BLM, 70.33 acres UTLA, and 641.9 acres of private land, encompassing all areas that may be disturbed or changed from their current conditions with potential to affect cultural resources (see Sections 1.4.2 and 5.5.1). This includes all construction sites, staging areas, access roads, borrow sources, inundation areas, and necessary buffer zones. The Indirect area of the APE was also defined in August 2024 with the above consulting parties as approximately 1,007.97 acres, including 17.05 acres of BLM, 0.51 acres of UTLA, and 990.41 acres of privately owned lands. In June 2026, an updated inundation area was provided, and an updated Indirect area of the APE Memo was sent for consultation on September 8, 2026, with the consulting parties listed above.

Additionally, the NRCS identified the Visual area of the APE as approximately 4,952.29 acres, including 245 acres of BLM, 1,698.01 acres of UTLA, and 3,009.28 acres of private lands (see Sections 3.2.5.1 and 5.5.1). These three sections under the APE partially overlap with each other.

Table 1.2. Total project Area of Potential Effect

Area of Potential Effect	BLM	USFS	UTLA	Tribal	Private	Total
Direct section of APE Acreage (Cove Reservoir with construction buffer, Pipes, Canals, Esplin Pit, Tait Pit, Lamb's Pit)	0.23	0.00	0.67	0.00	641.9	712.46
Indirect section of APE Acreage (Inundation Areas)	17.05	0.00	0.51	0.00	990.41	1,007.97
Visual section of APE Acreage (1 Mile Buffer of Cove Reservoir and Facilities)	245.00	0.00	1,698.01	0.00	3,009.28	4,952.29

1.5 Planning Process and Study Scope

The proposed project is authorized by the Watershed Protection and Flood Prevention Act of 1954 (PL 83-566). The area wide planning process is outlined in Title 390, Parts 500 – 506 Watershed Program Management Manual (NRCS, 2024a). Other applicable laws for this proposed project include NEPA, NHPA, Endangered Species Act of 1973 (ESA), CAA, the Wild and Scenic Rivers Act of 1968 (WSRA), and the CWA. Other laws, rules and regulations may also apply and are identified in the NRCS Watershed Program Manual (NWPM), Section 500.32 (NRCS, 2024a).

The geographic area for the proposed project is the Long Valley drainage, which is part of the EFVR Watershed. Washington County is included in the larger Upper Virgin Watershed. Planning policy for watershed plans requires consideration of all natural resources within the planning area, as well as social and economic considerations. The plan evaluation process (Departmental Manual [DM] 9500-013) involves the following:

- Identify problems and opportunities.

- Inventory existing resources and conditions.
- Forecast future conditions.
- Develop an array of alternatives.
- Evaluate effects of individual alternatives.
- Compare alternatives.
- Identify Recommended Alternative.
- Implement and evaluate.

The format of this document follows the plan process that must be followed for watershed project plans as outlined in the NWPM Parts 500 through 506 (NRCS, 2024a), National Watershed Program Handbook (NWPH), Parts 600 through 606 (NRCS, 2014a), and National Environmental Compliance Handbook, Part 610 (NRCS, 2016). The planning and decision-making process followed Principles, Requirements, and Guidelines (PR&G) for Federal Investments in Water Resources (CEQ, 2013), NRCS DM 95000-013 (USDA, 2017a), the PR&G eight-step evaluation process (refer to the PR&G Analysis Report included in Appendix E-1), and the nine-step planning procedures from the National Planning Procedures Handbook (NPPH) (NRCS, 2013). The nine-step planning process is defined in Section 1.5.1 below.

1.5.1 Stepwise Planning Process

The NRCS planning process consists of nine steps, divided into three phases covering 1) Collection and Analysis, 2) Decision Support, and 3) Application and Evaluation. The nine-step planning process, as presented in the NPPH (NRCS, 2013), was considered and incorporated into this Plan-EIS, as explained below.

1.6 Phase 1—Collection and Analysis

Step 1—Identify Problems and Opportunities: Problems and opportunities were identified during the project scoping process and are included in Chapter 2.2. Input from the sponsors, agencies, the public, organizations, and Tribes were solicited as described in Section 1.5.5 and Chapter 7.3 to help identify problems and opportunities. Engineering analysis was completed to further identify and evaluate problems, as documented in the Preliminary Design Report included in Appendix E-1.

Step 2—Determine Objectives: The purpose and need statement for the project was formulated with the problems and opportunities associated with the proposed project. Where the "purpose" identifies the fundamental reason why the action is being proposed, and the "need" describes the problem(s) that the proposed action is intended to address and explains the underlying causes of the problem(s). The Purpose and Need were prepared by the project proponents in cooperation with the NRCS, EPA, NPS, USACE, UTLA, PLPCO, ZNP, and SLOs. Chapter 2.0 identifies the purpose, objectives, and need to support Step 2.

Step 3—Inventory Resources: Resources and ecosystem services relevant to the alternative actions were determined during the scoping process and other resource evaluations, as described in Chapter 3.1. The resource conditions determined to be relevant are described in Chapter 3.0.

Step 4—Analyze Resource Data: The environmental baseline conditions for resources to be evaluated against alternative actions were identified and are included in Chapter 3.2. The best available data and science were used to inventory the existing resource conditions at the level and scale of analysis determined reasonable for evaluating alternatives and impacts during the planning stage.

1.7 Phase 2—Decision Support

Step 5—Formulate Alternatives: Project alternatives were formulated in consideration of the federal objective set forth in the Water Resources Development Act of 2007, the PL 83-566 general purposes, and the project purpose and need. Alternatives were formulated following procedures outlined in the NWPM, NWPH, DM 95000-013, and PR&G. Alternatives formulated are described in Chapter 4.0.

Step 6—Evaluate Alternatives: The effects of alternatives analyzed in detail were determined for each resource relevant to the alternative actions. The evaluation of alternatives is included in Chapter 5.0 and assesses the proposed alternatives against the baseline data presented in Chapter 3.2.

Step 7—Make Decisions: A National Economic Efficiency (NEE) Alternative, also identified as the Preferred Alternative, was selected based on the evaluation performed. The selection was made for the alternative that best maximized public benefits (environmental, economic, and social) with appropriate consideration of costs. Chapter 6.0 provides information on the decision-making process for selection of the Preferred Alternative. The Preferred Alternative was also agreed upon in cooperation with the project SLOs, NRCS, EPA, NPS, ZNP, USACE, BLM, UTLA, and PLPCO.

1.8 Phase 3—Application and Evaluation (Future Work)

Step 8—Implement the Plan: The Plan-EIS is the first phase of three phases to be completed for implementation of the preferred alternative. After the Final Plan-EIS is completed, Phase Two would consist of final design, and Phase Three would consist of installation of the project measures.

Step 9—Evaluate the Plan: After the installation of measures from Phase Three, NRCS and the SLOs would evaluate the effectiveness of the plan in solving the resource concerns. Adjustments to the plan would be made as needed.

1.8.1 Ecosystem Services Framework

An ecosystem services framework is required by the PR&G and provides for an integrated approach that allows consideration and transparent evaluation of the benefits (both tangible and intangible) and tradeoffs of potential alternatives (DM 9500-013). Four categories of ecosystem services are described in the PR&G and are included below for reference.

- **Provisioning services** are tangible goods provided for direct human use and consumption, such as food, fiber, water, timber, or biomass.

- **Regulating services** maintain a world in which it is possible for people to live, providing critical benefits that buffer against environmental catastrophe—examples include flood and disease control, water filtrations, climate stabilization, or crop pollination.

- **Supporting services** refer to the underlying processes maintaining conditions for life on earth, including nutrient cycling, soil formation, and primary production.

- **Culture services** make the world a place in which people want to live—recreational use, spiritual, aesthetic viewsheds, or Tribal values.

The scoping process identified resources relevant to the proposed action that were considered for the determination of applicable ecosystem services (see Chapter 3.1). Ecosystem service benefits can be both monetary and non-monetary. Appropriate metrics should be based on current methodology to quantify impacted services over time for determination of project and/or regional-specific effects. For reference, a list of ecosystem service categories and their subcategories from Earthwise Aware is provided as Figure 1-1 (Earthwise Aware, 2024). The ecosystem service categories/subcategories relevant to this proposed project and the applicable resources pertinent to each subcategory that were analyzed in this document are provided in Table 3.2 of Chapter 3.1.



Figure 1.1. Ecosystem Services.

The applicable ecosystem services were evaluated as part of the PR&G eight-step evaluation process. This process includes consideration of the federal objective, PL 83-566 general purposes, guiding principles, and ecosystem services to assist in decision-making. Refer to the PR&G Analysis Report included in Appendix E-1 for documentation of the PR&G eight-step evaluation process used for decision-making.

1.8.2 Period of Analysis

The NRCS period of analysis is the time required for project development (design and construction) plus the evaluated life of the project. The evaluated project life is the time over which implementation of an alternative is functional and would have significant beneficial or adverse effects when the project successfully functions with prescribed operations, maintenance, and replacement. The evaluated life is used for discounting and amortizing project benefits and costs. It is also used to determine the duration of operation and maintenance (O&M) agreements for the project works of improvement.

The NRCS period of analysis for this project is 103 years, which includes 100 years for the evaluated life and three years to construct the proposed project.

1.8.3 Project Scope

Section 1 of PL 83-566 sets forth three general purposes for Watershed Program projects:

- Flood prevention (including structural and land treatment measures).
- The conservation, development, utilization, and disposal of water.
- The conservation and proper utilization of land in watershed or sub-watershed areas not exceeding 250,000 acres for the primary purpose of flood prevention (including structural works of improvement and land treatment measures); The project may not include any single structure which provides more than 12,500 acre-feet of floodwater detention capacity, and more than 25,000 acre-feet of total capacity.

This proposed project scope falls under the second purpose; “the conservation, development, utilization, and disposal of water.” The proposed project is intended to increase the availability of water for AWM, M&I, and recreational water supply.

1.8.4 External Scoping

An external scoping process was conducted to provide opportunity for individuals, agencies, Tribes, and other organizations interested in or potentially affected by implementation of any of the proposed alternatives to share concerns and provide input. Details of the scoping process and results are provided in Chapter 7.0 of this document. Project scoping questions, comments, and concerns were requested from the public, SLOs, stakeholders, tribes, organizations, and agencies during the external scoping period, both orally at a public meeting and via written submittal of comments. Tribal Scoping letters were mailed to 17 representatives of 11 Tribes as part of the original Watershed Plan Environmental Assessment (Plan-EA) scoping outreach process on January 9, 2020. A Notice of Intent (NOI) to prepare the Plan-EIS was published in the *Federal Register* on March 29, 2022. The open comment period was 209 days beginning October 7, 2021, and ending Thursday, April 28, 2022. A scoping letter and project fact sheet were sent directly to landowners who own parcels adjacent to or within the project area. Scoping activities were initiated under 40 CFR 1500-1508 (May 20, 2022) and 7 CFR 650 regulations. These regulations have recently been rescinded and replaced with USDA regulations found under 7 CFR 1b, published as a Final Rule in the Federal Register on April 3, 2026 (91 FR 17062). However, in a good-faith effort to fulfill NEPA’s requirements, including Congressional timeline and considerations of fiscal restraints, the

agency decided to continue to use 40 CFR 1500-1508 (July 31, 2023) and 7 CFR 650. This is permissible per the USDA policy guidance issued in the Final Rule's preamble. The Federal Register notice said: "if the NOI for an EIS is published more than 90 days prior to the publication of this final rule, the USDA subcomponent has discretion to continue applying the versions of NEPA regulations being applied before publication of the NOI or to switch to applying 7 CFR 1b as published in this final rule." For a full summary of scoping activities, see the Scoping Report in Appendix A.

A notification was published in the *Southern Utah News* on October 7 and October 14, 2021 (Appendix A). Project press releases were sent to the *Salt Lake Tribune*, *The Spectrum*, and the *Desert Sun News*. Non-governmental organizations were also contacted.

A public meeting was held in Orderville along with a virtual meeting via Zoom Webinar on Wednesday, October 20, 2021, from 6:00 p.m. to 7:30 p.m. Approximately 41 members of the public attended, based on the number of unique names/emails contained in the Zoom attendee report. A list of attendees is included in Appendix A. A total of 66 public comment documents were received, which were categorized and organized into 249 specific comments. A total of nine agency comment documents were received, which were categorized and organized into 57 specific comments. A single comment letter was received from the Hopi Tribe during Plan-EA) scoping, and a Hopi and Navajo letter was received during EA Notice of Availability (NOA). The NRCS responded directly to Hopi via letter (Appendix A). These comments were considered in preparation of the Plan-EIS. A Scoping Report was prepared summarizing the scoping process and is included in Appendix A. The scoping report includes documentation of the scoping announcements and activities that occurred during the external scoping process. A Draft Plan-EA for this proposed project was prepared and published for public review in 2020. In 2021, NRCS determined that a Plan-EIS would be required for the proposed project. The external scoping process for the Plan-EIS is in addition to the scoping process conducted for the Plan-EA. Individuals, agencies, Tribes, and other organizations who participated in the scoping and public comment process for the Draft Plan-EA were included on an email and/or hard copy mailing list for the Plan-EIS. Comments received on the Draft Plan-EA were considered during preparation of the Draft Plan-EIS.

1.9 Related Projects and Studies

Related past, present, and reasonably foreseeable projects and studies within the project vicinity were identified to help define the scope of issues to be addressed in this watershed plan. Those issues found relevant to this project were used to describe the resources in Chapter 3.0 and to determine direct, indirect, and cumulative impacts addressed in Chapter 5.0. Studies are referenced, where applicable, throughout the Plan-EIS. Chapter 8.0 provides information on the references and where they can be found.

2.0 PURPOSE AND NEED

2.1 Purpose

Pursuant to PL 83-566, the purpose of this proposed project is to enhance the efficiency and reliability of the current AWM in Long Valley, Kane County and Hurricane, Washington County, Utah (part of the EFVR watershed) while complying with the Zion National Park Water Rights Settlement Agreement of 1996 (ZNP Agreement) (United States, Utah, Washington District, & Kane District, 1996). Effective irrigation systems and water management strategies, including construction of a water storage reservoir, would support agriculture profitability amid constraints posed by scarce and costly water resources.

The project would also provide a public recreation opportunity in Long Valley and increase M&I water supply to communities in Washington County. The water demand in the WCWCD service area is projected to increase as summer agricultural water shortages continue, and more M&I water providers join and receive water from the WCWCD system. The WCWCD manages reservoirs, pipelines, wells, water storage tanks, treatment plants, hydroelectric power plants, and diversion dams. The majority of the district's water is sold wholesale to its municipal customers including the Cities of St. George, Washington, Hurricane, Santa Clara, Ivins, Toquerville, La Verkin, and Virgin (WCWCD, 2025). A figure of the Service Areas is provided in Figure C-3 in Appendix C.

2.1.1 Federal Objective

Water resource investments, as defined by the NWPM, shall reflect national priorities, encourage economic development, and protect the environment by:

- Seeking to maximize sustainable economic development.
- Seeking to avoid the unwise use of floodplains and flood-prone areas and minimizing adverse impacts and vulnerabilities in any case in which a floodplain or flood-prone area must be used.
- Protecting and restoring the functions of natural systems and mitigating any unavoidable damage to natural systems.

2.1.2 Project Objectives

Project objectives were formulated at the beginning of the planning process by project SLOs and NRCS based on a documented need for water availability in Kane and Washington Counties. The project objective is to enhance the efficiency and reliability of the current AWM in Long Valley and Washington County, Utah, while complying with the ZNP Agreement (1996). The objectives listed below were identified by SLOs, cooperating agencies, organizations, and the public during development of this Plan-EIS:

- Provide a reliable source and long-term availability of agricultural water during the summer months in the Glendale, Orderville, and Mt. Carmel areas of Kane County and the Hurricane area of Washington County.
- Provide M&I water to Washington County.

- Provide an additional recreation opportunity in Kane County.
- Increase annual visitation in the communities of Orderville, Glendale, and Mt. Carmel by establishing an additional recreational hub that supports growth in local business revenues and employment opportunities.
- Provide for the maximum utilization of renewable energy for local communities, whose populations are projected to rise in the near term (Utah PLPCO, 2017); releases of excess water and water delivered to WCWCD would supplement energy provided by the existing Orderville hydroelectric plant.
- Comply with the ZNP Agreement (1996).

2.1.3 Constraints and Considerations

Constraints that influenced the alternatives analysis were identified for the planning area. These constraints limited the extent to which the objectives could be achieved. A description of the constraints is provided below, and further detail is provided in Chapter 4.0.

- **Siting limitations:** Topography in the Long Valley area limits the number of sites (seven) that potentially meet the necessary criteria for a reservoir. Issues with these sites are discussed in Chapter 4.0. A majority of the land in the area is not suitable for reservoir development.
- **Public safety:** The majority of the potential alternative sites would put residential property within the breach inundation zone of a dam.
- **Environmental resources:** Development of certain sites would involve the loss of existing agricultural land and residences.
- **Geotech restrictions:** Some of the available sites would not support construction due to geological structural limitations.
- **Engineering challenges:** Development of some potential sites would require extensive engineering, such as re-routing existing roads around dams and reservoirs. Some of this re-routing would be in steep topography. There would be differences in dam size depending on the site location.
- **Economic constraints:** An economic analysis was completed to find the alternative which best meets the proposed project's purpose and need while providing economic benefit. It was determined that development of some potential sites would be more expensive than others. Development of some sites would be cost prohibitive.

2.2 Need

The need for this project arises from annual water shortages experienced by local agricultural users served by the Glendale, Orderville, and Mt. Carmel irrigation companies. Due to a difference in timing between the melting of snowpack within the watershed and the peak demand for agricultural water use, these users experience water shortages during the summer months. Contributing factors include variable precipitation patterns, EFVR flow trends, absence of sufficient water storage facilities, and inefficiencies in current irrigation systems, such as unlined ditches in

Mt. Carmel. These factors combine to result in insufficient agricultural water during summer, causing inconsistent agricultural production and limiting the potential for cultivation of water-dependent crops.

Agricultural water users in Washington County, served by the Hurricane Canal Company, experience summer water shortages when Virgin River flows decrease. Additionally, the ongoing drought and historical population growth has stressed existing M&I water availability.

2.2.1 Water Usage Trends

A review of water usage in the area upstream of Mt. Carmel (over the last 20 years) shows that an average of 20 cubic feet per second (cfs) is needed during the irrigation season, which exceeds the river's average summer capacity by approximately 9 cfs (Figure 2-1). The Glendale, Orderville, and Mt. Carmel irrigation companies only had enough water to provide for full irrigation of 302 acres of their 1,124 acres during 90 percent of the record years.

2.2.2 Irrigation Infrastructure

The current irrigation infrastructure in Long Valley lacks sufficient capacity for storage during periods of non-use and high flow. Consequently, the water that could be stored remains largely inaccessible to local users. This could be achieved by enhancing water availability through the collection and storage of excess water that could be used during the irrigation season (June through August) during non-use periods. Figure 2-1 shows the river discharge available for diversion, including tributary flows between the U.S. Geological Survey (USGS) gauging station and Mt. Carmel, in comparison to the irrigation demand for the three irrigation companies (Alpha Engineering, 2026).

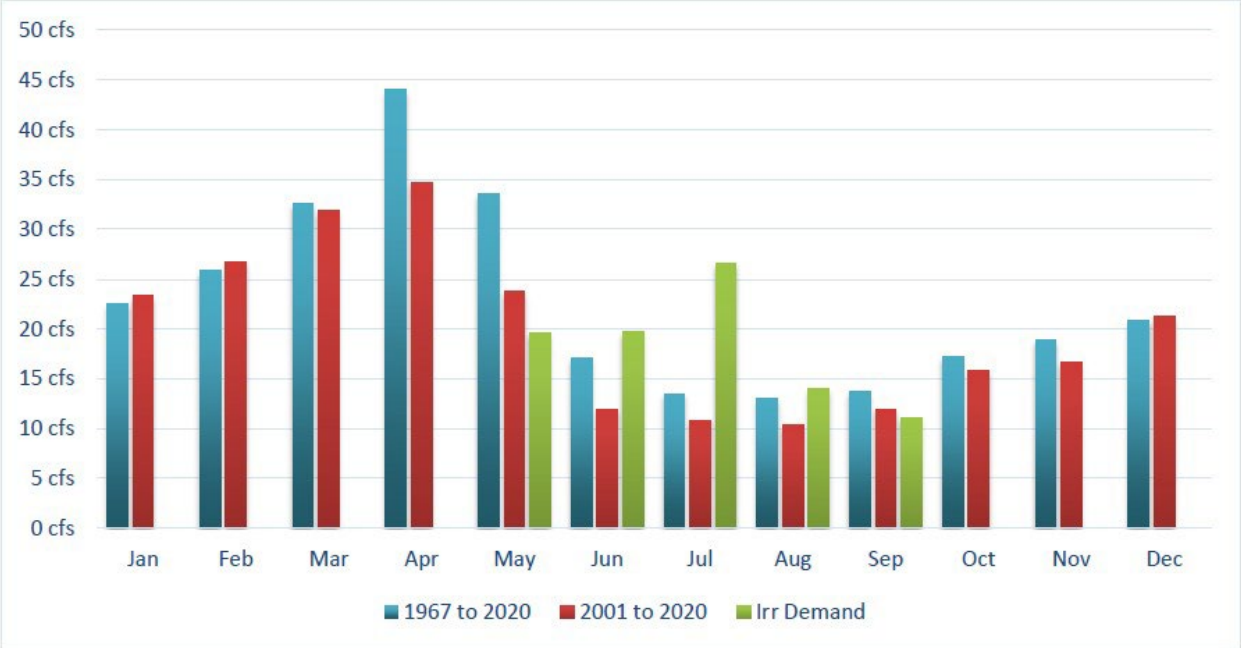

Figure 2.1. Average 09404450 Glendale USGS Gauge Data Compared to Irrigation Demand.

2.2.3 Problems

Despite using available water for irrigation with no new conveyance or storage, the EFVR's average flow is insufficient to meet annual crop demands in the critical months of June, July, and August. For example, to fully irrigate the existing agricultural acreage in Long Valley in July, an estimated flow of 26.9 cfs is required, which exceeds the river's average historic flow rates of approximately 10–14 cfs capacity (Figure 2-1).

There is a demand for new recreational facilities in Kane County and Utah in general. Frequently, recreational facilities exceed capacity with residents and non-resident tourists during peak travel seasons, particularly in the summer months. In 2023, the number of visitors to ZNP exceeded 5 million, which is an increase of 73.4 percent since 2010. Visitation at Bryce Canyon National Park (BCNP) to 2.5 million people in 2023, which is a 91.4 percent increase over 2010 visitation levels (NPS, 2024).

During the summer months, low flows in the Virgin River do not provide sufficient water to meet agricultural irrigation needs on land administered by the Hurricane Canal Company.

The extended drought has strained the existing M&I and agriculture water supply in Washington County resulting in implementation of enhanced conservation measures. Further, the historical increase in population for Washington County has increased demand for M&I water. Washington County is among the fastest-growing regions in the western U.S. and is located within an arid, hydrologically constrained basin. M&I water demand has increased substantially due to population growth, economic activity, and increases in equivalent residential connections, even under aggressive conservation implementation.

Despite implementing aggressive conservation measures, existing potable and secondary supplies are insufficient to meet the existing and future M&I demand. Local surface water sources within the Virgin River Basin are fully allocated, groundwater basins are closed to new appropriations, and supply diversification options are limited.

2.2.3.1 Agricultural Water Deficits of Long Valley Irrigation Companies

Although the Utah Division of Water Rights has revised the irrigation water duty from 6-acre-feet per acre to 5-acre-feet per acre, the analysis presented in this document uses the historical 6-acre-foot duty because it reflects the current water use under existing irrigation practices. The revised 5-acre-foot duty was negotiated between the Utah Division of Water Rights and the KCWCD for the Glendale, Orderville, and Mt. Carmel Irrigation Companies. Under this revision, the 5-acre-foot duty would only apply when irrigation rights are converted to another beneficial use. Accordingly, the historical 6-acre-foot duty was used throughout this document to evaluate existing agricultural demands and shortages because it represents current conditions.

Research, such as Utah State University Research Report 145, indicates that under certain technological applications, water usage could be optimized to 4-acre-feet per acre for crops like alfalfa in the Orderville area. With a conversion to pressurized systems and the current acreage, an average of 1,412 acre-feet of water is required to allow these irrigation companies to meet their full water right during the USGS period of record. Table 2.1 shows the water rights of the Glendale Irrigation Company, Orderville irrigation Company, and Mt. Carmel Irrigation Company. Refer to Appendix E-1 for more detail.

Table 2.1. Irrigation Company Acreage and Water Demand (Appendix E-1).

Irrigation Company	Total Combined Water Right (Acreage)	Maximum Allowable Diversion Rate (cfs)	Prescribed Water Duty (Acre-Feet per Year [afy])
Glendale Irrigation Company	434.0	7.2	2,170.0
Orderville Irrigation Company	286.0	4.7	1,430.0
Mt. Carmel Irrigation Company	404.0	6.7	2,020.0
Total	**1,124.0**	**18.5**	**5,620.0**

Note: The projected need for water in Washington County is 4.5 cfs or 1,350 afy.

2.2.3.2 Available Water within the EFVR Drainage Area

The portion of the EFVR drainage area extending above Mt. Carmel Junction to the Quail Creek Reservoir Diversion point is the primary focus of the water availability analysis. A water model, integrating historical USGS data, Utah Department of Water Rights records, and statistical inflow estimations from various drainage basins, was developed to assess water flow and diversions in the EFVR. This model, though not precise, is designed to reflect real-world water flow scenarios accurately.

Analysis of USGS gauge data over a 54-year period and a more recent 20-year period highlights the impact of persistent drought on river flows, especially during spring and summer. These data, along with statistical calculations for watershed drainage, help construct a comprehensive water budget for the area upstream of Mt. Carmel. Figure 2-2 illustrates the seasonal irrigation demands of the three irrigation companies versus the average river flow, translating crop water needs into equivalent cfs flow rates for comparison (Alpha Engineering, 2026).

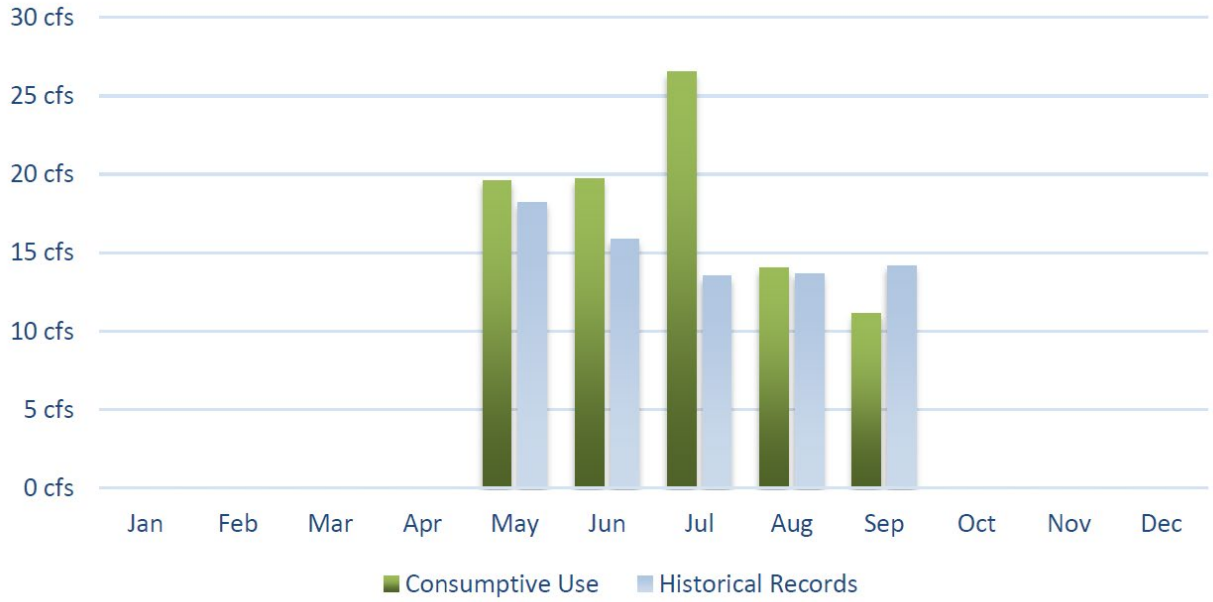

Figure 2.2. Modeled current average conditions of the EFVR drainage above Mt. Carmel Junction.

Despite converting all available water for irrigation with no conveyance or application losses, the EFVR's average flow is insufficient to meet the crop demands, particularly in the critical months of June, July, and August. To fully irrigate the necessary acreage in July, for instance, an estimated flow of 26.9 cfs is required, which nearly exceeds the river's average capacity.

A schematic representation of the EFVR drainage area (Figure 2.3) highlights the inflows from tributaries and outflows to irrigation diversions using data from USGS gauging station 09404450, located near Glendale, Utah (Alpha Engineering, 2026). This includes additional drainage areas (shown in blue) that contribute flow to the EFVR as the stream channel traverses between the various irrigation company diversion dams. Proposed connections to and from the Cove Reservoir are shown in red and green.

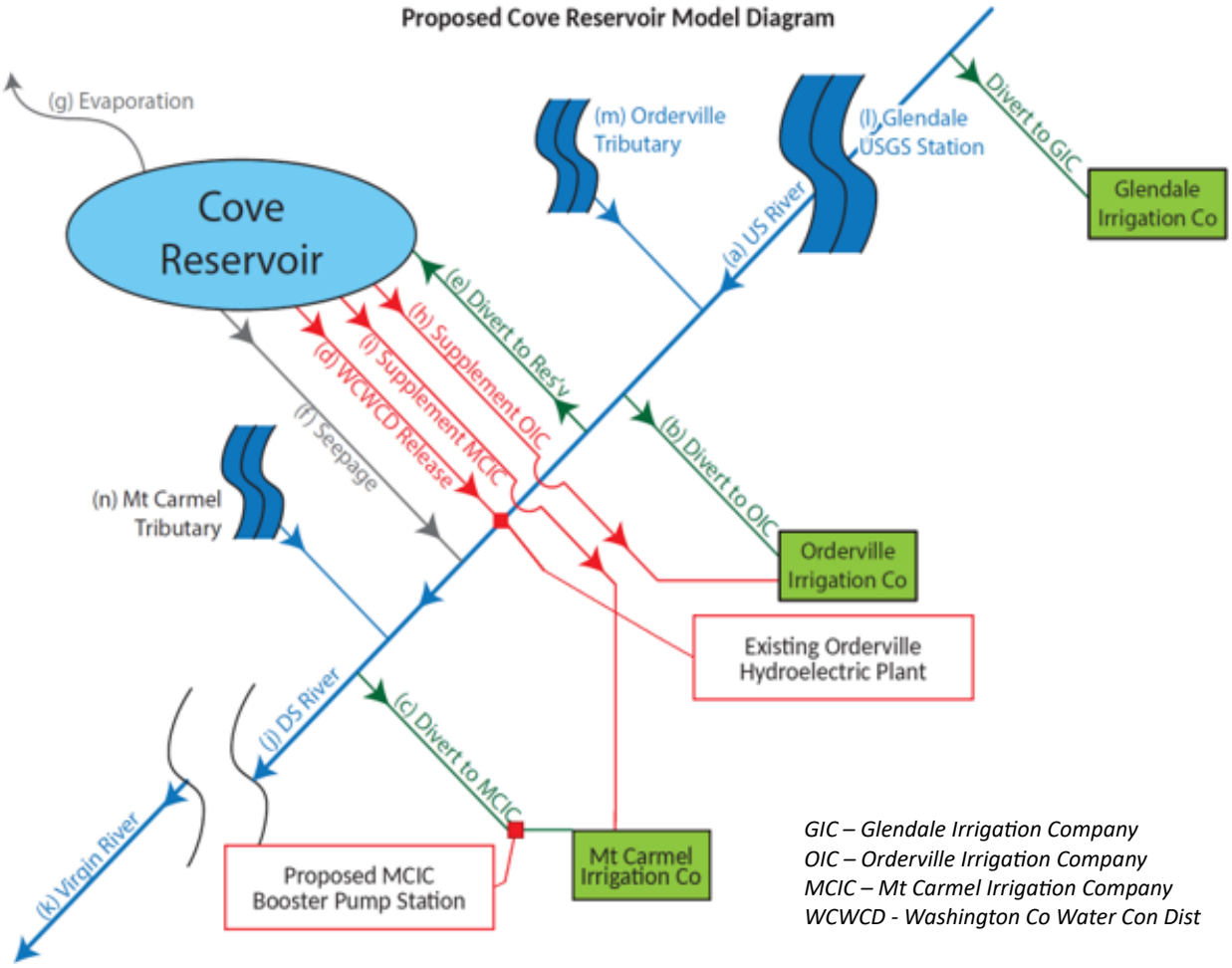

Figure 2.3. Proposed Cove Reservoir Model Diagram.

2.2.4 Opportunities

Project measures associated with AWM address deficiencies in drainage, ground water recharge, irrigation, water conservation, water quality and agricultural (including rural communities) water supply (NRCS, 2024a).

Project measures associated with M&I water supply provide storage capacity in reservoirs to increase the availability of water for present and future M&I use (NRCS, 2024a).

Project measures associated with Public Recreation provide a recreation opportunity in Kane County, addressing the currently overcrowded recreational facilities, particularly in the summer months.

This proposed project would provide the following long-term benefits:

- Increased water availability to local agricultural users in Kane and Washington Counties.
- Increased water availability for municipal users in Washington County.

- Increased water security for present and future residents in both Kane and Washington counties.
- Increased resilience to climate stressors, including potentially long-term extreme drought conditions.
- Added recreation opportunities for Kane County and the surrounding communities.

3.0 AFFECTED ENVIRONMENT: CURRENT AND FUTURE CONDITIONS

3.1 Resource Categories of Concern

A scoping process was completed to identify relevant resources, environmental concerns, and ecosystem services to be analyzed in detail and determine which items could be eliminated from the detailed study. These items were identified for the project based on required scoping concerns outlined in the 390 NWPM Section 501.24(B) (NRCS, 2024b), as well as additional concerns identified by the public, SLOs, stakeholders, Tribes, agencies, and cooperating agencies during the scoping process.

Table 3.1 provides a list of resources and their relevancy to the project. Items determined to be not relevant to the proposed action have been eliminated from the detailed study. Items determined to be relevant to the to the proposed action are detailed in Chapter 3.2 and Chapter 5.0.

Table 3.1. Resource Categories of Concern and Ecosystem Services Identified During Scoping.

Item/Concern	Relevant to the Proposed Action?	Rationale
Soil Resources **(Soil-Related Concerns)**	Yes	Soil resources are relevant for determining sediment yield and reservoir storage capacity within the watershed, and construction activities could increase erosion potential and change sediment transport conditions.
Prime and Unique Farmland, and Farmland of Statewide or Local Importance **(Soil-Related Concerns)**	No	No prime or unique farmland or farmland of statewide significance is located within the study area.
Water Resources **(Water-Related Concerns)**	Yes	Construction activities would occur in drainages and near water sources. Water would be made available for agricultural purposes during the summer months. The proposed action could affect downstream water flow.
Sole Source Aquifers **(Water-Related Concerns)**	No	There are no Sole Source Aquifer's in or near the study area according to the EPA Sole Source Aquifer interactive map (EPA, 2024a).
Water Quality **(Water-Related Concerns)**	Yes	Surface water quality could be affected. No measurable changes to groundwater quality are anticipated. Stream flow patterns could be altered.
Floodplain Management **(Water-Related Concerns)**	Yes	Construction activities could affect the floodplain in the project area.

Item/Concern	Relevant to the Proposed Action?	Rationale
Coastal Zone Management Areas **(Water-Related Concerns)**	No	There are no Coastal Zone Management Areas in the study area.
WOTUS, Wetlands, and Special Aquatic Sites **(Water-Related Concerns)**	Yes	Jurisdictional WOTUS are located within the study area. Two artificial wetlands were identified in the study area based on review of an aquatic resource survey conducted and included in Appendix E-1.
Coral Reefs **(Water-Related Concerns)**	No	There are no coastal reefs present in the study area.
Regional Water Resource Plans (including Coastal Plans) **(Water-Related Concerns)**	Yes	KCWCD and WCWCD have Water Conservation Plans for the study area. Coastal Plans are not applicable.
Wild and Scenic Rivers **(Water-Related Concerns)**	Yes	The EFVR has WSRs status for the portion that flows through ZNP that may be affected.
Air Quality **(Air-Related Concerns)**	Yes	Construction activities would produce emissions and fugitive dust. The proposed action would not generate long-term emissions (beyond the 15-month construction period). Permits would not be required.
Threatened and Endangered Species **(Plant and Animal-Related Concerns)**	Yes	Habitat for ESA-listed, BLM-listed, and state-listed Species of Greatest Conservation Need (SGCN) occur in the study area and may be affected.
Migratory Birds **(Plant and Animal-Related Concerns)**	Yes	Habitat for migratory birds is present within the study area and may be affected.
Bald and Golden Eagles **(Plant and Animal-Related Concerns)**	Yes	Habitat for bald and golden eagles is present within the study area and may be affected.
Essential Fish Habitat **(Plant and Animal-Related Concerns)**	No	There is no essential fish habitat located in the study area based on National Oceanic and Atmospheric Administration (NOAA) fisheries Essential Fish Habitat Mapper (NOAA, 2021)
Ecologically Critical Areas **(Plant and Animal-Related Concerns)**	Yes	The Parunuweap Canyon Wilderness Study Area (WSA), Zion Wilderness, and Parunuweap RNA are in the study area and may be

Item/Concern	Relevant to the Proposed Action?	Rationale
		impacted due to changes in water flows.
Invasive Species **(Plant and Animal-Related Concerns)**	Yes	The proposed action has potential for the introduction of invasive animal species. Construction disturbance increases the risk of invasive plant species becoming established.
Fish and Wildlife **(Plant and Animal-Related Concerns)**	Yes	The Utah Natural Heritage Program (UNHP) identified potential fish and wildlife habitat within the study area which may be affected.
Natural Areas **(Plant and Animal-Related Concerns)**	No	There are no protected natural areas or conservation areas located in the study area.
Riparian Areas **(Plant and Animal-Related Concerns)**	Yes	Changes in water flow may impact downstream riparian areas.
Forest Resources **(Plant and Animal-Related Concerns)**	No	There are no forest resources in or near the study area.
Cultural Resources and Tribal Consultation **(Human Use-Related Concerns)**	Yes	Historic/cultural resources are present within the study area and may be affected.
Social Issues **(Human Use-Related Concerns)**	Yes	The project is located near populated areas, and project implementation could impact local social conditions.
Local, Regional, and National Economy **(Human Use-Related Concerns)**	No	The project is not anticipated to have impact to the regional or national economy.
Public Health and Safety **(Human Use-Related Concerns)**	Yes	The proposed action has potential for increased risks to public safety due to dam failure and increased risk for construction-related traffic while construction is occurring.
Scenic Beauty **(Human Use-Related Concerns)**	Yes	The development of a reservoir and earthen dam would change the visual character of the immediate area. According to the National Trails System Map, there are no National Scenic and Historic Trails located in or near the study area (NPS, 2025)

Item/Concern	Relevant to the Proposed Action?	Rationale
Parklands (including National Parks, Monuments, and Historical Sites) **(Human Use-Related Concerns)**	No	According to the National Parks and Monuments Map (NPS, 2024), the Utah State Parks Map (Utah Department of Natural Resources, 2025) and the National Natural Landmarks Map (NPS, 2024), there are no parklands located within the project area. Zion National Park is located downstream of the project and is discussed throughout the document.
Significant Scientific Resources **(Human Use-Related Concerns)**	Yes	Paleontological resources exist near the project area and would not be disturbed. Resources found within the Project Area were determined to be invertebrate and non-significant
Land Use **(Human Use-Related Concerns)**	Yes	Alternative measures would affect land use.
Provisioning **(Scoped Ecosystem Services of Concern)**	Yes	Project measures could change flooding conditions on agricultural land that influence crop yield.
Regulating **(Scoped Ecosystem Services of Concern)**	Yes	Project measures include regulation for water, biology, and flooding that influence ecosystem processes. Climate variation also plays a role in flood conditions.
Supporting **(Scoped Ecosystem Services of Concern)**	Yes	Project measures could change surface water flow and water cycling.
Cultural **(Scoped Ecosystem Services of Concern)**	Yes	The project would improve the safety, wellbeing, and sustainability of the local community.

Consideration of ecosystem services that are relevant to the study area is required by the PR&G. This framework provides an integrated approach allowing consideration, transparent evaluation of the benefits (both tangible and intangible), and tradeoffs of potential alternatives. The four categories of ecosystem services are described in Section 1.8.1.

Ecosystem service categories overlap with resource concerns, and therefore, are not discussed separately from the resource concerns. The ecosystem service categories relevant to this project and the applicable resource concerns are provided in Table 3.2.

Table 3.2. Applicable Ecosystem Services and Related Resources.

Category	Service	Applicable Resources
Provisioning	Food/Biomass (crop yield)	Social Issues and Local Economy, Prime and Unique Farmland
Provisioning	Irrigation and livestock water	Water Resources, Social Issues and Local Economy
Regulating	Climate	Surface Water Quantity and Flow, Floodplain Management
Regulating	Water Regulation (quality and quantity)	WOTUS, Surface Water Quality, Surface Water Quantity and Flow, Floodplain Management
Regulating	Biological Regulation (plants and animals)	Plant and Animal Resources
Regulating	Natural Hazards Moderation (flood)	Floodplain Management, Public Health and Safety, Transportation Infrastructure
Supporting	Water Flow and Cycling	Surface Water Flow and Cumulative Affects
Cultural	Cultural/Historical Identity and Heritage	Historic/Cultural Resources/Native American Religious Concerns
Cultural	Peace and Sustainability	Social Issues and Local Economy, Public Health and Safety, Recreation, Visual Resources, Transportation Infrastructure, Noise and Vibration
Cultural	Well-Being and Safety	Floodplain Management, Public Health and Safety

The applicable ecosystem services were evaluated as part of the PR&G eight-step evaluation process. This process includes consideration of the federal objective, PL 83-566 general purposes, guiding principles, and ecosystem services to assist in decision making. Refer to the PR&G Analysis Report included in Appendix E-1 for documentation of the PR&G eight-step evaluation process used for decision-making.

3.2 Inventory of Existing Resources and Conditions

This chapter describes the resources that were determined to be relevant to the proposed action from Table 3.1 and the applicable ecosystem services from Table 3.2. Describing the affected environment defines the context in which the impacts could occur. The environmental analysis process has been conducted in compliance with applicable federal, state, and local regulations. Table S.1 (located in the Summary) provides a condensed overview of the resources that could potentially be influenced by consideration of the Alternatives. Further elaboration on these resources is provided within this chapter.

Each resource in this chapter includes the baseline environmental conditions in the project area and may extend beyond the project area, as applicable, to include the areas of potential impact (the study area). Refer to Section 1.4.2 for a description of the project area and study area.

Per requirements of the PR&G, where applicable, this chapter describes the ecosystem services associated with each resource. Refer to Section 1.8.1 for a definition of ecosystem services and service categories.

3.2.1 Soil

3.2.1.1 Soil Resources

The predominant soil types within the study area primarily consist of sand, sandy loams, upland clay loams, and shale. These soil types are classified by the NRCS Web Soil Survey as Bluesky family-Rock Outcrop complex, Catdraw-Quezcan-Vessilla complex, Marthaspeak-Ramps-Moonshine complex, Quezcan deep Sideshow-Orderville complex, Ramps-Modo-Kunz-Rock outcrop complex, Sili-Sideshow-Gypsic Haplustepts complex (upland clay loam), and Zigzag Family-Badland-Quezcan complex (upland clay loam and Naplene-Teromote-Arboles-Oxyaquic Ustifluvents complex) (NRCS, 2019).

The project area lies in an alluvial valley carved into Cretaceous and Tertiary sedimentary rocks, mainly comprising of sandstone and shale. Residual soils consist of silt and clay, with steep slopes adjacent to the site. Sediment rate studies conducted by Alpha Engineering and RB&G Engineering indicate that sediment volumes over the 100-year project lifespan would range from 253 acre-feet to 600 acre-feet, representing no more than 10 percent of the project reservoir's storage volume (Alpha Engineering and RB&G Engineering, 2020).

The project area is susceptible to occasional flash floods, leading to sheet, rill, and gully soil erosion following significant precipitation events. Although small retention dams have been constructed in the past, many are filled with sediment and provide minimal effectiveness.

Biological soil crusts are found in certain portions of the project area where surface disturbance is minimal. These crusts play an important role in retaining soil moisture and inhibiting the growth of certain annual weeds. They also contribute to reducing wind and water erosion, fixing atmospheric nitrogen into a form usable by plants, and enhancing soil organic matter. The absence of these crusts is a treatable resource concern and considered an indicator of physical disturbance (BLM, 2008)

The material at the three borrow sites that would be used for the proposed project contains either gravel (Lamb and Tait pits) or basalt (Esplin pit). All three pits have been previously used with topsoil removed and gravel or basalt removed on a total of approximately 24.7 acres (Tait pit 7.0 acres; Lamb pit 16.2 acres; Esplin pit 1.5 acres). The areas not disturbed at these sites have limited topsoil derived from sand/gravel or basalt sources. Source material for the embankment would be taken from the reservoir basin and would be covered by water once the reservoir is operational.

3.2.1.2 Ecosystem Services

Agricultural lands and associated soil resources in the study area provide ecosystem services categorized as provisioning services. Specifically, soil resources allow for the production of grasses (alfalfa and oats) and crops that feed cattle and humans. As described in Chapter 2.2, water from the EFVR is used by local agricultural users served by the KCWCD and WCWCD Service areas, including the Mt. Carmel, Orderville, Glendale, Washington, Hurricane, and La Verkin irrigation areas. Provision of this water allow lands to be maintained for agricultural production. Feed grasses,

including alfalfa and oats, contribute to the production of meat and dairy food; this water may also be used to grow food crops for people.

3.2.2 Water

3.2.2.1 Water Resources

Surface flows in the EFVR vary considerably, mainly in response to spring runoff or intense storm events, during which the river carries high sediment loads. From 1967 to 2020, the average monthly discharge of the river ranged from a high of 33.8 cfs in April to a low of 9.9 cfs in August. Gauge data (USGS gauging station 09404450) revealed that the last 20 years have exhibited drier hydrology and may be indicative of future conditions (Alpha Engineering, 2026).

A survey of the project area and surrounding land identified a total of two wetlands, 12 intermittent and/or perennial streams, five ephemeral streams, and three ephemeral ponds. Refer to the Aquatic Resource Delineation Report for more details (Appendix E-1).

The ZNP Agreement (1996) negotiates the settlement of reserved water right claims filed by ZNP (Appendix E-1). The agreement is signed by the U.S. Department of the Interior, the State of Utah, the KCWCD, and the WCWCD. Agreement stipulations include:

1. One or more new reservoirs with cumulative active storage capacity of up to but not exceeding 6,750 acre-feet may be constructed on Stout Creek, Lydia's Canyon, Muddy Creek or Cove Canyon (site of the proposed reservoir), East Fork above Stout Canyon, and on other tributaries of the East Fork upstream of Glendale.

2. New surface water diversions on the EFVR or its tributaries shall not cumulatively exceed 60 cfs.

3. The existing flow or 2 cfs, whichever is less, shall be maintained immediately below any new surface water diversions to reservoirs constructed.

4. The existing flow or 1 cfs (including seepage), whichever is less, shall be maintained immediately below any new reservoir constructed.

5. Cumulative releases from new reservoirs constructed on streams identified above shall not increase the flow measured at the USGS gage on the EFVR near Springdale (USGS No. 09404900), by more than 25 cfs during any 7-day period and shall not exceed the long-term monthly average at Springdale gage by more than 15 cfs. As measured at said gage, the maximum instantaneous flow attributable to releases from such reservoirs shall not exceed 50 cfs, except for matters involving dam safety.

6. Surface water diversions to new reservoirs described above shall not occur except during the period from November 1 to May 31, subject to the bypass flow requirements described above.

The use of EFVR water by the GIC, OIC, and the MCIC is monitored on a regular basis. The three companies divert water from the EFVR in different locations. A weir is present at each diversion site. Each weir has staff gages to read water elevation. Each weir is equipped with an electronic flow meter that sends information to a website to provide remote monitoring. The data collected

from these flow meters is used to determine the total amount of water diverted. Additionally, the Utah State Water engineer collects money from the GIC, OIC, and the MCIC to fund a water commissioner. The commissioner is responsible for monitoring the diversions and making certain that companies are using the correct amount of water according to their water right.

3.2.2.2 Water Quality

The State of Utah has designated the EFVR and its tributaries as High-Quality Waters (HQW) (BLM, 2008). Water quality standards are set by the State of Utah according to EPA guidelines and are reviewed and updated (if necessary) every three years. The water quality standards are intended to protect Utah's waters and improve the quality for beneficial uses (Utah Department of Environmental Quality, 2023). HQWs are protected against "new point source discharges of wastewater, treated or otherwise" (Utah Administrative Code Rule R317-2-3.2).

3.2.2.3 Floodplain Management

The portion of the EFVR within the study area is in a Federal Emergency Management Agency (FEMA) Zone A floodplain (Figure C-4, Appendix C). This designation signifies an area susceptible to inundation by the 1-percent-annual chance flood event, typically determined using approximate methodologies (FEMA, 2019).

The project area is prone to sporadic and occasionally intense flash floods. These floods, though brief, result in significant sediment movement, leading to localized sheet, rill, and gully erosion issues.

3.2.2.4 WOTUS, Wetlands, and Special Aquatic Sites

A desktop review of the study area was completed using National Wetlands Inventory (NWI) data provided by the U.S. Fish and Wildlife Service (USFWS) (USFWS, 2024). The review identified one wetland and sixteen riverine features. A full list of NWI feature types is included in Appendix E-1.

In 2018, qualified professionals with Eocene Environmental Group, Inc. (Eocene; formerly Transcon Environmental, Inc.,) conducted a survey of wetlands and other potentially jurisdictional WOTUS within the project area (Appendix E-1). Follow-up field visits to evaluate additional borrow pits were conducted in 2019, and a survey of the Mt. Carmel Improvement area was conducted in 2021.

Two small wetlands were documented on private land in the Long Valley portion of the project area. The first wetland (0.03 acres), located south of the proposed reservoir and access road, is an isolated, artificial structure consisting of cattail (*Typha latifoli*) and other hydrophytic vegetation. The second wetland (0.73 acres), also isolated and artificial, lies within the right-of-way (ROW) where the replacement of the existing irrigation pipeline would occur. This wetland supports willows and other hydrophytic species (Eocene, 2025). Refer to Appendix E-1 for a detailed description of aquatic resources. The field review also noted that prior anthropogenic disturbances had altered several streams that were identified by NWI, and these streams no longer exist or no longer exhibit connectivity to other aquatic features downstream.

The NRCS communicated with USACE (memorandum dated July 21, 2022, and updated February 18, 2026) requesting an Approved Jurisdictional Determination (AJD) for the project area. By

memorandum dated April 23, 2026, USACE concurred with the aquatic resources' delineation made for the project area. This includes approximately 7.43 acres of aquatic resources, consisting of 9,665 linear feet (3.43 acres) of ephemeral channels; 0.62 acres of irrigation/stock pond features; and 29,415 linear feet (3.38 acres) of irrigations ditches. The USACE memorandum also verified that the location and boundaries of wetlands were delineated consistent with the wetland definition at 33 CFR §328.3 §(16), the 1987 *Corps of Engineers Wetlands Delineation Manual* (Wetlands Research Program Technical Report Y-87-1) and the applicable regional supplements. The location and boundaries of non-tidal waters were found to conform with the ordinary high-water mark definition found at 33 CFR §328.3(c)(7), Regulatory Guidance Letter 05-05, and any applicable regional guides. The USACE AJD memorandum is included as Appendix A.

Flash floods in the EFVR drainage are a common occurrence during the summer monsoon season. While these events can be damaging, one effect of these high-pulse events (i.e., flash floods) is that benefits to the stream and associated riparian habitat also may occur. Willows are early successional plants that benefit from disturbances such as flash floods (PLPCO, 2026).

3.2.2.5 Regional Water Resource Plans

3.2.2.5.1 Colorado River Compact of 1922

The Colorado River Compact of 1922 is an agreement between the states of Arizona, California, Nevada, New Mexico, Utah, and Wyoming under the Act of the Congress of the U.S. of America. The major purposes of the compact are to "provide for the equitable division and appointment of the use of the waters of the Colorado River system; to establish the relative importance of different beneficial uses of water, to promote interstate comity; to remove causes of present and future controversies; and to secure the expeditious agricultural and industrial development of the Colorado River Basin, the storage of its waters, and the protection of life and property from floods" (43 USC 617l). The Virgin River is a Lower Basin tributary of the Colorado River, which connects at Lake Mead approximately 120 river miles away from the Quail Creek Reservoir Diversion site. Because the Virgin River is a Lower Basin tributary, Utah's water use on the Virgin River is not accounted for as part of the Upper Basin's non-depletion obligation. Water would be diverted to Cove Reservoir, then stored, released, conveyed, and applied to beneficial use in accordance with water rights and change applications approved by the Utah State Engineer's Office. Refer to Appendix E-1 for more information.

3.2.2.5.2 Kane County Resource Management Plan

As part of its overall General Plan, Kane County has adopted the Kane County Resource Management Plan to address the present and future needs of the county, as well as the growth and development of all or any part of the land within the unincorporated portions of the county (Kane County, 2018). As part of the Kane County Resource Management Plan, Kane County has addressed aspects of the health, general welfare, safety, transportation, prosperity, civic activities, recreational and cultural activities, natural resources, and the efficient economic use of the land within the unincorporated portions of the county. The plan outlines that Kane County "supports the development, adoption, and implementation of water collection, storage, and distribution" (Utah PLPCO, 2017). Kane County's water management goals include "cooperating with the State of Utah to achieve the provisions of the State of Utah water quality plan, while complying with Utah constitutional and statutory law as to vested water rights and control of in-stream flow. The

county will support efforts to maintain or improve riparian areas and aquatic habitat that represents a range of variability for functioning condition."

3.2.2.5.3 Washington County Water Conservancy District Water Conservation Plan

WCWCD has also adopted a Water Conservation Plan which outlines water conservation goals and programs to ensure the community has a safe, reliable water supply for current and future generations. Washington County is targeting a 14 percent reduction in per capita water use by 2030 (WCWCD, 2021). Key milestones to achieve the 2030 water conservation goal include:

- Continuing existing water conservation programs.
- Creating programs for residential landscape consultations, water audits for hotels/motels and a customized water-saving incentive program for high users.
- Developing rebate programs for turf removal, hot water on demand systems and leak devices/flow sensors.
- Working with municipal partners to pass and enforce new development standards.
- Hiring additional staff to promote, implement and track conservation programs.
- Increasing participation levels and conservation budgets.

3.2.2.6 Wild and Scenic Rivers

The EFVR enters ZNP approximately 20 river miles downstream and southwest of the project area. The river flows through ZNP from the east boundary to the west boundary. This portion of the river has been designated as wild under the WSRA (National Wild and Scenic Rivers System, 2024). This designation means that the river is free of impoundments and generally inaccessible, except by trail, and includes watersheds or shorelines that are essentially primitive as waters are unpolluted and represent vestiges of primitive America. Outstandingly remarkable values associated with this stretch of the river include cultural, geologic, ecological processes, wildlife, and fish. These designations were made possible by the Omnibus Public Land Management Act of 2009. The Omnibus Public Land Management Act also includes a savings clause in Section 1976 to ensure that the new wild and scenic river designations on the Virgin River would not conflict with the 1996 agreement. "SAVINGS CLAUSE—The amendment made by subsection (a) does not affect the agreement among the U.S., the State of Utah, the Washington County Water Conservancy District, and the Kane County Water Conservancy District entitled 'Zion National Park Water Rights Settlement Agreement' and dated December 4, 1996." Additionally, the EFVR was designated as a Research Natural Area in 2001. The area has been set aside for research purposes and is closed to recreation (NPS, 2013).

3.2.2.7 Ecosystem Services

Water flowing through the EFVR provides the following ecosystem services:

- **Provisioning Services**—As described in Chapter 2.2, the EFVR provides agricultural water for livestock feed and food as well as water for M&I purposes in Kane and Washington Counties.

- **Regulating Services**—The amount of water instream affects water qualities, including temperature, turbidity, sediment, and pollutants. Greater instream flow helps to regulate water temperature and decrease bank erosion/sedimentation in the water. Greater streamflow also helps to dilute pollutants. Section 3.2.2.2 describes surface water quality in the study area.

- **Supporting Services**—As described in Section 3.2.4, the EFVR provides fundamental ecosystem processes, such as providing habitat for plants and wildlife and maintaining genetic and biological diversity.

- **Cultural Services**—Water from the EFVR provides recreation opportunities for the local community.

3.2.3 Air

3.2.3.1 Air Quality

The CAA requires the EPA to set National Ambient Air Quality Standards (NAAQS) (40 CFR part 50) for six principal pollutants (known as criteria air pollutants) with potential to be harmful to public health and the environment. The CAA identifies two types of NAAQS: primary standards and secondary standards. Primary standards provide public health protection, including protecting the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

Any county within the U.S. classified as a nonattainment area (an area not meeting the national primary or secondary ambient air quality standards for NAAQS) is listed in the EPA Greenbook. Neither Kane County nor Washington County are classified as nonattainment areas (EPA, 2024b).

Air quality in the project area is typical of undeveloped regions of southern Utah and is generally very good. This is primarily due to the project's remote location and lack of any nearby large-scale developments or urban centers (EPA and Partners, 2024).

3.2.3.2 Ecosystem Services

Air quality provides the following ecosystem services:

- **Regulating Services**—Maintaining air quality standards promotes climate regulation as many sources of air pollutants are also greenhouse gases.

- **Supporting Services**—Nutrient cycling in the air involves abiotic components such as carbon, hydrogen, nitrogen, and oxygen. These elements are transferred to living organisms through the air when they breathe.

- **Cultural Services**—Air quality directly relates to the health of the local population. Air pollution can affect lung development and is associated with respiratory diseases such as emphysema, asthma, stroke, and heart disease.

3.2.4 Plants and Animals

3.2.4.1 Threatened and Endangered Species

The ESA was established to protect threatened and endangered species and their habitats. Section 7 of the ESA requires federal agencies to ensure that federal actions do not jeopardize the existence of any listed species. This is accomplished through Section 7 consultation with USFWS. A list of threatened, endangered, and candidate species for the study area was obtained from the USFWS Information for Planning and Conservation (IPaC) database. The USFWS list includes specific threatened and endangered species and designated/proposed critical habitat that may occur within or near the study area (Appendix E-1 and E-2). Table 3.3 presents federally listed species with the potential to occur in the project area, along with their preferred habitat and the potential for each species to occur (Eocene, 2025).

Table 3.3. Federally Listed Species Potentially Occurring in the Study Area.

Species and Scientific Name	Federal Listing Status	Range or Habitat and Potential for Species Occurrence
Birds California condor (*Gymnogyps californianus*)	Experimental Non-Essential; (Threatened in ZNP)	The California condor utilizes a variety of habitats for foraging and nesting, including caves and ledges of steep rocky terrain. The study area is located within the experimental non-essential range of the California condor (FR, 1996). Experimental non-essential species are treated as threatened within ZNP. The species is present in ZNP and may visit other parts of the study area (ZNP, 2025a). However, no surface disturbance would occur within known occupied California condor habitat. UNHP data did not identify any known occurrences of the species in the study area (UNHP, 2024).
Birds Mexican spotted owl (MSO) (*Strix occidentalis lucida*)	Threatened	In Utah, the Mexican spotted owl (MSO) inhabits isolated mountain ranges and narrow canyons (USFWS, 2013; ZNP, 2025b). Occupied designated critical habitat is present in the Parunuweap Canyon WSA and ZNP, within the study area (FR, 2004). Protected Activity Centers (PACs) for the MSO are also present in the ZNP portion of the study area. No surface disturbance would occur within MSO habitat, and minor streamflow changes would not negatively affect riparian habitat. UNHP data did not identify any known occurrences of the species in the study area (UNHP, 2024).
Birds Southwestern willow flycatcher (*Empidonax traillii extimus*)	Endangered	The southwestern willow flycatcher (SWFL) breeds in riparian vegetation and nests where willows or tamarisk are present. Occupied habitat exists downstream in the Parunuweap Canyon WSA and ZNP within the study area (USFWS, 2002b). However, no surface disturbance would occur within SWFL habitat, and minor streamflow changes would not negatively affect riparian habitat. UNHP data identified the presence of the SWFL within 2 miles of the study area (UNHP, 2024).

Species and Scientific Name	Federal Listing Status	Range or Habitat and Potential for Species Occurrence
Birds Western yellow-billed cuckoo (WYBC) (*Coccyzus americanus*)	Threatened	The western yellow-billed cuckoo (WYBC) breeds in riparian habitat with wide floodplains and dense willow-cottonwood or mesquite forests. They rarely occupy areas less than 325 feet wide. No suitable breeding habitat is present in the Parunuweap Canyon WSA and ZNP areas within the study area (FR, 2014). Potential suitable stop-over habitat for migrating WYBC may be present in these areas. No surface disturbance would occur within WYBC habitat, and minor streamflow changes would not negatively affect riparian habitat. UNHP data did not identify any known occurrences of the species in the study area (UNHP, 2024).
Reptiles Desert tortoise (*Gopherus agassizii*)	Threatened	The desert tortoise inhabits deserts, grasslands, and rocky hillsides, typically in desert shrub areas below 5,500 feet. The Upper Virgin River Recovery Unit extends from the Quail Creek Reservoir diversion to Springdale, Utah, outside of the study area (USFWS, 2011). UNHP data identified the presence of the desert tortoise within 2 miles of the study area (UNHP, 2024).
Fish Virgin River chub (*Gila seminuda*)	Endangered	The Virgin River chub is found below 4,500 feet in deep runs or pools with low to medium velocities, and in-stream cover over sandy substrate (USFWS, 1995a). In Utah, the Virgin River from the Arizona state line to the La Verkin Creek confluence, supports Virgin River chub populations. Virgin River chub has also colonized habitat upstream of the La Verkin Creek confluence following the establishment of population maintenance flows below Quail Creek Diversion. Virgin River chub distribution currently extends upstream to the old diversion structure in Timpoweap Canyon (2 miles upstream from Pah Tempe Springs, and 4 miles upstream from the La Verkin Creek confluence (PLPCO, 2025). In Utah, designated critical habitat extends from approximately 4.8 miles downstream from the Quail Creek Diversion, at the confluence of La Verkin Creek and the Virgin River, to the Utah-Arizona state line (USFWS, 2000). UNHP data did not identify any known occurrences of the species in the study area (UNHP, 2024).

Species and Scientific Name	Federal Listing Status	Range or Habitat and Potential for Species Occurrence
Fish Woundfin (*Plagopterus argentissimus*)	Endangered	The woundfin is found in swift, turbid, warm streams over sand. Adult woundfin prefer depths of 8 to 18 inches and avoid quieter pools (USFWS, 1995a). Occupied habitat exists below the Quail Creek Reservoir Diversion. In Utah, designated critical habitat exists approximately 4.8 river miles downstream from the Diversion, beginning at the confluence of La Verkin Creek and the Virgin River to the Utah-Arizona state line (FR, 2000). UNHP data did not identify any known occurrences of the species in the study area (UNHP, 2024).
Insects Monarch butterfly (*Danaus plexippus*)	Proposed Threatened	Adult monarch butterflies feed on various flowers but only breed where milkweed is present. Monarch caterpillars have been observed within portions of the proposed study area, primarily in ZNP; however, breeding is unlikely within the Long Valley portion of the study area due to a lack of milkweed presence. UNHP data did not identify any known occurrences of the species in the study area (UNHP, 2024). The Cove Reservoir area is likely a flyover area for migrating monarch butterflies but is not an over-wintering site.
Insects Suckley's cuckoo bumble bee (*Bombus suckleyi*)	Proposed Endangered	Suckley's cuckoo bumble bee is an obligate social parasite, dependent on host bumble bees for much of its life cycle. The species has a broad historical distribution across North America, and it has been found in various habitat types, including prairies, grasslands, meadows, and woodlands. Occurrence records were found at elevations ranging from approximately 6,000 to 10,500 feet. In the western portion of the range, Suckley's cuckoo bumble bee observations extend from the Yukon, to Arizona, and east to Minnesota. However, the species has not been observed within the western U.S. since 2016 (USFWS, 2024a). It is unlikely that the species is found within the study area. UNHP data did not identify any known occurrences of the species in the study area (UNHP, 2024).
Plants Jones cycladenia (*Cycladenia humilis* var. *jonesii*)	Threatened	Jones cycladenia is found in sparsely vegetated desert scrub between 4,000 to 6,660 feet, typically on steep slopes with gypsiferous, saline soils of the Wasatch, Cutler, Summerville, and Chinle formations (USFWS, 2021). No suitable habitat exists in the study area. UNHP data did not identify any known occurrences of the species in the study area (UNHP, 2024).

Species and Scientific Name	Federal Listing Status	Range or Habitat and Potential for Species Occurrence
Plants Shivwits milk-vetch (*Astragalus ampullariodies*)	Endangered	Shivwits milk-vetch grows at elevations of 3,018 to 4,367 feet on soft clay soils linked to the Petrified Forest member of the Chinle Formation. Occupied habitat is restricted to six isolated populations in Washington County, none of which are near the study area (USFWS, 2006). UNHP data did not identify any known occurrences of the species in the study area (UNHP, 2024).
Plants Siler's pincushion cactus (*Pediocactus sileri*)	Threatened	Siler pincushion is endemic to the Arizona/Utah border in Kane and Washington County, Utah, and grows in gypsiferous and calcareous soils from the Moenkopi, Chinle, and Kaibab Formations (USFWS, 2008). No occupied habitat exists in the study area. UNHP data did not identify any known occurrences of the species in the study area (UNHP 2024).
Plants Ute ladies'-tresses (*Spiranthes diluvialis*)	Threatened	The Ute ladies-tresses is found in wet meadows near springs, lakes, or streams at elevations of 4,300 to 7,000 feet (USFWS, 1995b). While the study area is in a Ute ladies'-tresses Analytical Unit, habitat as described above is not present (USFWS, 2023). Further, no surface disturbance would occur within any riparian habitat. UNHP data did not identify any known occurrences of the species in the study area (UNHP, 2024). A general habitat assessment was conducted in the vicinity of the proposed reservoir and borrow pits. No Ute ladies-tresses suitable habitat was located. The proposed reservoir site in located in dry, terrestrial habitat. Nearby riparian areas along the EFVR are generally woody, lack understory, and are often dry during summer low flow.

3.2.4.2 Migratory Birds

The protection of migratory birds is regulated by the Migratory Bird Treaty Act (MBTA [16 USC 703-711]). The MBTA prohibits the take of any migratory bird, part, nest, egg, or product thereof, with "take" being defined as to pursue, hunt, shoot, wound, kill, trap, capture, or collect; or to attempt any of these activities. Most species of birds in the U.S. are legally protected under the MBTA. Exceptions to this statute include game and non-native species. A complete list of protected species is found in 50 CFR 10.13. All of the migratory bird species with potential to occur within the study area, with the exception of bald and golden eagles, are also considered to be Birds of Conservation Concern. These are migratory and non-migratory bird species (beyond those already designated as federally threatened or endangered) that represent the highest conservation priorities of the USFWS.

The USFWS IPaC identified 16 migratory bird species, including bald and golden eagles as potentially occurring within the study area (USFWS, 2025) (Table 3.4).

Table 3.4. Migratory Bird Species with Potential to Occur in the Study Area Identified by IPaC.

Common Name (*Scientific Name*)	**Highest Probability of Presence in Study Area**	**Breeding Season***
Bald eagle (*Haliaeetus leucocephalus*)	December–March, May	December–August
Black-chinned sparrow (*Spizella atogularis*)	March–September	April–July
Broad-tailed hummingbird (*Selasphorus Platycercus*)	April–September	May–August
California gull (*Larus californicus)*	February–March, August	March–July
Cassins's finch (*Haemorhous cassinii*)	October–April, July	May–July
Clark's nutcracker (*Nucifraga Columbiana*)	April-June, September–October	January–July
Evening grosbeak (*Coccothraustes vespertinus*)	April–May, September–November	May–August
Golden eagle (*Aquila chrysaetos*)	January–December	December–August
Grace's warbler (*Setophaga graciae*)	April–June	May–July
Lesser yellowlegs (*Triga flavipes*)	April, October	None

Common Name (*Scientific Name*)	Highest Probability of Presence in Study Area	Breeding Season*
Lewis's woodpecker (*Melanerpes lewis*)	January–February, April, September	April–September
Long-eared owl (*Asio otus*)	March, May–June, October	March–July
Olive-sided flycatcher (*Contopus cooperi*)	May, July, September	May–August
Pinyon jay (*Gymnorhinus cyanocephalus*)	November–August	February–July
Virginia's warbler (*Vermivora virginiae*)	April–June, August–September	May–July
Western grebe (*Aechmophorus occidentalis*)	May, July	June–August

*Breeding season may differ from actual exclusion periods that may be required should nesting birds inhabit the project area during construction.

3.2.4.3 Bald and Golden Eagles

Bald and golden eagles are protected under the Bald and Golden Eagle Protect Act (BGEPA) (16 USC 668). The act makes it illegal to take, possess, sell, purchase, barter, or transport any bald or golden eagle, alive or dead, or any part, nest, or egg thereof. Under the BGEPA, the term "take" includes pursuing, shooting, shooting at, poisoning, wounding, killing, capturing, trapping, collecting, molesting, or disturbing species. Bald eagles (*Haliaeetus leucocephalus*) are listed on the IPaC report, and golden eagles (*Aquila chrysaetos*) are listed on the UNHP Report, indicating they have potential to occur within or near the study area (USFWS, 2025; UNHP, 2024).

3.2.4.4 Ecologically Critical Areas

WSAs are places that have wilderness characteristics, are of a minimum size, and contain naturalness and outstanding opportunities for recreation which make them eligible for designation as wilderness (BLM, n.d.) The 30,800-acre Parunuweap Canyon WSA is located immediately east of and adjoins ZNP. It contains recreation opportunities such as hiking, wildlife viewing, and landmark sight-seeing. Stunning canyon vistas and unique hiking opportunities are present. Landmarks in the WSA include Harris Mountain and Elephant Butte. Wildlife, including mule deer, mountain lions, rattlesnakes, and birds are common. The EFVR flows through the WSA. By following the EFVR, hikers can traverse over 10 miles through the canyon to the east side of ZNP (BLM, 2008; BLM, 2025).

The Zion Wilderness was designated by Congress in 2009 and comprises approximately 83 percent of ZNP. It is composed of a labyrinth of multicolored canyons carved out of the Markagunt Plateau. The wilderness area is located on the Colorado Plateau but borders the Great Basin and Mojave Desert provinces and is home to plants and animals from each of the three regions. A ribbon of

green marks the EFVR's approximately 7-mile course through the arid southernmost portion of the Zion Wilderness (ZNP, 2025).

The 4,625-acre ZNP Parunuweap Research Natural Area (RNA) was established in 2001 and includes Parunuweap and Shunes Canyons. The EFVR flows through the Parunuweap Canyon portion of the RNA. Surrounding lands include slickrock and old-growth pinyon-juniper woodlands. Ecological units present within the RNA include rock crevice and slickrock communities; riparian, fluvial, and aquatic habitats; springs and seeps; hanging gardens; hanging canyons; eolian landscapes; and riverine ancestral Puebloan people habitation sites (Lauren DeGennaro ZNP, 2025).

3.2.4.5 Invasive Species

Plant species listed under the Utah Noxious Weed Act known to be within or are likely to inhabit the project area include Russian olive (*Elaeagnus angustifolia*), tamarisk (*tamarisk*), wild morning glory (*Calystegia sepium*), puncture vine (*Tribulus terrestris*), tall whitetop (*Lepidium latifolium*), Scotch thistle (*Onopordum acanthium*), purple loosestrife (*Lythrum salicaria*), spotted knapweed (*Centaurea stoebe*), and Canada thistle (*Cirsium arvense*). Other invasive species not specified under the Utah Noxious Weed Act, such as cheatgrass (*Bromus tectorum*) and Russian thistle (*Salsola* spp.), have been observed within the project area.

These invasive species typically proliferate in disturbed areas where native vegetation has been substantially or entirely removed, including locations such as roadsides, livestock trails, and areas damaged by floods. Noxious weeds and invasive plant species often outcompete native vegetation, leading to reduced species diversity and ecosystem instability.

Invasive animal species that may inhabit the project area include bullfrog (*Rana catesbeiana*), European starling (*Sturnus vulgaris*), fathead/rosy red minnow (*Pimephales promelas*), mosquitofish (*Gambusia affinis*), muskrat (*Ondatra zibethicus)*, New Zealand mudsnail (*Potamopyrgus antipodarum*), nutria (*Myocastor coypus*), quagga mussel (*Dreissena rostiformis bugensis*), red fox (*Vulpes vulpes*), raccoon (*Procyon lotor*), red shiner (*Cyprinella lutrensis*), red swamp crayfish (*Procambrus clarkia*), signal crayfish (*Procambrus leniusculus*), white-tailed deer (*Odocoileus virginianus*), Zebra mussel (*Dreissena polymorpha*), and non-native non-sport fish (NRCS, 2012). Administrative Rule R657-60 identifies regulations and procedures designed to prevent and control the spread of aquatic invasive species in Utah. No surveys have been conducted for invasive animal species within the project area, but it can be assumed that some of these species are likely present.

3.2.4.6 Fish and Wildlife

Terrestrial wildlife species likely to inhabit or frequent the proposed project areas are typical of the Colorado Plateau physiographic province. Mammalian species include mule deer (*Odocoileus hemionus*), coyote (*Canis latrans*), jackrabbit (*Lepus californicus*), cottontail rabbit (*Sylvilagus* spp.), bobcat (*Lynx rufus*), raccoon (*Procyon lotor*), badger (*Taxidea taxus*), and weasel (*Mustela frenata*). Additionally, various species of small mammals such as voles, squirrels, chipmunks, mice, and bats are expected to be present (Eocene, 2025).

Upland game species likely to inhabit the project area include mourning dove (*Zenaida macroura*), band-tailed pigeon (*Patagioenas fasciata*), and chukar (*Alectoris chukar*). Other species are likely to inhabit the area. Fisheries and aquatic habitat are limited.

Habitat for greater sage-grouse extends into Kane County and is present within the Panguitch Priority Habitat Management Area (PHMA) (BLM, 2018). A project-related survey determined that no portion of the PHMA is located within the project area and that there is no sage-grouse habitat located outside of the PHMA.

Utah has developed a Wildlife Action Plan with the purpose of managing native wildlife species and their habitats to prevent additional ESA listings (UDWR, 2015). The Wildlife Action Plan identifies SGCN that are considered jurisdictional wildlife. A UNHP Online Species Search Report was completed for the study area, and SGCN or habitat within a 0.5- and 2.0-mile radius of the study area was identified (UNHP, 2024). Data from the UNHP site are summarized in Table 3.4.

The Virgin River Program (VRP) is a collaborative effort between local, state, and federal partners and was established to reconcile and avoid potential conflicts between water development and wildlife conservation. Actions implemented under the VRP help recover, conserve, enhance, and protect native species in the Virgin River Basin (such as the Virgin spinedace) while providing adequate water supplies for sustaining human needs. The Program simplifies regulatory processes for water users and landowners while ensuring that future generations can enjoy Utah's natural heritage (Virgin River Program, 2025).

Table 3.5. Species of Greatest Conservation Need Potentially Occurring in the Study Area.

Species and Scientific Name	State Status	Range or Habitat and Potential for Species Occurrence
Bird Bald eagle (*Haliaeetus leucocephalus*)	SGCN	Nests near coastlines, rivers, large lakes, or streams that support an adequate food supply. Nesting substrates often include mature or old-growth trees, snags, cliffs, rock promontories, on the ground (rarely), and on human-made structures (more frequently). Bald eagles occasionally nest in southern Utah but are more typically present during their winter migration. Suitable foraging habitat located within and adjacent to the project area supports a variety of raptors, including bald eagles. Bald eagles may utilize cottonwood trees adjacent to the EFVR for winter roosting and stopover habitat during migration periods. Historical records exist of eagle occurrence within 0.5 miles of the project area. The BGEPA prohibits the "taking" of the eagle without a special permit issued by the U.S. Department of the Interior.
Bird Band-tailed pigeon (*Patagioenas fasciata*)	SGCN	Typical habitat is coniferous forest. Primary concentrations in Utah are in the southern pine forests from the Pine Valley Mountains in the west to the La Sal and Blue Mountains in the east. Nesting in Utah takes place in May, June, and July. Normally only one egg is laid. The nest is usually a frail platform of dead twigs 8–20 feet above the ground in a coniferous tree. Food of the band-tailed pigeon consists mainly of acorns, berries, pine buds, seeds, and needles. Only a small portion of the diet is insects, although a few grasshoppers and other large insects may be taken. The band-tailed pigeon is migratory, and only limited breeding populations occur in southern Utah. Potential habitat is limited in the project area. The last occurrence record for the pigeon in the project area was in 1971.
Bird Burrowing owl (*Athene cunicularia*)	SGCN	Uncommon during the summer in proper habitat throughout Utah. Habitats are open grassland and prairies, as well as other open situations, such as golf courses, cemeteries, and airports. The nest is in a mammal burrow, usually that of a prairie dog, ground squirrel, badger, or armadillo; if a mammal burrow is not available, the owls will sometimes excavate their own nest burrow. Confirmed breeding occurrences are known in at least 17 counties, including Kane and Washington Counties. It eats mainly terrestrial invertebrates, but also consumes a variety of small vertebrates, including small mammals, birds, frogs, toads, lizards, and snakes. Habitat is limited within the project area; however, a historic occurrence was documented in 1987.

Species and Scientific Name	State Status	Range or Habitat and Potential for Species Occurrence
Bird Ferruginous hawk (*Buteo regalis*)	SGCN	Occurs throughout Utah in proper habitat. The hawk is found primarily in open lowland desert country. Pinyon-juniper woodland, barren cliffs and bluffs, sagebrush-rabbitbrush, and cold desert shrub (including saltbush and greasewood) are habitats utilized by this species in Utah during the breeding season. Mammals are the primary prey during the breeding season, although birds, amphibians, reptiles, and insects also are taken. Suitable habitats near agricultural lands and adjacent to pinyon-juniper woodland exist within the Cove Reservoir portion of the project area. However, occurrence of the ferruginous hawks would be expected to be very low and only migratory in nature. No occurrences of the ferruginous hawk have been documented within the project area.
Bird Flammulated owl (*Psiloscops flammeolus*)	SGCN	A common raptor in montane pine forests (especially ponderosa pine and aspen forests) in the western U.S. and Utah. Flammulated owls are strictly nocturnal and eat insects and other terrestrial invertebrates, such as spiders, centipedes, and scorpions. It is known to nest in woodpecker holes. Montane pine habitat is lacking within the project area; however, an occurrence was documented in 2020.
Bird Golden eagle (*Aquila chrysaetos*)	SGCN	Breeds across western North America, from southern Alaska to northern Mexico. Populations in the northern parts of the breeding range migrate south for winter, but most populations in the western U.S. are year-round residents of the same area. Typically found in open country and semi-open prairies, sagebrush, savannah or sparse woodland, and barren areas. Commonly found in Utah. It feeds mainly on small mammals, especially rabbits, marmots, and ground squirrels, but also eats insects, snakes, birds, juvenile ungulates, and carrion. Nests are most often found on rock ledges but sometimes in large trees. It is common in Utah and habitat is present within the project area. A historical record located the golden eagle within the project area in 2008. The BGEPA prohibits the “taking” of an eagle without a special permit issued by the U.S. Department of the Interior.

Species and Scientific Name	State Status	Range or Habitat and Potential for Species Occurrence
Bird Lewis's woodpecker (*Melanerpes lewis*)	SGCN	This species is widespread but is generally uncommon in Utah. The population may be declining. It is a cavity nester, excavating a hole in tall trees that are often dead or blackened by fire. It will also nest in utility poles or stumps, but prefers ponderosa pine, cottonwood, or sycamore trees. The major breeding habitat consists of open park-like ponderosa pine forests. The woodpecker is also attracted to burned-over Douglas-fir, mixed conifer, pinyon-juniper woodland, and riparian vegetation, especially riparian cottonwoods. Habitat for this species is present in the project area but has not been documented since 1985.
Bird Peregrine falcon (*Falco peregrinus*)	SGCN	Although the peregrine falcon is still rare in Utah, it has become more abundant throughout its range in recent years. In Utah, this species breeds mainly on the Colorado Plateau, and to a lesser extent, along the Wasatch Front. Breeding habitat is characterized as cliffs, bluffs, caves, and rock pockets (often near water). Habitat during migration includes water-based croplands; orchards; cold desert shrub (including saltbush and greasewood); and sagebrush-rabbitbrush (at lower elevations). Its wintering habitats in Utah include desert riparian woodlands (including Fremont cottonwood, willows, etc., at lower elevations), marshes and wet hummocks. Potential habitat is found within the project area, but the species has not been documented since 1985.
Bird Pinyon Jay (*Gymnorhinus cyanocephalus*)	SGCN	The pinyon jay occurs throughout much of the western U.S. and is a common bird of the pinyon-juniper woodland forests of Utah. Their diet consists primarily of pinyon and other pine seeds, but also includes berries, small seeds, grains, and insects. Nests are located in trees (usually conifers) 5–30 feet off the ground in the pinyon-juniper woodland but less frequently pine. Nests also occur in scrub oak and sagebrush. Habitat is found within the project area, and the jay is likely present.

Species and Scientific Name	State Status	Range or Habitat and Potential for Species Occurrence
Bird Yuma myotis (*Myotis yumanensis*)	SGCN	Uncommon to rare in in the state. The species is not overly abundant in Utah but occurs in the southwestern, central, and northeastern parts of the state. Records of this species occur in eight counties, including Washington and Kane counties. The Yuma myotis can be found in a variety of habitats but is almost always found near open water. Old buildings, caves, and bridges are used as roosting and nursery colony sites. It is also found in a wide variety of upland and lowland habitats, including riparian, desert scrub, moist woodlands, and forests near open water. Habitat is present in the project area, and a historical occurrence of the species was recorded in 2004.
Mammal Kit fox (*Vulpes macrotis*)	SGCN	Although the species is not overly abundant in Utah, it does occur in the western, east central, and southeastern areas of the state. Habitat is primarily open desert as well as shrubby and shrub-grass ecosystems, including creosote bush, shadscale, greasewood and sagebrush. Prey abundance and interference competition by coyotes may regulate fox populations. Habitat is present in the project area, and a historical occurrence of the species was recorded in 1975.
Reptile Arizona toad (*Anaxyrus microscaphus*)	SGCN	Found only in the southwestern portion of Utah. Common to streams, washes, irrigated crop lands, reservoirs, and uplands adjacent to water. Inactive in cold weather, adults are known to be primarily nocturnal; however, young are active during daylight hours. Eggs are laid on the bottoms of shallow, slow-moving streams. Suitable habitat exists within the project area. This habitat is found within washes in the Cove Reservoir portion of the project. Uplands within the project area adjacent to these aquatic features may also provide suitable habitat. Historical records identify an occurrence of the species in the project area in 2023.
Reptile Gila monster (*Heloderma suspectum*)	SGCN	Occurs in Utah only in southern Washington County, where urban expansion and collecting are the main threats to the species Utah provides the northern-most range for the gila monster. Preferred habitats include large rocky shelves, sandy areas, and creosote-sagebrush areas. Gila monsters in Utah are most active during the spring and summer months, although they do spend about 95 percent of the active season in burrows or under rocks. Populations usually occur in rocky areas, using cavities in basalt and sandstone formations for shelters. Very limited habitat is present in the project area, although a historical occurrence of the species was recorded in 2021.

Species and Scientific Name	State Status	Range or Habitat and Potential for Species Occurrence
Reptile Northern leopard frog (*Lithobates pipiens*)	SGCN	The northern leopard frog is common in Utah, but some reports indicate that its numbers may be declining. The species occurs in a variety of aquatic habitats, particularly near cattails and other aquatic vegetation, but it may be found foraging relatively far from water. During cold winter months, this species is inactive and takes cover underwater or in damp burrows. Suitable habitat may be found within the portion of the EFVR located within the project area. A historical occurrence of the species was recorded in 1982.
Reptile Western toad (*Anaxyrus boreas*)	SGCN	Occurs throughout most of Utah, and is found in a variety of habitats, including slow moving streams, wetlands, desert springs, ponds, lakes, meadows, and woodlands. Adults feed on numerous types of small invertebrates, such as ants, beetles, and grasshoppers, whereas larvae (tadpoles) filter algae from the water or feed on detritus. In Utah, the toad is known to occur from areas of high elevation, mainly the Wasatch Mountains and central high plateaus, from Rich and Daggett counties in the northeast to Washington and Kane counties in the southwest portion of the state. Habitat loss is a widely recognized contributing factor, and has played a role in population losses, especially populations formerly occupying what are now urban areas. Limited habitat may be present in the project area. A historical occurrence of the species was recorded in 2021.
Fish Desert sucker (*Catostomus clarkia*)	SGCN	Native to parts of the Colorado River system. Limited distribution occurs only in the Virgin River system in southwestern Utah. They are bottom dwellers (benthic); primarily eat algae, and occasionally insects and other invertebrates. Spawning occurs in riffles during winter and spring. Historical records of occurrence within 0.5 miles of the project area. Suitable habitat is found within the portion of the EFVR located within the project area.
Fish Flannelmouth sucker (*Catostomus latipinnis*)	SGCN	In Utah, the species occurs in the main-stem Colorado River, as well as in many of the Colorado River's large tributaries, including the Virgin River. Flannelmouth suckers are usually absent from impoundments. In recent times, Utah flannelmouth sucker populations have been reduced in both numbers and distribution, primarily due to flow alteration, habitat loss/alteration, and the introduction of nonnative fishes. Limited habitat is present in the project area, although a historical occurrence of the species was recorded in 2012.

Species and Scientific Name	State Status	Range or Habitat and Potential for Species Occurrence
Fish Virgin spinedace (*Lepidomeda mollispinis*)	SGCN	This species is endemic to the Virgin River system in a small area of Utah, Nevada, and Arizona; in Utah, it occurs only in Washington County. Most often associated with clear, cool, relatively swift streams comprised of [sic] pools, runs, and riffles. Feeds seasonally on insects, insect larvae, and plant material. Virgin spinedace populations have been reduced in recent times, and the species is now found only in portions of its historic range. The spinedace has been recovered to 90 percent of its historically occupied habitat (Virgin River Program 2026. Additionally, the species has been introduced into areas not previously occupied. The species known occupied habitat includes the EFVR within ZNP.
Insect Lyrate mountainsnail (*Oreohelix haydeni*)	SGCN	The distribution of this species in Utah is somewhat patchy and scattered through Cache, Rich, Weber, Morgan, Salt Lake, and Tooele counties. A 1921 report identified the species as occurring in Washington County. It is widely considered to be erroneous. It is highly unlikely that this species of snail occurs within the project area.
Insect Mitered Vertigo (*Vertigo Modesta concinnula*)	SGCN	This species has been reported historically, from montane habitat in four Utah counties: Salt Lake, Sevier, Box Elder, and San Juan. The Utah Division of Wildlife Resources (UDWR) website does not recognize this species as occurring in either Kane or Washington Counties even though the UNHP website notes a 1942 occurrence. It is highly unlikely that this species occurs within the project area.

Source: (UNHP, 2024)

3.2.4.7 Riparian Areas

Riparian areas exist in the transitional zone between aquatic and terrestrial ecosystems. They feature different vegetative species than the adjoining ecosystems and exhibit more vigorous growth due to shallow groundwater interaction. They generally consist of long strips of vegetation adjacent to streams, rivers, lakes, reservoirs, and other inland aquatic systems that affect or are affected by the presence of water (Fischer, Martin, Ratti, & Guidice, 2001) These areas typically harbor many wildlife species and perform numerous ecological functions. In Washington County, riparian species along the Virgin River include a dense layer of willow (*Salix* spp.), common reed grass (*Phragmites* spp.), cottonwood trees (*Populus* spp.), and invasive species, such as tamarisk (*Tamarix* spp.) and Russian olive (*Elaeagnus angustifolia*), as well as various grasses/forbs. Riparian vegetation along the EFVR in Long Valley is mature and consists of cottonwoods, Russian olive trees, tamarisk, willows, and various shrubs and forbs. This vegetation is spotty and lacking in some areas due to repeated disturbances, such as flooding.

3.2.4.8 Ecosystem Services

Plants and animals in the study area provide the following ecosystem services:

- **Provisioning services**: The EVFR provides fishing opportunities for various species of trout. Rainbow trout (*Oncorhynchus mykiss*), cutthroat trout (*Oncorhynchus clarki*), brown trout (*Salmo trutta*), and brook trout (*Salvelinus fontinalis*) have all been documented in portions of the EFVR.

- **Regulating services**: Riparian zones play an important role in water filtration, nutrient cycling, and providing habitat for fish and wildlife.

- **Cultural services**: Peoples values for species conservation may arise from personal use, personal beliefs and moral ethics, altruism, and/or a desire to preserve the resource for future generations.

3.2.5 Human

3.2.5.1 Cultural Resources and Tribal Consultation

Cultural resources encompass various elements such as archaeological sites, historic structures, sacred sites, and traditional cultural places (TCPs), which are all integral to a community's traditions, beliefs, and preserving its cultural identity. The NHPA of 1966, as amended (54 USC 300101), mandates that federal agencies consider the effects of their actions on historic properties. "Historic properties" denote cultural resources deemed significant to history by meeting specific criteria outlined in 36 CFR Part 60.4, and described below, for inclusion on the NRHP.

The quality of significance in American history, architecture, archaeology, and culture is present in districts, sites, buildings, structures, and objects of state and local importance that possesses integrity of location, design, setting, material, workmanship, feeling, and association, and that they:

- Criterion A—Are associated with events that have made a significant contribution to the broad patterns of our history.

- Criterion B—Are associated with the lives of significant persons in or past.

- Criterion C—Have distinctive characteristics of a type, period, or methods of construction, or that represent a significant and distinguishable entity whose components may lack individual distinction.

- Criterion D—Yielded or may be likely to yield information important in prehistory or history.

Section 106 of the NHPA requires federal agencies to consider the effect, including visual effects, of authorized undertakings on the ability of historic properties to convey their historic significance.

The APE for Section 106 of the National Historic Preservation Act of 1966 (NHPA) is the geographic area or areas where an undertaking may directly or indirectly cause alterations in the character or use of historic properties, as defined in 36 CFR Part 800.16(d). The APE for the proposed project was defined by the NRCS, as lead federal agency, and consulting parties, per 36 CFR 800.4. The NRCS established the project's APE to include all potential direct and indirect effects. The project APE consists of three sections; the Direct section of the APE (712.46 acres), Indirect section of the APE (1,007.97 acres), and Visual section of the APE (4,952.29 acres). The three APE sections partially overlap with each other. The Direct section of the APE consists of the proposed reservoir (buffered), pipelines, and three borrow pits. The Indirect section of the APE consists of the proposed reservoir and the unbuffered breach inundation zone below the reservoir. The Visual section of the APE consists of a 1-mile buffer around the proposed reservoir (Eocene, 2025). The Direct section of the APE consisted of a total of 874.23 acres, including an original Direct APE of 791.68 acres (identified in 2018), and addendum of 68.83 acres (identified in 2021) and 13.72-acres acres (identified in 2023). In 2024, the project extent changed to remove 3 borrow pits, reducing the Direct APE to 712.46 acres. This Direct section of the APE encompasses all areas that may be disturbed or changed from their current conditions with potential to affect cultural resources. See Section 1.4.3 for a detailed description of the APE development process and Figure C-2 in Appendix C for the APE figure.

Eocene archaeologists, meeting 36 CFR 61 Secretary of the Interior (SOI) qualification standards in archaeology, conducted Class II (reconnaissance) and III (intensive) cultural resources inventories of the original project Direct section of the APE. In October 2018, a comprehensive Class III cultural resources survey was conducted of the initial 791.68-acre APE. In November 2021, a Class III and Class II cultural resources inventory was conducted of the 68.83-acre Direct section of the APE addendum (Mt. Carmel pipeline). In October 2023, a Class III and Class II cultural resources inventory was conducted of the 13.72-acre Direct section of the APE addendum (Esplin Borrow Source Location). The total area surveyed was 874.23 acres.

All three surveys were conducted in 15-meter-wide transects, except for the Lambs pit, which is located on private property and was spot checked for any potential areas that may be previously undisturbed and may contain significant cultural resources. A total of 848.81 acres were surveyed to Class III standards. The remaining 25.42 acres were surveyed to Class II standards due to being in inaccessible areas.

The surveys revealed 17 cultural resource sites and 19 isolated occurrences (IOs) within the project Direct section of the APE. Additionally, two sites that were previously determined Not Eligible for the NRHP were previously mapped within but relocated outside of the project Direct section of the APE. Cultural Resources Inventory Reports (CRIRs) for each survey have been prepared, and

redacted copies are found in Appendix E-2. Table 3.6 summarizes the cultural resource findings and the NRCS' determination of site eligibility. Per 36 CFR 800.4, the NRCS consulted with the Utah State Historic Preservation Officer (SHPO), and the BLM, UTLA, and USACE as land managing agencies. Letters requesting concurrence on site eligibility were sent on January 9, 2020, January 23, 2023, and May 20, 2024. The SHPO concurred with site eligibility in letters dated January 17, 2020, February 6, 2023, and June 2, 2024 (Appendix A). No responses were received from the land managing agencies.

The NRCS also consulted with 12 Native American Tribes on the determination of site eligibility. The Kaibab Band of Paiute Indians of the Kaibab Indian Reservation responded with a statement of no comments on site eligibility on May 24, 2024. No other responses were received. Follow-up with the Tribes has been ongoing throughout the life of the project. Refer to Section 7.1.10 for a detailed description of all Tribal consultations conducted and Appendix A for a Tribal Consultation Summary Table.

In April 2025, Eocene submitted a Cultural Resources Review Memorandum to the NRCS addressing the Indirect and Visual section of the APE within the project area (Eocene, 2025). This desktop review identified 26 cultural resources and nine historic structures within the overlapping APEs. Of these cultural resources, the NRCS determined that 14 are eligible for the NRHP. Of the nine historic structures, five are eligible for the NRHP. Within the Visual section of the APE, there are three eligible buildings/structures (Property ID Nos., 32819, 50442, and 33219). Within the Indirect section of the APE breach inundation zone, there are three historic properties: Mt. Carmel School and Church (Property ID No. 37252); Dixon, Maynard, House and Studio (Property ID No. 40479); and Steven's Barn (Property ID No. 31786). Steven's Barn (Property ID NO. 31786) has likely been demolished. The NRCS consulted on the Indirect, Visual, and revised Direct section of the APE with SHPO via letter and with the cooperating agencies and 11 Tribes via email on June 4, 2025. SHPO responded by letter on June 6, 2025, stating concurrence with the findings. The Moapa Band of Paiute Indians Tribe responded on June 5, 2025, with an email regarding potential auditory effects. Resolution of these concerns are included in Section 5.5.1.2. No other responses were received. A copy of these correspondences is included in Appendix A.

A review of these previously recorded sites and structures within the Indirect and Visual section of the APE indicates that none would require a formal Visual Effects Analysis as they would not be subject to adverse visual or indirect impacts (Eocene, 2025). Refer to Appendix E-2 for the Redacted Cultural Resources Review Memorandum.

Table 3.6. Cultural Resources in the Direct section of the APE.

Survey Date	Site No.	Temporal Affiliation	Site Description	Eligibility
2018	42KA6331	Prehistoric	Lithic Scatter	Eligible
2018	42KA8900	Historic	Artifact Scatter	Not Eligible
2018	42KA8901	Multicomponent	Lithic and artifact Scatter	Not Eligible
2018	42KA8902	Historic	Artifact scatter	Not Eligible
2018	42KA8903	Historic	Artifact Scatter	Not Eligible
2018	42KA8904	Prehistoric	Artifact Scatter	Eligible
2018	42KA8972	Prehistoric	Lithic Scatter	Not Eligible
2018	42KA8973	Prehistoric	Artifact Scatter	Not Eligible
2018	42KA8974	Prehistoric	Artifact Scatter	Eligible
2018	42KA6331	Prehistoric	Lithic Scatter	Eligible
2021	42KA1157	Prehistoric	Artifact Scatter	Eligible
2021	42KA4538*	Historic	Historic bridge abutment	Not Eligible
2021	42KA4539*	Historic	Historic ditch/flume	Not Eligible
2021	42KA9490	Historic	Ditch	Eligible
2021	42KA9491	Historic	Ditch	Eligible
2021	42KS9492	Historic	Road	Not Eligible
2021	42KA9493	Historic	Road	Not Eligible
2023	42KA7537	Prehistoric	Cave and Artifact Scatter	Eligible
2023	42KA9789	Prehistoric	Artifact Scatter	Eligible

*Outside of the original and current Project APE

3.2.5.2 Social Issues

Socioeconomic baseline is characterized by population, demographics, employment, income, and housing. Socioeconomic baseline conditions of Kane County and Washington County are identified in the subsections below. For comparative purposes, baseline socioeconomic conditions for Utah are also provided.

3.2.5.2.1 Population

Table 3.7 shows the population trends from 2018–2022 for Kane County, Washington County, and the State of Utah. Growth rates are high in Washington County with an approximate 15 percent increase from 2018 to 2022 compared to an approximate 6 percent growth in Kane County and 7 percent in the State of Utah.

Table 3.7. Population Trends.

Year	Kane County	Washington County	Utah
2018	7,350	171,700	3,161,105
2019	7,484	177,556	3,205,958
2020	7,658	172,127	3,151,239
2021	7,635	191,226	3,337,975
2022	7,814	197,680	3,380,800
Percent change	6.3%	15.1%	6.9%

Source: (USCB, 2022)

3.2.5.2.2 Demographics

Demographic data from Table 3.8 shows that the percentage of minority populations in Kane County (6.8 percent) and Washington County (15.3 percent) are less than that of the State of Utah's (20.8 percent).

Table 3.8. Demographics.

-	Kane County	Washington County	Utah
Total Population	7,814	197,680	3,380,800
Percent White	93.2%	84.7%	79.2%
Percent Minority	6.8%	15.3%	20.8%

Source: (USCB, 2022)

3.2.5.2.3 Employment and Income

Low-income population include those making less than or equal to twice the federal poverty level. The median household income for the project study area is $84,861, which is higher than Kane County but comparable to the State of Utah. Limited English speakers in the study area represent less than 3 percent of the population, which is comparable to Kane County and much lower than in the State of Utah. The percentage of the population 65 years of age and older represent approximately 17 percent within the study area, which is comparable to Kane County and the U.S.

Table 3.9. Employment and Income.

-	Kane County	Washington County	Utah
Median Household Income	$70,327	$74,543	$89,168
Low Income/Poverty	12.9%	10.3%	8.2%

Source: (USCB, 2022)

3.2.5.2.4 Housing

Housing characteristics data shows Kane County and Washington County have more owner-occupied units than the State of Utah (Table 3.10).

Table 3.10. Employment and Income.

-	Kane County	Washington County	Utah
Total Households	3,225	71,891	1,129,660
Average household size	2.34	2.71	2.95
Percent Owner-occupied	78.0%	76.1%	71.2%
Percent Renter-occupied	22.0%	23.9%	28.8%

Source: (USCB, 2022)

3.2.5.2.5 Economy

The small communities of Glendale, Orderville, and Mt. Carmel, which are situated in western Kane County, make up the proposed project area. Livestock, farming, and tourism serve as the primary economic drivers for these communities. While livestock and farming have traditionally been the backbone of Kane County's economy, agricultural activities have faced challenges due to costly and limited agricultural water (Utah PLPCO, 2017). Irrigated lands within the study area primarily cultivate alfalfa with an oat cover crop planted every 7–9 years.

The study area includes communities within Washington County, primarily the towns of La Verkin, Hurricane, Washington, and St. George. Construction, retail trade, and healthcare/social services make up most of the labor profile in Washington County (EDCUtah, 2021).

Kane and Washington County's allure as a tourist destination stems from its abundant recreation opportunities. Well-known attractions like the Grand Canyon, ZNP, BCNP, Glen Canyon National Recreation Area, Grand Staircase-Escalante and Cedar Breaks National Monuments, and Coral Pink Sand Dunes State Park draw numerous visitors. However, many of these sites exceed capacity, particularly during the peak summer tourist season (Simmonds, et al., 2018). To help address visitor use, Secretarial Order 3424, *Strengthening Coordination with Gateway Communities*, was issued to improve coordination between the NPS and gateway communities such as Orderville, Mt. Carmel, Kanab, Rockville, Springdale, and other locations (USDI, 2025).

According to DWRe's water-related land-use data, crop acreage in the project area has declined by about 300 acres since 2009. The data show the urban area has increased by about that same acreage. Using average net crop ET, the resulting water requirement is roughly 1,000 acre-feet lower than the value shown in Table 2.1 due to the area's high elevation (5,460 feet above sea level), lower temperatures, and higher evapotranspiration demand. While irrigated agriculture is slowly declining, the population during that same period increased by roughly 10 percent, according to the Utah Division of Water Rights' public water supply data. The area's beauty and proximity to national parks drive that increase (PLPCO, 2026).

3.2.5.3 Public Health and Safety

The Long Valley area within Kane County relies heavily on agriculture to support local livelihoods and provide forage and feed for livestock operations. Existing limitations in water storage and delivery infrastructure results in reduced water availability during peak summer irrigation periods, leading to recurring agricultural water shortages. These shortages can reduce crop yields and forage production, resulting in financial losses for agricultural producers and ranching operations. For many local residents, agricultural production represents a primary source of household income, and uncertainty regarding water availability can create significant financial stress and anxiety. Research has shown that water shortages, drought conditions, and agricultural financial instability can contribute to increased stress, depression, and other mental health challenges among farming and ranching communities, particularly in rural areas where access to health services may be limited (RHIhub, 2026) (Elliott, n.d.).

Existing water supply limitations also affect operation of the Orderville hydroelectric facility during periods of peak summer demand. Available water flows are insufficient to fully meet hydropower generation needs during certain summer periods, reducing the amount of renewable electricity that can be generated (Alpha Engineering, 2026). While electrical service is provided through the broader regional power grid, reliable energy infrastructure is important for maintaining community services, communications systems, and emergency response capabilities.

The nearest hazardous or petroleum waste facility to the Project area is the Jenkins Oil Company Orderville Bulk Plant. This facility is located 0.72 miles north of Orderville and would not be affected by construction or operation of the proposed project (EPA 2026).

3.2.5.4 Scenic Beauty

The landscape in the study area is primarily desert shrub and pinyon-juniper woodland vegetation intersected with fences, unpaved roads, trails, and pastures. The EFVR runs through the east portion of the project area and is accompanied by mature riparian vegetation. However, no dominant artificial structures are present. U.S. Highway 89 (US-89) is approximately 0.5 mile east of the project area. The small towns of Glendale, Orderville, Mt. Carmel, and Mount Carmel Junction are present in the study area and provide a quiet, rural human-induced element to the general landscape. Pastures located along the EFVR also provide a human aspect to the landscape.

Though the project area is not located on BLM-administered public land, the BLM visual resource management (VRM) process was used to determine the landscape character of the area and the visual impact of the proposed project. Visual management objectives are developed through the BLM land-use planning process. BLM-administered public lands near the project area are currently identified as VRM Class IV which allows for major modifications to the existing landscape character (BLM, 2026; BLM, 2008). Under Class IV, the degree of visual change may be high, and modifications may attract attention, dominate the view, and become a major focus of viewer attention. Class IV is typically applied where land-use plans anticipate infrastructure development, resource use, or other activities that substantially alter landscape character, while still requiring consideration of visual design measures to support applicable land use objectives. For this project, the Area of Visual Effect includes areas from which the dam and reservoir may generally be visible, including portions of U.S. Highway 89, local roads, and downstream canyon viewpoints. Although the project would introduce a visible dam and reservoir in localized areas, these changes would be

consistent with the BLM VRM Class IV management intent, as they would be limited by topography and distance (Appendix E-2).

3.2.5.5 Significant Scientific Resources

A preliminary desktop review of potential paleontological resources near the project area was conducted by a qualified paleontologist to assess the potential number of resources that may exist. Paleontological resources are classified using the Potential Fossil Yield Classification (PFYC) system, which helps determine the likelihood of resource presence in the area. The PFYC classifications are as follows:

- PFYC 1—Very low potential.
- PFYC 2—Low potential.
- PFYC 3—Moderate potential.
- PFYC 4—High potential.
- PFYC 5—Very high potential.

The preliminary review indicated that areas classified as PFYC 3, PFYC 4, and of Unknown potential may exist near the project area (Figure C-5, Appendix C).

In Utah, the Utah Geological Survey (UGS) is responsible for managing all paleontological locality information. A paleontological record search was conducted with UGS on November 12, 2024. On November 21 and 22, 2024, and February 10, 2025, Eocene paleontologists conducted field surveys of the PFYC 4 to 5 geologic formations within the proposed project area. Although 12 new paleontological localities were documented during the survey, they were determined to be invertebrate and non-significant due to their commonality and poor preservation, and none were collected. (Eocene, 2025b). The survey results report was accepted and approved by NRCS Utah State Geologist Todd Sieber and is included in Appendix E-2.

3.2.5.6 Land Use

The project area is in Kane County, Utah. Kane County is a rural county in Southwestern Utah. The total land area of Kane County is approximately 2,629,760 acres (4,109 square miles). Kane County is sparsely populated with most of its 7,667 residents (United States Census Bureau [USCB], 2020) spread out among the various mountains, plateaus, and canyon lands that surround the City of Kanab, the largest city and county seat within Kane County. Kane County land is used predominantly for tourism, services, and agriculture with most of the land being federally owned. Other land uses include forest land, residential, light industrial, and commercial (Kane County, 2024).

The study area includes both Kane County and Washington County, Utah. The total land area of Washington County is 1,555,200 acres (2,430 square miles). Washington County is the fifth most populous county in Utah with 52 percent of the County's population (197,680 people) located in the City of St. George. Washington County land is used predominantly for grazing with much of the land managed by the BLM. Other land uses include residential and industrial development (Washington County, 2012).

Irrigated lands (6,896 acres in Kane County and 12,984 acres in Washington County) within the study area are primarily alfalfa fields and oats, which are used as a cover crop every 7–9 years (USDA, 2017b). Private residences, out buildings, livestock grazing, and limited recreation opportunities are also present.

3.2.5.7 Ecosystem Services

The human environment provides Cultural Services. Cultural resources, social status, public health and safety, scenic beaty, and land use all relate directly to non-material benefits such as spiritual enrichment, aesthetic experiences, recreation, sense of place, heritage, and development.

3.3 Forecast Future Conditions

The resource conditions were projected into the future, where applicable, to establish a baseline against which alternatives will be evaluated. This baseline is known as the No Action Alternative condition. This No Action Alternative forecast of future conditions is compared to the Action Alternative forecast of future conditions. Chapter 5.0 includes the No Action Alternative forecast of future conditions for each resource.

4.0 FORMATION OF ALTERNATIVES

4.1 Alternative Formulation Process

The alternative formulation process followed the eight-step watershed planning process for PR&G and the NRCS nine-step planning process, as described in Chapter 1.5. The PR&G eight-step evaluation process includes consideration of the federal objective (Section 2.1.1), PL 83-566 general purposes (Section 2.2.2), guiding principles (Section 4.11), and ecosystem services (Chapter 3.1). A framework was developed that included comparison of alternatives against guiding principles, ecosystem services, and economic benefits to select the alternative that maximizes public benefits (environmental, economic, and social goals). A PR&G analysis was completed to document the alternative formulation process and framework comparison for project decision-making (Appendix E-1).

4.1.1 Guiding Principles

Guiding principles were used to assist in decision-making and weighing tradeoffs of project alternatives. The guiding principles were included in a comparison framework, as documented in the PR&G Analysis (Appendix E-1), and are listed below:

1. Healthy and Resilient Ecosystems.
2. Sustainable Economic Development.
3. Floodplains (avoiding unwise use of floodplains).
4. Public Safety (reducing public health and safety risks).
5. Watershed Approach.

4.1.2 Alternative Formulation Criteria

The process of formulating alternatives for the project followed procedures outlined in the NRCS NWPM Parts 500 through 506; NRCS NWPH Parts 600 through 606; PR&G (DM 9500-013); and other NRCS watershed planning policy (NRCS, 2024a; NRCS, 2014a; NRCS, 2014b; USDA, 2017). Numerous alternatives were developed to meet the project Purpose and Need by the project team. The alternatives were developed considering problems and opportunities, as presented in Chapter **2.2.**, and objectives and constraints as presented in Chapter 2.1. Alternatives were formulated in consideration of four criteria: completeness, effectiveness, efficiency, and acceptability.

4.1.3 Risk and Uncertainty

During the planning process, decisions are made with information that is uncertain, including errors in measurements and climatic changes that could alter rainfall storm events. Assumptions made during the planning process are based on the best available science, technology, and information. Extended delays between the planning process and construction increase the degree of risk and uncertainty. Estimated alternative costs are based on computed work quantities multiplied by the appropriate unit cost for that type of work. Unit costs are based on current market prices from similar projects. Costs can be influenced by economic factors that cannot be predicted between

the planning process and construction that could increase the actual cost and decrease the availability of materials.

Additional risks and uncertainties associated with the project decision-making include the following:

- Erosion and Sedimentation: Erosion and sedimentation are dependent upon several unpredictable factors. Sedimentation could vary based on conditions in the drainage area, including construction activity, wildfires, storm events, climate variation, and off-highway vehicle/pedestrian traffic, among others. Erosion can vary based on climactic, hydrological, topographic, soil, geological, and vegetation conditions.

- Costs and Benefits: As with all projections of future costs and benefits, there is a degree of uncertainty assumed. Installation costs, O&M costs, crop yields, housing markets, labor markets, and commodity and input prices will all fluctuate.

- Flood Protection: Flood frequencies and magnitudes used in the analysis carry a degree of uncertainty. Economic estimates of flood control measures are not precise. The intention is that they are reasonably accurate and can assist in decision making.

- Recreation: Impacts associated with recreation-related projects can be uncertain and are dependent on external factors, including gas prices and availability, weather, construction, political status of other counties, etc. It can be assumed that recreation-related visitations would provide local economic benefits, but it is difficult to determine the extent.

4.2 Alternatives Considered

The project team considered two action alternatives and one no action alternative in detailed study. Multiple additional alternatives were formulated but eliminated from further study, as described in Chapter 4.3. The cooperating agencies were included in the alternative's formulation process described below.

The cost estimates for the alternatives provide an appropriate level of detail for the purpose of identifying the NRCS NEE Alternative among the alternatives considered. Project costs for alternatives selected for detailed study incorporate installation and O&M costs. Installation costs are those costs to be incurred for installing the works of improvement after the project is authorized. Installation costs include, as applicable, construction, engineering, real property rights, natural resource rights, permitting, replacement in-kind relocation payments, and project administration costs. Detailed construction cost estimates are provided in the PR&G Analysis Report included in Appendix E-1.

An analysis of feasible alternatives is required to determine potential actions that would meet the purpose and need of the proposed project (Chapter 2.0). After careful consideration, it was determined that two action alternatives would meet the purpose and need and would be analyzed in detail throughout the Plan-EIS. While the No Action Alternative does not meet the purpose and need of the project, it is also evaluated in detail to serve as a baseline for comparison and to meet NEPA requirements.

4.2.1 Alternative 1—No Action Alternative (Future Without Federal Investment)

The No Action Alternative considers the actions that would take place if no federal action or federal funding were provided for the project. Current irrigation facilities and existing environmental conditions in the project area would remain the same. Irrigation demand during summer months would continue to exceed water availability. Deficiencies in crop production would continue for the foreseeable future. Recreation and socioeconomic opportunities associated with the Preferred Alternative would not be realized. Due to the extended drought and historical population growth, current M&I water availability would continue to be stressed despite implementation of aggressive conservation measures. M&I water deficiencies would be exacerbated in the foreseeable future.

4.2.2 Action Alternatives

The action alternatives include measures to enhance the efficiency and reliability of the current AWM and to increase public recreation opportunities for Kane County, Utah, while increasing agricultural water, and M&I water supply for Washington County, Utah. Water need was calculated in the Cove Reservoir Water Model as part of the alternative formulation (Appendix E-1); several alternatives were developed to meet this water need. Based on the amount of water needed, alternatives for a 6,000-acre-foot and a 3,000-acre-foot reservoir were developed in detail and are described below.

4.2.2.1 Alternative 2—6,000-Acre-Foot Reservoir Alternative (Preferred Alternative)

4.2.2.1.1 Project Components

Alternative 2 consists of construction of a 6,000-acre-foot reservoir and earthen dam, principal and auxiliary spillways, recreation area, pipelines, and booster pump station (Figure B-2 through B-6, Appendix B). Access road improvements would be included as part of Alternative 2, and three borrow pit sites in addition to the reservoir basin were identified to supply material for dam construction (Figure B-1, Appendix B). Embankment material would be taken from the reservoir basin. The individual project components are discussed in detail in the following sections and in the Investigation and Analysis Report (Appendix D).

4.2.2.1.1.1 Reservoir and Dam

The proposed dam would be designed to meet current NRCS and Utah Dam Safety regulations (Utah Code Chapter 73-5a) and engineering standards. The structure, located near Orderville, Utah, would consist of a homogeneous earth-fill dam with an internal filter/drain. The length of the dam would be approximately 1,900 feet with a maximum dam height of 90 feet and a crest elevation of 5,552 feet above mean sea level (amsl). The reservoir would have a maximum capacity of approximately 6,000 acre-feet. The dam would be situated 0.6 miles from US-89 southwest of downtown Orderville (Figure B-1, Appendix B). This site was identified in the mid- to late- 1980s during a reconnaissance level inventory of potential dam sites associated with tributaries of the Virgin River.

4.2.2.1.1.2 Principal and Auxiliary Spillways

Two spillways, one principal, and one auxiliary would be constructed as part of the reservoir development. The principal spillway would be located at a lower elevation, and it would be

designed to route the principal spillway hydrograph and 100-year 24-hour average moisture condition flood through the reservoir without the use of the auxiliary spillway. The auxiliary spillway would also be designed to route larger flood events through the reservoir without overtopping the dam (Alpha Engineering and RB&G Engineering, 2024).

The principal spillway would be a 30-inch-diameter pipeline that is approximately 870 linear feet and would include a structure with an intake screen as well as an energy dissipater structure at the outfall. The pipeline would be located near the left abutment of the dam.

The auxiliary spillway would be approximately 1,070 linear feet and 30 feet wide. It would consist of a trapezoidal, earthen channel with a concrete weir structure near the reservoir. The auxiliary spillway would extend from the left abutment of the dam near the principal spillway, down the hillside, and enter an existing downstream drainage channel. Additional armoring or riprap would be installed to prevent erosion of the spillway or adjacent grades, as needed. See Figure B-3 in Appendix B for details on the principal and auxiliary spillways associated with Alternative 2.

4.2.2.1.1.3 Recreation Area and Boat Ramp

The Preferred Alternative would include the development of an approximately 4.1-acre outdoor recreation area. The recreation area would include a non-motorized boat ramp, two pit toilets, a pavilion, and 20 recreational vehicle site facilities (including a barbecue grill, table, and fire pit). No utilities would be extended to the recreation facilities. See Figure B-4 in Appendix B for details on the recreation area for Alternative 2.

4.2.2.1.1.4 Pipelines and Mt. Carmel Booster Pump Station

The installation of three water pipelines, the Reservoir Outlet Pipeline, the Glendale Irrigation Pipeline, the Mt. Carmel Irrigation Pipeline, and Booster Pump Station would be completed as part of the Preferred Alternative. The purpose of the Glendale Pipeline is to provide the additional capacity needed for the Glendale irrigation Company service area. This pipeline can also be used to convey water to the inlet of the Orderville Diversion by gravity flow which, with the extension of the Reservoir Outlet Pipeline, will convey water by gravity flow to the Cove Reservoir. The purpose of the Mt. Carmel Pipeline and booster pump station would be to pipe areas which are currently open canals and to provide pressurization to the existing and proposed piping. Water that is supplemented from the reservoir will have adequate pressure for the Mt. Carmel irrigation system without the need for the booster pump. The existing Mt. Carmel diversion dam does not provide enough elevation to service the system without the aid of a booster pump.

All pipelines would be bedded and buried to a minimum depth of 3 feet to the top of pipe and deeper under streambed crossings. The trench width and depth would vary depending upon the size of the pipe being installed; however, the trench would generally be 2 feet wider than the pipeline. It is anticipated that the material for the pipelines would be HDPE or PVC, depending on pipe size and cost of materials at the time the project is constructed. These materials have been found to be cost effective and durable for pressurized irrigation systems. The advantage of HDPE is that it can follow meandering canal alignments without the need for many fittings and thrust restraint. However, it is sometimes more difficult to repair. PVC has been found to also be a durable material and is used in many canal piping systems and has readily available repair couplings.

4.2.2.1.1.4.1 Reservoir Outlet Pipeline

The Reservoir Outlet Pipeline would include approximately 700 linear feet (0.13-mile) of new, large-diameter, concrete-encased, steel pipe. This new line would connect to the existing pipeline running from the Orderville irrigation diversion dam to just below the proposed dam site. The new line would access the proposed reservoir through the base of the dam. This new extension would provide water from the EFVR to fill the reservoir in the spring during high runoff. It would also be used to provide water from the reservoir to local irrigation users, as needed, during the summer months. Short-term surface disturbance would occur within the dam footprint. An inlet/outlet structure would be placed near the upstream toe of the dam with a control gate.

4.2.2.1.1.4.2 Glendale Irrigation Pipeline

The existing Glendale Irrigation Pipeline is a 4- to 8-inch pipeline that comprises the primary portion of the Glendale irrigation system. A new 8- to 16-inch pipeline would replace approximately 1.7 miles of the Glendale Irrigation Pipeline installed from the existing Glendale hydroelectric power plant to the Orderville Diversion Dam. Excess water from this pipeline would be combined with water diverted from the Orderville Diversion Dam to fill the proposed reservoir. The pipeline servicing Orderville's irrigation system was oversized by the KCWCD in agreement with the Orderville Irrigation Company in anticipation of the construction of the new reservoir. The existing irrigation pipeline would be used to fill the new reservoir during the non-irrigation season.

4.2.2.1.1.4.3 Mt. Carmel Pipeline and Mt. Carmel Booster Pump Station

The Mt. Carmel Pipeline would include the addition of approximately 24,000 linear feet of HDPE or PVC piping, varying in size from 8- to 16-inch diameters, to provide pressurized agricultural water to areas within the Mt. Carmel area. The proposed pipeline would be located entirely within existing roadways, open canals, or through existing fields and would not create permanent disturbance or require additional ROW.

The water demand for the Mt. Carmel Irrigation System varies from a low of 4 cfs to a high of 9.7 cfs. Depending on the year, this water is available from their diversion dam. The head of the proposed reservoir provides adequate pressure for pressurized irrigation in the Mt. Carmel area when supplemental water is required. However, when water is diverted from the existing Mt. Carmel Diversion Dam, it does not provide adequate pressure for sprinkler irrigation. In order to provide for pressurized irrigation, water diverted from the existing Mt. Carmel diversion dam needs to be boosted approximately 100 feet to provide the minimum pressure required for the irrigation system. It is proposed to install three pumps with variable frequency drives with approximate capacities of 1,450 gallons per minute per pump. Each pump would require approximately 50 HP or a total of 150 HP for the pump station. The pump station would be housed in a building approximately 25 feet by 25 feet and be constructed near the existing Orderville Hydroelectric Power Plant where an existing electrical transmission and substation are located.

Details regarding pipeline construction are presented in Appendix E-2 and E-3, and figures of the proposed pipelines and Mt. Carmel Booster Pump Station are presented as figures B-2, B-5, and B-6 in Appendix B.

4.2.2.1.2 Access Roads

Approximately 3.2 miles of new and existing access roads would be constructed and/or improved to provide access around the reservoir and to maintain access to properties surrounding the reservoir. See Figure B-3 in Appendix B for details on the access roads for Alternative 2.

- Approximately 1.2 miles of existing gravel roadway would be widened to 28 feet (currently 12–16 feet wide).
- Approximately 2.0 miles of new 2-lane roadway would be constructed at 28 feet wide.
- The access road would be covered with a graded and compacted road base material (gravel).

4.2.2.1.3 Borrow Material

Three existing borrow pit sites outside of the reservoir basin have been identified to provide gravel and riprap material: the Tait (29 acres), Lamb (17 acres), and Esplin (13.8 acres) pits. The project would use two of these three sites—the Esplin for riprap and either the Tait or Lamb pit for gravel. Because the final selection between the Tait and Lamb pits has not yet been determined, all three pits are analyzed as part of the project.

Use of the borrow pits would result in a maximum of 5.7 acres of disturbance, consisting of approximately 5 acres at the Esplin pit and either 0.5 acres at the Lamb pit or 0.7 acres at the Tait pit. Although only a portion of the pits would be disturbed, the entire area of each pit was included in the project area as the exact location of disturbance is unknown.

The Tait and Esplin pits contain avoidance areas for cultural and/or paleontological resources which are mapped in Figures C-6 and C-7 in Appendix C. Any disturbance within these pits would occur outside of these avoidance areas. The Tait and Lamb sites, located on private land near US-89 close to Mt. Carmel, Utah, would supply gravel while the Esplin site, located on private land east of Glendale near Glendale Bench Road, would supply riprap. Transportation to and from the three borrow pits would be on existing roads. See Figure B-1 in Appendix B for details on the borrow pit sites for Alternative 2.

4.2.2.1.4 Construction Staging and Access

Staging areas for the construction of the dam would be located within the footprint of the reservoir and would eventually be covered with water. An additional 200- to 300-foot buffer downstream of the dam would be used for instrumentation and additional staging. Construction would require staging large, earth-moving machinery, a portable gravel pit operation, water, and multiple personnel.

4.2.2.1.5 Schedule

Construction would begin after all necessary permits are obtained and plans are finalized. Construction of the reservoir, pipelines, associated recreation facilities, and access roads is estimated to take up to 15 months to complete. The spillway will be constructed simultaneously with the dam, as needed, for additional access to the left abutment. This will allow easier access during construction of the dam. The spillway ROW will be staked and cleared of all vegetation (Appendix E-2).

4.2.2.1.6 Operation and Maintenance

4.2.2.1.6.1 Water Diversions

Per the ZNP Agreement, water would be diverted from the EFVR at the Orderville Diversion and delivered by pipeline to the proposed reservoir between November 1 and May 31. No diversions are allowed outside of this period. During the summer months, up to 4.7 cfs would be diverted for OIC agricultural use, while MCIC would continue to divert up to 6.58 cfs (United States, Utah, Washington District, & Kane District, 1996).

The use of EFVR water by the GIC, OIC, and the MCIC is monitored on a regular basis. The three companies divert water from the EFVR at different locations. A weir is present at each diversion site with gages to read water elevation. Additionally, each weir is equipped with an electronic flow meter that sends information to a website to provide remote monitoring. The data collected from these flow meters are used to determine the total amount of water diverted. Additionally, the Utah State Water engineer collects money from the GIC, OIC, and the MCIC to fund a water commissioner. The commissioner is responsible for monitoring the diversions and making certain that companies are using the correct amount of water according to their water right.

4.2.2.1.6.2 Water Releases

Releases from the reservoir would be timed to supplement low, natural flows. Water for Long Valley agricultural purposes would be released into existing and proposed irrigation pipelines during the summer months, when natural flows are lowest. Water committed to Washington County for agricultural and M&I purposes could be released any time during the year to meet demand but would most likely be during the summer months for agricultural needs and during the fall and winter months for M&I needs.

The ZNP Agreement allows releases of up to 25 cfs for a 1-week period or 15 cfs continually (United States, Utah, Washington District, & Kane District, 1996). Releases would be managed to optimize irrigation efficiency and to meet M&I demands.

4.2.2.1.6.3 Monitoring

The use of EFVR water by the GIC, OIC, and the MCIC would continue to be monitored on a regular basis. The three companies divert water from the EFVR in different locations. A weir is present at each diversion site. Each weir has staff gages to read water elevation and an electronic flow meter that sends information to a website to provide remote monitoring. The data collected from these flow meters are used to determine the total amount of water diverted. A commissioner funded by the GIC, OIC, and MCIC is responsible for monitoring the diversions and making certain that companies are using the correct amount of water according to their water right.

Additional measuring devices would be installed to record flows into and out of the Cove Reservoir. Metering devices would be installed to record flows through the existing Orderville hydroelectric power plant that will release water rights owned by the WCWCD back into the EFVR, as well as water-right shortages being delivered from the reservoir to the Mt. Carmel and Orderville irrigation companies. These meter records would also be filed annually with the Utah State Division of Water Rights.

Water for Long Valley irrigation purposes would be used during the summer months. Water committed to Washington County for irrigation and M&I purposes could be released any time during the year to meet demand but would most likely be used during the fall and winter months. Releases to Washington County would be in compliance with the Zion Agreement (1996).

4.2.2.1.6.4 Maintenance

Routine maintenance and replacement actions would be required for the life of the proposed project. O&M measures that would be implemented through a signed O&M Agreement between the NRCS and the sponsor include:

- Regular inspection and maintenance of the dam and associated components.
- Grading of the spillways, as necessary, to maintain access and functionality.
- Annual inspection of the pipeline air valves to ensure that they are functioning properly.
- Annual cleaning of the pipelines with a polyurethane pig.
- Regular inspection and maintenance of the recreation area and non-motorized boat ramp to ensure hard surfaces and erosional protection and to keep the site free of debris.
- Regular O&M of the reservoir levels by agreement between the WCWCD and the KCWCD.

4.2.2.1.7 Costs

The average annual cost of implementing Alternative 2 is estimated to be approximately $1,359,000 and the total cost of implementing Alternative 2 is estimated to be approximately $39,730,000. The PR&G Analysis in Appendix E-1 describes how costs were calculated.

4.2.2.2 Alternative 3—3,000-Acre-Foot Reservoir Alternative

4.2.2.2.1 Project Components

Alternative 3 consists of a 3,000-acre-foot reservoir and dam, principal and auxiliary spillways, recreation area, pipelines, and booster pump station (Figure B-8, Appendix B). Access road improvements would be included under Alternative 3, and three borrow pit sites outside of the reservoir basin were identified to supply necessary materials for the dam construction (Figure B-1, Appendix B). Material for the embankment would be taken from within the reservoir basin. The individual project components are discussed in detail in the following sections below and in the Investigation and Analysis Report (Appendix D).

4.2.2.2.1.1 Reservoir and Dam

The proposed dam would be designed to meet current NRCS and Utah Dam Safety regulations and engineering standards. The structure would consist of a homogeneous earth fill dam with an internal filter/drain. The length of the dam would be approximately 1,700 feet with a maximum dam height of 70 feet and a crest elevation of 5,530 feet amsl. The reservoir would have a maximum capacity of approximately 3,000 acre-feet. The location for the reservoir and dam would be the same as described in Alternative 2 (Section 4.2.2.1.1.1).

4.2.2.2.1.2 Principal and Auxiliary Spillway

Two spillways, one principal, and one auxiliary would be constructed as part of the reservoir development. The principal spillway length would be the same as in Alternative 2; however, the auxiliary spillway would be slightly wider for Alternative 3 as there would be less surface area to attenuate storm water flows. See Figure B-8 in Appendix B for details on the principal and auxiliary spillways associated with Alternative 3.

4.2.2.2.1.3 Recreation Area and Boat Ramp

Alternative 3 would include the development of an approximately 2-acre outdoor recreation area. The recreation area would include a non-motorized boat ramp, one pit toilet, a pavilion, and 12 recreational vehicle site facilities (including a barbecue grill, table, and fire pit). No utilities would be extended to the recreation facilities.

4.2.2.2.1.4 Pipelines and Mt. Carmel Booster Pump Station

The installation of the three water pipelines (HDPE or PVC) and a booster pump station would be the same as described for Alternative 2 (Section 4.2.2.1.1.4). See Figures B-2, B-5, and B-6 in Appendix B for details on the pipelines associated with Alternative 3.

4.2.2.2.2 Access Roads

Access roads developed/improved for Alternative 3 would be the same as described for Alternative 2 (Section 4.2.2.1.2). See Figure B-8 in Appendix B for details on the access roads for Alternative 3.

4.2.2.2.3 Borrow Material

The same three existing borrow pit sites described for Alternative 2 would be used for Alternative 3 (Section 4.2.2.1.3). Embankment material would be taken from the reservoir basin. See Figure B-1 in Appendix B for details on the borrow pit sites for Alternative 3.

4.2.2.2.4 Construction Staging and Access

Staging areas for the construction of the dam would be located within the footprint of the reservoir and will eventually be covered with water. An additional 200- to 300-foot buffer downstream of the dam will be used for instrumentation and additional staging. Construction of the dam would require staging for large, earth-moving machinery; a portable gravel pit operation; water; and multiple personnel.

4.2.2.2.5 Schedule

Construction would begin after all necessary permits are obtained and plans are finalized. Construction of the reservoir, pipelines, associated recreation facilities, and access roads is estimated to take up to 15 months to complete. The spillway will be constructed simultaneously with the dam, as needed, for additional access to the left abutment. This will allow easier access for the construction of the dam. The spillway ROW will be staked and cleared of all vegetation (Appendix E-2 and E-3).

4.2.2.2.6 Operation and Maintenance

Operation and maintenance for Alternative 3 would be the same as those discussed for Alternative 2 under Section 4.2.2.1.6.

4.2.2.2.7 Costs

The average annual cost of implementing Alternative 3 is estimated to be approximately $1,017,000 and includes amortization of installation cost ($1,004,022) and OM&R ($13,000). The PR&G Analysis in Appendix E-1 describes how costs were calculated.

4.2.3 Nonstructural Alternative

Nonstructural alternatives, such as water conservation, water recycling, high pressure irrigation systems, replacing open irrigation ditches with pipelines, and other sources of water were considered. The KCWCD and WCWCD have implemented and continue to implement several conservation measures for water use in Kane and Washington counties, Utah. However, continued implementation of these conservation measures alone would not be sufficient to meet the purpose and need of the proposed project; therefore, the nonstructural alternatives were determined not feasible. The No Action Alternative, which would not include any structural measures, is considered the nonstructural alternative for the purposes of this Plan-EIS.

4.3 Alternatives Considered but Eliminated from Detailed Study

A full range of alternatives and options were considered for detailed study during project formulation and scoping, including alternative reservoir sites, alternative reservoir size, and non-structural measures. After careful examination, several alternatives were eliminated from detailed study as they were considered infeasible, did not adequately meet the purpose and need for the project, were environmentally more impactful, presented safety concerns, or were cost prohibitive (Appendix E-3).

The ZNP Agreement (1996) identifies allowable water use and depletion in the EFVR Basin east of ZNP (United States, Utah, Washington District, & Kane District, 1996). The Agreement establishes that new diversions or depletions of surface and ground water sources in the EFVR would not exceed a total depletion of 5,000 afy. It was also stipulated that one or more reservoirs constructed in the Basin could not exceed 6,750 acre-feet. For the purposes of this analysis and in addition to the Cove Reservoir site, seven other potential dam sites have been identified in the general vicinity of the project area and are discussed below.

4.3.1 Alternative Reservoir Sites

A 1988 publication titled “Inventory of Reservoirs and Potential Damsites in the Virgin River Basin” from the Utah Division of Water Resources (UDWRe) identified several potential reservoir sites in the Upper and Lower EFVR Subareas (UDWRe, 1988). These were cursory reviews, and the exact Cove Reservoir site was not identified in this document; however, two nearby sites (Orderville and Dry Wash) were located and reviewed. The report also identifies several sites downstream of the Cove (UDWRe, 1988). These sites are not considered feasible to meet the needs of the Preferred Alternative due to environmental and logistical concerns, including the distance of these sites from

the Glendale, Orderville, and Mt. Carmel agricultural fields, and the need to pump water upstream to access the fields.

Six sites from the UDWRe report and four sites from the ZNP Agreement (1996) were reviewed as potential alternatives and are described below.

4.3.1.1 Sites identified from the UDWRe Report

4.3.1.1.1 Swapp and Lower Swapp Sites

The Swapp and Lower Swapp sites partially overlap each other at the junction of US-89 and the paved Alton County Road, approximately 13 miles north of the proposed Cove Reservoir site. Of the potential sites reviewed, the Swapp site and Lower Swapp site are furthest from the proposed project site. Two small reservoirs exist in the area and would be inundated if this site were to be selected. A maximum dam height of about 97 feet would be required to store 6,000 acre-feet of water. This would be slightly higher than the height required for Alternative 2. Additionally, realignment between 0.8 and 1.0 mile of Alton Road, the primary access road to the town of Alton and surrounding area, would be required.

The required realignment of Alton Road would make the development of either of these sites more expensive, more environmental impacts, and less effective than the proposed Cove Reservoir site. Therefore, neither site was developed in further detail.

4.3.1.1.2 Lower and Upper Lydia's Canyon Sites

4.3.1.1.2.1 Lower Lydia Canyon

The lower Lydia's Canyon site is located approximately 0.33 miles up the canyon from US-89 and the upper site is located approximately 2.0 miles up the canyon from the highway. Both sites are located entirely on private land. Lydia's Canyon contains several private developments, including business, residential homes, ponds, and agricultural fields, which would all be inundated if a reservoir was developed at this site. The estimated required earthwork would be roughly 1.5 times the amount required to develop the Preferred Alternative. A 6,000-acre-foot reservoir would require a dam approximately 162 feet in height, 72 feet higher than the Preferred Alternative.

4.3.1.1.2.2 Upper Lydia Canyon

At the upper Lydia's Canyon site, development of a reservoir would result in inundation of one residential structure and agricultural land. The estimated required earthwork would be roughly twice the amount required to develop the Preferred Alternative as a 6,000-acre-foot reservoir would require a dam approximately 185 feet in height, more than twice the height of the proposed Cove Reservoir site.

Both reservoirs would be located on-stream to the perennial Lydia's Creek and would result in the loss of riparian and wetland habitat. This loss would likely be replaced by new habitat that would surround either reservoir. Both reservoirs would inundate the only access road in Lydia's Canyon, a maintained gravel county road. Re-routing would necessitate a major road realignment as the road would need to be cut into the side of the adjoining hillside.

No detailed cost evaluation has been completed for either of these two sites. However, development of either site would require the purchase of private land, including occupied residences and other structures, ponds, and developed agricultural lands. There would be additional costs resulting from rerouting the existing access road. These costs would be exacerbated by the need to construct the road on a hillside. These estimated additional costs would make the development of either of these sites prohibitive. The additional earthwork associated with either dam site would result in additional undetermined costs.

Based on the estimated high cost of additional earthwork for the dams, the cost of the purchase of private property, loss of existing agricultural fields, existing homes and other structures, the rerouting of the Lydia's Canyon Road, and environmental impacts from an on-stream reservoir, these sites were eliminated from detailed study and are not discussed further in this document.

4.3.1.1.3 Dry Wash Site

The Dry Wash site is located approximately 0.5 miles above Glendale in Dry Wash, a tributary to the EFVR. Two possible drawbacks to this site were identified in the 1988 report. The first drawback is that the site lies "…just west of the main Sevier fault and lies on at least two faults that might promote seepage from the reservoir." The second drawback was "…steep and narrow topography which would require a high and probably expensive dam" (UDWRe, 1988). A follow-up evaluation determined that the dam site would be founded on Cretaceous age Straight Cliffs formation or Tropic Shale bedrock. Multiple fault traces have been mapped within the Dry Wash area. Based on available information, these faults are inactive, and their presence would not necessarily preclude this site as a feasible location for a dam and water storage reservoir. However, it is likely that the bedrock formations in the area are fractured due to past faulting, and the faulting would increase the risk that seepage from the reservoir would be greater at this site compared to other sites (RB&G Engineering, 2021). A dam approximately 139 feet high would be required to store 6,000-acre-feet of water. This would be 49 feet higher than what would be required for the Preferred Alternative. Due to the cost and environmental concerns, this site was eliminated from detailed study and not considered further in this document.

4.3.1.1.4 Orderville Site

The Orderville site is located approximately 0.5 mile north of Orderville on the EFVR. However, the UDWRe determined that this site lies on a complex fault structure in the middle of the Sevier Fault zone. One major and two minor faults converge at the potential dam site axis and as a result, the site was determined to be a very unfavorable geologic setting for a dam. Additionally, the depth to bedrock was determined to be excessive (UDWRe, 1988). No additional studies have been conducted at this site due to unfavorable environmental conditions. Therefore, the site was eliminated from detailed study and not considered further in this document.

4.3.1.2 Sites identified from the ZNP Agreement (1996)

4.3.1.2.1 Lower and Upper Stout Creek Sites

The Lower Stout Creek reservoir site is located approximately 0.3 miles up Stout Canyon from US-89. The Upper Stout Creek site would overlap the upper portion of the lower reservoir and is located approximately 1.1 miles up the canyon from US-89. These sites are located on private and U.S. Forest Service (USFS) Dixie National Forest-administered lands, approximately 9.8 road miles

north of the proposed Cove Reservoir site. The dams at these sites would be off stream to the EFVR but would be on stream to the small, perennial tributary creek that flows down Stout Canyon into the EFVR. A review of topography at both sites indicates that a dam with a maximum height between 152 (upper site) and 158 feet (lower site) would need to be constructed to store 6,000 acre-feet of water (RB&G Engineering, 2021). Realignment of the Lower Stout Creek Rd and the Upper Stout Creek would be required to get around each reservoir. Given the steep topography surrounding the reservoir sites, this would be a substantial undertaking. Additionally, maintenance of this stretch of road would be difficult due to potential slope failures resulting from cutting into the steep canyon wall. The affected road runs through the Stout Canyon from US-89 to State Highway 14 and is a popular route for local users accessing ranches or recreating in the canyon. Sedimentation within the reservoirs would be a design concern as well, with an estimated average sedimentation rate of 1 acre-foot/yr/mi^2 (Appendix D) (Alpha Engineering and RB&G Engineering, 2024). Since these reservoirs are on stream there would be a loss of riverine and/or wetland habitat. This loss would likely be replaced by new habitat that would surround either reservoir. Since both sites are located primarily on private land, additional costs would be incurred to purchase the land for the reservoirs. Due to the increased costs and environmental impacts that would be associated with the road relocation and additional earthwork necessary to construct the dams as described above, these sites were eliminated from further study and are not discussed further in this document.

4.3.1.2.2 Lower Muddy Creek Site

The Lower Muddy Creek site is located approximately 2.5 miles south of the proposed Cove Reservoir site, approximately 0.16 miles up the cove from US-89. It would be situated on private, agricultural land. A review of topography at this site indicates that a dam with a maximum height of about 115 feet would need to be constructed to store 6,000 acre-feet of water. This is approximately 25 feet higher than that planned for the proposed Cove Reservoir dam (RB&G Engineering, 2021).

Geologic descriptions indicate that gypsum deposits within the upper portion of the Winsor member and lower portion of the Paria River member are present at this site (RB&G Engineering, 2021). A gypsum deposit with an exposed thickness of approximately 5 feet was observed near the base of the right abutment of the dam alignment (lower portion of Winsor member/upper portion of Paria River member). Additional gypsum deposits, several feet thick, were observed along the right side of the possible reservoir site and within the erosion channel near the center of the basin, particularly near the location of a historic flume. Defining the lateral and vertical limits of the gypsum deposits will require detailed foundation investigations. Depending on the extents of the gypsum deposits, it may not be feasible to construct a safe dam at the lower Muddy Creek site.

There are additional concerns with this site. An erosion channel visually estimated to be 20– 30 feet deep was observed within the center of the basin at this location. It is likely that a cutoff would need to be excavated to a depth of at least 30 feet to expose the bedrock formation prior to treating the foundation bedrock. Considering the availability of other potential reservoir sites, this site is not the preferred alternative for the project. Development of a reservoir at this site would result in the loss of active agriculture fields and would require the purchase of private property (RB&G Engineering, 2021).

The Lower Muddy Creek site is located at a lower elevation than most of the target agriculture fields within the project area; therefore, active pumping rather than gravity flow would be required to transport the water to the fields. Up to 1.8 miles of additional new pipeline beyond that needed for the Cove Reservoir site would be required to access the Glendale and Orderville fields. Additionally, studies conducted by Eocene cultural resource specialists determined that construction of a reservoir at this location would potentially result in the loss of historic cultural resources.

Due to safety concerns, engineering feasibility issues, the loss of agricultural land, additional costs associated with the purchase of private property, pipeline construction and maintenance, and cultural resource concerns, this site was eliminated from further study and is not discussed further in this document.

4.3.1.2.3 Upper Muddy Creek Site

The Upper Muddy Creek site is located approximately 1.8 miles up Muddy Creek from the lower site and 2.0 miles from US-89. Should a reservoir be constructed here, no irrigated agricultural land would be lost. However, the site is located on private land, and it would be necessary to purchase the property. Sedimentation would also be a concern, as an estimated 1,300 acre-feet of a reservoir at the upper Muddy Creek location would be filled with sediment after 50 years, resulting in a considerable loss of capacity (RB&G Engineering, 2021). The reservoir would also be on-stream to intermittent Muddy Creek. Approximately 3.6 miles of additional new pipeline would also be required to access the target agricultural fields.

The geology at the upper Muddy Creek site is believed to be like the lower Muddy Creek site. No gypsum surface deposits were observed during a field review, and a detailed geotechnical investigation would be required to determine if a dam could be safely constructed at this location. Gypsum deposits may be present at relatively shallow depths within the dam foundation area (RB&G Engineering, 2021). A review of topography at this site indicates that a dam with a maximum height of approximately 115 feet would need to be constructed to store 6,000 acre-feet of water. This would be approximately 25 feet higher than that planned for the Cove Reservoir site.

Due to potential safety concerns, engineering feasibility concerns, and additional environmental issues (e.g. larger dam, pipeline construction and maintenance), this site was eliminated from further study and is not discussed further in this document.

4.4 Final Array of Alternatives

Fourteen action alternatives were explored during the scoping process, including a nonstructural alternative. In accordance with NEPA (7 CFR 650), some initial alternatives were eliminated from further analysis due to exorbitant costs, logistics, environmental reasons, or other critical factors (see Chapter 4.3).

The feasibility of implementing the measures was assessed by evaluating various alternatives. This assessment involved examining each alternative's capacity to:

- Address the project's purpose and needs.
- Provide positive economic benefits.

- Ensure manageable land acquisition.
- Handle logistical requirements.
- Utilize existing technology.
- Avoid excessive costs.

Refer to the PR&G Analysis Report included in Appendix E-1 for further information.

The feasible alternatives determined from the screening process are being carried forward in detailed study. These include the 6,000-acre-foot reservoir and the 3,000-acre-foot reservoir. The No Action Alternative is also required to be evaluated in the Plan-EIS to provide a baseline comparison.

Table 4.1. Summary of Alternatives Preliminary Screening Evaluation

Plan Description	Purpose	Alternative 1 (No Action)	Alternative 2 (6,000-Acre-Foot Reservoir)	Alternative 3 (3,000-Acre-Foot Reservoir)
NEPA Purpose and Need	-	Alternative 1 would not meet the NEPA primary or secondary purpose and need to enhance the efficiency and reliability of the current AWM and recreation water in Long Valley, or increase agricultural and M&I water supply to communities in Washington County	Alternative 2 would meet the primary and secondary NEPA purpose and need by providing a reliable source of 6,000 acre-feet of water to be used for agricultural and recreation purposes in the Long Valley area, and agricultural and M&I purposes in Washington County.	Alternative 3 would meet the primary and secondary NEPA purpose and need by providing a reliable source of 3,000 acre-feet of water to be used for agricultural and recreation purposes in the Long Valley area, and agricultural and M&I purposes in Washington County.
Objective 1: Provide reliable source and long-term availability of agricultural water during the summer months in the Glendale, Orderville, and Mt. Carmel agricultural areas in Kane County and the Hurricane area in Washington County	Contribution to Planning Objectives	Alternative 1 would not provide a reliable and long-term available source of agricultural water.	Alternative 2 would provide agricultural water for up to 1,109.06 acres in Kane County and 67 acres in Washington County (Appendix E-3).	Alternative 3 would provide agricultural water for up to 750 acres in Kane County and 45 acres in Washington County (Appendix E-3).
Objective 2: Provide M&I water for Washington County	Contribution to Planning Objectives	Alternative 1 would not provide M&I water for Washington County.	Alternative 2 would provide up to 300 acre-feet of M&I water in Washington County (Appendix E-3).	Alternative 3 would provide up to 200 acre-feet of M&I water in Washington County (Appendix E-3).

Plan Description	Purpose	Alternative 1 (No Action)	Alternative 2 (6,000-Acre-Foot Reservoir)	Alternative 3 (3,000-Acre-Foot Reservoir)
Objective 3: Provide a recreation opportunity in Kane County	Contribution to Planning Objectives	Alternative 1 would not provide an additional recreation opportunity in Kane County.	Alternative 2 would provide a 6,000-acre-foot reservoir for non-motorized water-related enjoyment, a 4.1-acre recreation area with a non-motorized boat ramp, pavilion, and 20 RV sites at the reservoir site.	Alternative 3 would provide a 3,000-acre-foot reservoir for non-motorized water related enjoyment, a 2-acre recreation area with a non-motorized boat ramp, pavilion, and 12 RV sites in Kane County.
Objective 4: Present economic prospects for the communities of Orderville, Glendale, and Mt. Carmel by offering an extra recreational hub during the summer season	Contribution to Planning Objectives	Alternative 1 would not provide an additional recreational hub during the summer season and would therefore not increase economic prospects for the communities of Orderville, Glendale, and Mt. Carmel.	Alternative 2 would provide a reliable source of water for approximately 1,176.06 acres of farmland to support economic prospects.	Alternative 3 would provide a reliable source of water for approximately 795 acres of farmland to support economic prospects.
Objective 5: Provide for the maximum utilization of renewable energy for local communities whose populations are projected to rise	Contribution to Planning Objectives	Alternative 1 would not meet Objective 5 as no change in the utilization of renewable energy would occur.	Releases of excess water and water delivered to WCWCD would supplement the energy provided by the existing Orderville hydroelectric plant.	Releases of excess water and water delivered to WCWCD would supplement the energy provided by the existing Orderville hydroelectric plant.
Objective 6: Comply with the ZNP Agreement (1996)	Contribution to Planning Objectives	Alternative 1 would comply with the ZNP Agreement (1996)	Alternative 2 would comply with the ZNP Agreement (1996).	Alternative 3 would comply with the ZNP Agreement (1996).

Plan Description	Purpose	Alternative 1 (No Action)	Alternative 2 (6,000-Acre-Foot Reservoir)	Alternative 3 (3,000-Acre-Foot Reservoir)
Constraint 1: Siting limitations	Response to Planning Constraints	Alternative 1 has no siting limitations.	Alternative 2 would address siting limitation by using one of the limited number of sites that meet the necessary criteria for a reservoir.	Alternative 3 would address siting limitations by using one of the limited number of sites that meet the necessary criteria for a reservoir.
Constraint 2: Public safety	Response to Planning Constraints	Alternative 1 would put no additional risk to public safety.	Alternative 2 would minimize the risk put on residential property within the breach inundation zone at the Cove Reservoir site.	Alternative 3 would minimize the risk put on residential property within the breach inundation zone at the Cove Reservoir site.
Constraint 3: Environmental resources	Response to Planning Constraint	Alternative 1 would not cause the direct loss of existing agricultural land or residences.	The Cove Reservoir site would not require the direct loss of existing agricultural land or residences.	The Cove Reservoir site would not require the direct loss of existing agricultural land or residences.
Constraint 4: Geotechnical restrictions	Response to Planning Constraint	Alternative 1 has no geotechnical restrictions.	Alternative 2 has no geological structural limitations and would support construction.	Alternative 3 has no geological structural limitations and would support construction.
Constraint 5: Engineering Challenges	Response to Planning Constraint	Alternative 1 would have no engineering involved.	Alternative 2 would minimize the engineering requirements needed compared to the other reservoir sites evaluated.	Alternative 3 would minimize the engineering requirements needed compared to the other reservoir sites evaluated.
Constraint 6: Economic constraints	Response to Planning Constraint	Alternative 1 would have no construction costs.	Alternative 2 would have $39,730,000 in costs.	Alternative 3 would have $32,345,000 in costs.

Plan Description	Purpose	Alternative 1 (No Action)	Alternative 2 (6,000-Acre-Foot Reservoir)	Alternative 3 (3,000-Acre-Foot Reservoir)
Acceptability	Response to Evaluation Criteria	Alternative 1 would be consistent with existing federal and state laws, authorities, and public policies.	Alternative 2 would be consistent with existing federal and state laws, authorities, and public policies.	Alternative 3 would be consistent with existing federal and state laws, authorities, and public policies.
Completeness	Response to Evaluation Criteria	Alternative 1 would have no change to the current investments in Kane and Washington Counties.	Alternative 2 evaluates all necessary investments needed by Kane and Washington Counties to achieve the project.	Alternative 3 evaluates all necessary investments needed by Kane and Washington Counties to achieve the project.
Efficiency	Response to Evaluation Criteria	Alternative 1 would not address the water deficiencies or demand for recreational areas in Kane County, or the demand for M&I water in Washington County	Alternative 2 would have a cost of $6,622 per acre-foot in 2026 dollars.	Alternative 3 would have a cost of $10,782 per acre-foot in 2026 dollars.
Effectiveness	Response to Evaluation Criteria	Alternative 1 would not address the water deficiencies or demand for recreational areas in Kane County, or the demand for M&I water in Washington County.	Alternative 2 would effectively alleviate the specified problems and achieve the specified opportunities while providing minor impacts to the environment.	Alternative 3 would effectively alleviate the specified problems and achieve the specified opportunities while providing minor impacts to the environment.

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5.0 ENVIRONMENTAL CONSEQUENCES

A final array of alternatives was evaluated to compare the economic, environmental, and social effects that may result from each alternative. The final array of alternatives includes Alternative 1—No Action Alternative, Alternative 2—6,000-Acre-Foot Reservoir Alternative, and Alternative 3—3,000-Acre-Foot Reservoir Alternative. Refer to Chapter 4.0 for a detailed description of each alternative.

This chapter describes the potential effects of the alternatives within each resource category, as defined in Chapter 3.0. Ecosystem service categories are discussed for each resource category. For reference, the ecosystem service categories relevant to this project and the applicable resource concerns that discuss these categories are provided in Table 3.2 of Chapter 3.1. A summary and comparison of resource concerns for alternatives is provided as Table 5.11 in Section 5.7.2. A summary of ecosystem services is also provided as Table 5.6 in Section 5.7.3 to identify the ecosystem services tradeoffs between alternatives. The PR&G Analysis in Appendix E-1 also provides a detailed ecosystem services tradeoff analysis.

The following lists the specific terminology used to describe impacts associated with alternative measures, consistent with 7 CFR 650.

Type

- Direct Effect: Impacts caused by a proposed action occurring at the same time and place.
- Indirect Effect: Impacts caused by an action that are later in time or farther removed in distance but are still reasonably foreseeable.
- Cumulative Effect: The impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person(s) is undertaking such other action, which may include both beneficial and detrimental effects.

Duration

- Temporary and Permanent Impacts: Temporary impacts are impacts that are not lasting and the affected resource will return or be restored to its previous (pre-project) state. Permanent impacts are those in which the affected resource will not return to its previous state within one's lifetime.
- Short- and Long-Term Impacts: Short-term impacts are those that last through the duration of construction and shortly after (duration of impact is approximately 3 to 4 years). Long-term impacts are those that last for an extended duration of time. For this evaluation, long-term impacts extend beyond Year 4 and up to the end of the 100-year project life.

Intensity

- No effect: Resource conditions would not change.

- Negligible: Resource condition changes would be so slight there would be no measurable or perceptible consequence to the resource.

- Minor: A measurable effect to the resource, but localized, small, and of little consequence to the resource. Mitigation measures, if needed to offset adverse effects, would be easily implemented and successful.

- Moderate: A measurable effect on the resource from the alternative actions. Mitigation measures would be needed to offset adverse effects and could be extensive and moderately complicated to implement but would be successful.

- Major: A large, measurable effect to the resource from the alternative actions. Mitigation measures would be needed to offset adverse effects and could be extensive and complicated to implement.

5.1 Soil

Refer to Section 3.2.1 for existing soil resource conditions within the study area.

5.1.1 Soil Resources

5.1.1.1 Alternative 1—No Action Alternative

The drainage area in the project area would remain vulnerable to occasional flash floods, that transport sediments into the EFVR. This risk is heightened by the limited effectiveness of existing small flood control structures. Without additional flood risk management, the area could continue to experience channel scour, erosion, sedimentation, short-term disruptions to agricultural production, long-term degradation of soil health, and agricultural viability.

During dry periods, wind erosion within the project area would persist on disturbed and cleared areas, leading to soil loss into the foreseeable future. Under Alternative 1, no surface disturbance would occur; however, this alternative would not provide long-term soil stabilization benefits.

5.1.1.2 Alternative 2—6,000-Acre-Foot Reservoir Alternative

Approximately 259 acres of permanent disturbance and 64 acres of temporary disturbance would occur from implementation of Alternative 2 (Table 5.1). This disturbed area would be vulnerable to an indeterminate degree of soil erosion, mainly in the form of airborne dust, particularly on windy days or during heavy rainfall events. Direct impacts to soil resources would result from excavation and earthwork to build a dam, spillways, and access roads. It is anticipated that any soil needed for construction of the dam would be sourced from the reservoir footprint. If characteristics of excavated soils do not fully meet the specifications of design for the embankment upon the beginning of construction, additional soil resources would need to be taken from a nearby source.

Table 5.1. Permanent and Temporary Disturbance Under Alternative 2

Project Component	Permanent Disturbance (acres)	Temporary Disturbance (acres)
Reservoir	235	0
Principal Spillway	0.1	0.8
Auxiliary Spillway	0.2	0.6
Pipelines	0	37.9
Access Road	14	24.8
Borrow Area	5.7	0
Recreation Area	4.1	0
Total	259.1	64

The implementation of conservation and protective measures by the applicant, along with best management practices (BMPs) as detailed in Chapter 6.0, would mitigate but not entirely prevent this potential soil degradation. Once the planned reservoir is fully filled, approximately 190 acres of the affected land would be submerged, effectively preventing further soil erosion in that area, so long as the reservoir remains full. Thus, most of the soil loss at the reservoir site would be temporary and minor in extent. Given the relatively low amount of permanent soil disturbance for the execution of construction of the spillways, access roads, pipelines, and recreation area would likely lead to minor soil loss (18.4 acres, Table 5.1). The prolonged use of the newly constructed access road around the proposed reservoir would result in an unquantified amount of soil erosion caused by vehicle traffic, wind, and significant rainfall events. This would add to the soil loss already caused by existing roadways in the vicinity. However, this potential erosion would be partially mitigated by graveling and routine maintenance of the road.

While the exact amount of soil loss due to erosion is uncertain, all disturbed areas would remain susceptible to erosion as long as they remain barren or are not submerged, as in the case of the reservoir. Over time, soil erosion would likely decrease as vegetation gradually regrows or reclamation efforts take effect (i.e., the pipeline). The implementation of mitigation measures and BMPs (including revegetation and long-term weed control) committed to by the applicant would lessen, but not eliminate, the amount of soil lost. However, as the proposed project is in a region with limited summer rainfall, revegetation efforts would likely take several growing seasons to be fully successful.

Surface disturbance could cause a reduction in the biological soil crusts that exist in the project area. As mentioned in Section 3.2.1.1, this is a treatable resource concern. Treatment measures include artificial soil stabilization, cover crops, over-seeding, supplemental watering, shading, and wind erosion reduction. The implementation of mitigation measures and BMPS discussed in Chapter 6.0 would lessen the impacts biological soil crusts.

Use of the three existing borrow pits for construction of the earthen-fill dam is expected to result in the surface disturbance of an estimated 5.7 acres. Use of the Lamb Pit and Tait Pit would result in permanent disturbance of approximately 0.5 acres or 0.7 acres, respectively. Approximately 5 acres of permanent disturbance would result from use of the Esplin Pit (See Table 5.1). Embankment material would be taken from the reservoir basin. The basin would be covered by water when the reservoir is operational.

Direct impacts would include soil erosion through wind and water (dust and runoff) and the loss of native vegetation, which helps prevent erosion. Fugitive dust generated from borrow pit operations would be visible, particularly during windy conditions. While soil loss would be minor, it would be long term, lasting for the duration of the pits' operational period. Adherence to the BMPs outlined in Chapter 6.6 and the Standard BMPs and Standard Operating Procedures in Appendix E-3 would ensure that these effects are minimized.

Sediment would gradually accumulate in the proposed reservoir over time, primarily due to occasional flash floods in the area. If not removed, this sediment could reduce the reservoir's effectiveness for water storage or recreational use. Periodic maintenance, including dredging, may be necessary to maintain the reservoir's overall functionality. However, as stated in Appendix D, Section D.2.4 of the Plan-EIS, the estimated 100-year reservoir sedimentation is 418 acre-feet, which is less than 10 percent of the planned reservoir volume. The average depth of sediment within the reservoir after 100 years is expected to be 2.1 feet. The total estimated sediment volume equates to an average erosion of 1.7 inches of soil over the 4.7 square mile drainage area over a period of 100 years. Standard NRCS practice is to evaluate methods to reduce sedimentation if the sediment yield is greater than 2 inches in 50 years (4 inches in 100 years). The estimated sediment yield for Cove Dam site is less than 50 percent of the NRCS threshold for evaluation of sediment reduction. For the relatively low volume of expected sediment, storing the sediment in the reservoir is expected to be more cost efficient than implementing sediment reduction, particularly because sediment reduction would need to be combined with sediment storage since it is not practical to completely eliminate sediment transport into the reservoir. While this impact would be long-lasting, its overall effect would be negligible in scale.

Soil would be disturbed, vegetation would be cleared, and backfilling and grading would also be required during the short-term construction period. There is increased erosion and sedimentation potential during construction activities, which would be managed using BMPs during and immediately after construction. Post-construction monitoring would also be used to ensure successful reclamation of vegetated areas. No significant adverse impacts on soil would be anticipated with the implementation of BMPs.

5.1.1.3 Alternative 3—3,000-Acre-Foot Reservoir Alternative

Earthwork quantities for the construction of the dam and reservoir in Alternative 3 would be reduced by approximately 40 percent; however, the excavation required for the spillway would be doubled due to the smaller surface area in the reservoir. Approximately 165.3 acres of permanent disturbance and 64.7 acres of temporary disturbance would occur from implementation of Alternative 3 (Table 5.2). Direct impacts to soil resources would be the same as those evaluated in Alternative 2, with a slightly smaller disturbance footprint for the reduced reservoir area. The disturbance area for the principal spillway, pipelines, access roads, borrow areas, and recreation area would be the same as Alternative 2.

Table 5.2. Permanent and Temporary Disturbance Under Alternative 3

Project Component	Permanent Disturbance (acres)	Temporary Disturbance (acres)
Reservoir	141	0
Principal Spillway	0.1	0.8
Auxiliary Spillway	0.4	1.2
Pipelines	0	37.9
Access Roads	14	24.8
Borrow Areas	5.7	0
Recreation Area	4.1	0
Total	165.3	64.7

The same BMPs described for Alternative 2 would be used for Alternative 3 to prevent impacts to soil resources (Chapter 6.6). Under Alternative 3, negligible long-term impacts to soil resources are anticipated.

5.1.2 Ecosystem Services

5.1.2.1 Alternative 1—No Action Alternative

Provisioning service, agricultural land—Under Alternative 1, Agricultural land users in the project area would continue to experience water shortages during summer months at an increasing rate.

5.1.2.2 Alternative 2—6,000-Acre-Foot Reservoir Alternative

Provisioning service, agricultural land—Water from Alternative 2 would provide agricultural water the Hurricane Bench Lake area for maintaining agricultural production. Water could also be used to provide urban agricultural benefits to water users in St. George for personal food production through gardening or other enterprises that produce local food.

5.1.2.3 Alternative 3—3,000-Acre-Foot Reservoir Alternative

Provisioning service, agricultural land—Implementation of Alternative 3 would have the same impacts on ecosystem services for soil resources as Alternative 2 (Section 5.1.2.2).

5.2 Water

Refer to Section 3.2.2 for existing water resource conditions within the study area.

5.2.1 Water Resources

5.2.1.1 Alternative 1—No Action Alternative

No direct or indirect effects to water resources would occur from implementation of Alternative 1. Surface flows in the EFVR would continue to vary considerably in response to spring runoff or intense storm events.

5.2.1.2 Alternative 2—6,000-Acre-Foot Reservoir Alternative

Alternative 2 would have direct, positive benefits on water resources by making 2,148 acre-feet of existing water available for agricultural water users in Kane and Washington County annually. Additional water would be made available for M&I use in Washington County.

Because the proposed reservoir location is located away from the EFVR, construction of the proposed project is not anticipated to negatively affect the river. There are no permanent pools or streams located within the proposed reservoir footprint.

A water modeling analysis was completed by Alpha Engineering to determine the downstream effects of Alternative 2 on the EFVR. The changes in river flow, width, and depth on an annual and average monthly basis are described below.

5.2.1.2.1 Water Modeling Results

5.2.1.2.1.1 Annual Changes

Modeling shows that reservoir operations would cause minor changes to EFVR flows. On an annual basis, modeled changes in EFVR flows were small, ranging from a decrease of 1.8 cfs under low-flow conditions to an increase of 0.9 cfs under high flow conditions (Table 5.3). Larger short-term operational changes may occur during specific release or diversion periods, as discussed in section 5.2.1.2.1.2.

Current seasonal EFVR flows can vary from less than 40 cfs to more than 2,000 cfs, representing a range of more than 1,960 cfs, or approximately a 4,900 percent increase from 40 cfs. By comparison, modeled project-related annual average changes are less than 2 cfs (Alpha Engineering, 2026).

Tables 5.3 through 5.5 summarize the modeled changes in flow, depth, and width (Alpha Engineering, 2026).

Table 5.3. Annual Changes to EFVR Flow

Scenario	Low-Flow Condition	High-Flow Condition
Pre-Project Flow	34.8 cfs	82.2 cfs
Post-Project Flow	33.0 cfs	83.1 cfs
Change	-1.7 cfs	+1.9 cfs
Percent Change	5.17% decrease	1.09% increase

Table 5.4. Annual Changes to EFVR Depth

Scenario	Low-Flow Condition	High-Flow Condition
Pre-Project Depth	1.13 ft	1.71 ft
Post-Project Depth	1.10 ft	1.72 ft
Change	-0.03 ft	+0.01 ft
Percent Change	2.65% decrease	0.5% increase

Table 5.5. Annual Changes to EFVR Width

Scenario	Low-Flow Condition	High-Flow Condition
Pre-Project Width	19.32 ft	22.31 ft
Post-Project Width	19.37 ft	22.36 ft
Change	+0.05 ft	+0.05 ft
Percent Change	0.25% increase	0.22% increase

These results show that changes in flow (-5.17% to +1.09%), depth (-2.65% to +0.5%), and width (+0.25% to +0.22%) would be minor. Downstream tributaries such as Meadow Creek in Mineral Gulch would not be affected, because they are hydrologically independent of EFVR baseflow and the project would not alter tributary inflow, sediment supply, or confluence hydraulics (UDWRe, 2000). Because the project would not include construction, diversion, or flow modifications within the Meadow Creek watershed, and because modeled changes are limited to EFVR mainstream flows, no effect to Meadow Creek inflow, sediment supply, or confluence hydraulics is anticipated.

5.2.1.2.1.2 Monthly Changes

An analysis was completed by Alpha to evaluate anticipated changes in river flow on a monthly basis associated with the Project. The analysis evaluated river flows at the Mount Carmel and Springdale gauges during average, driest, and wettest hydrologic conditions for each month of the year. Detailed results of the analysis are provided in the Water Model Report in Appendix E-1. A summary of findings at each gauge is provided in the following sections.

At the Mount Carmel Gauge, flow is projected to increase by approximately 35 to 97 percent during average conditions. Driest conditions exhibit the largest relative increases, with several months exceeding 75 percent and some low-flow periods exceeding 200 percent due to the relatively small existing flows.

Because of additional watershed inflows between Mount Carmel and Springdale, the relative changes at the Springdale gauge are generally smaller. Average monthly flows at the Springdale gauge increase approximately 7 to 41 percent. Driest conditions increase approximately 7 to 60 percent, while wettest conditions generally increase approximately 4 to 78 percent.

Modeled decreases occur primarily during the authorized diversion season, when flows are generally higher and ecological water stress is lower. Modeled increases occur primarily during

summer low-flow periods, when surface water availability and riparian vegetation stress are more limiting. This seasonal redistribution is the basis for concluding that the project would have only minor impacts on downstream flows.

The percent change in flows is higher when looking at the monthly change compared to the annual change because the Project would shift water timing from naturally low-demand seasons to periods when ecological needs are higher. Although some monthly percent changes appear large, particularly during dry low-flow periods, these percentages reflect small baseline flows; the absolute change in cfs remains within the modeled operational range and does not exceed authorized release limits.

5.2.1.2.2 Downstream Flow Impact Analysis

The proposed reservoir would store excess water during high-flow periods and release it during low-flow periods to meet irrigation and water conservancy demands. Although the timing of flows would change, modeled flow alterations would be small compared to natural seasonal variability of EFVR flows (Alpha Engineering, 2026). Yearly monitoring would continue to be required to regulate water flows on the EFVR as discussed in Sections 3.2.2.1, 4.2.2.1.6.3 and 5.2.6.2.1.1. and. Because of the small annual changes in flow and the positive benefits of seasonally adjusting water timing to align with ecological needs, impacts on downstream EFVR flow would be minor.

5.2.1.3 Alternative 3—3,000-Acre-Foot Reservoir Alternative

Alternative 3 would have direct, positive benefits on water resources by making 1,453 acre-feet of existing water available for agricultural water users in Kane County and Washington County annually. Additional water would be available for M&I use in Washington County. Downstream impacts to water resources under Alternative 3 would be similar to those of Alternative 2. Construction of the proposed project would require crossing the EFVR along existing roadway, resulting in temporary and minimal soil bank erosion and causing minor sediment deposition into the stream. Increases and decreases in downstream river flow and sediment loading would be negligible (Refer to Section 5.2.1.2.1 for more detail).

5.2.2 Water Quality

5.2.2.1 Alternative 1—No Action Alternative

There would be no direct or indirect effects to water quality from the implementation of Alternative 1. The existing water quality of the EFVR would not change, and the EFVR and its tributaries would continue to be designated as HQW.

5.2.2.2 Alternative 2—6,000-Acre-Foot Reservoir Alternative

Construction activities associated with Alternative 2 are not expected to directly affect the water quality of the EFVR as no construction would occur within the river. Accessing the Lamb and Tait borrow pits would require crossing the EFVR along existing roadways, which could result in temporary, minimal and unquantifiable soil bank erosion and cause minor sediment deposition into the stream during construction. As discussed in the Investigation and Analysis Report in Appendix D, the proposed cove reservoir site is situated in an alluvial valley, which likely produces large sediment volumes during intense storm events. Water storage in the reservoir would allow

sediment to settle before leaving the reservoir, thereby improving downstream water quality conditions. A Site Erosion Analysis and Sediment Report were completed for the proposed reservoir (Appendix E-3), indicating that a sediment accumulation of approximately 6 afy would occur, of which 100 percent is expected to be contained in the reservoir.

Releases from the reservoir would regulate stream flow in the EFVR, which would also improve water quality for municipal and agricultural users, as well as improve aquatic habitat.

Through implementation of the BMPs listed in Chapter 6.6, Alternative 2 would have negligible temporary direct impacts on water quality and positive long-term impacts on water quality. Project design elements, including standard BMPs, would be implemented to reduce the quantity of sediment entering drainages, flowing downstream, and potentially violating any federal or state water quality rules and regulations. Under Alternative 2, the EFVR's designation as an HQW would not change.

The increase or decrease in streamflow during the summer months is expected to result in negligible changes to water quality in the EFVR. Flow regimes would continue to replicate natural variability to prevent alterations to sediment, channel morphology, and habitat structure, which are necessary for maintaining the "wild" character of the EFVR in ZNP, as designated by the NPS.

The ZNP Agreement (1996) ensures that water quality would benefit by maintaining controlled flow rates that prevent excessive sedimentation, nutrient loading, or changes in water temperature that could degrade the river's water quality and aquatic habitats. The change in water flow would not introduce pollutants or alter the river's chemistry in a way that would impact its designation as "wild". Water quality and the existing streamside vegetation would remain unchanged.

5.2.2.3 Alternative 3—3,000-Acre-Foot Reservoir Alternative

Under Alternative 3, impacts to water quality would be similar to those described for Alternative 2. Accessing the Lamb and Tait borrow pits during construction would cause temporary and minor soil bank erosion along the EFVR; however, only existing roadways would be used to cross the river.

The proposed reservoir would capture sediment during storm events, which would prevent it from entering the EFVR, which would have beneficial impacts to water quality within the EFVR. Alternative 3 would have a smaller drainage area compared to Alternative 2, therefore collecting less sediment per year.

5.2.3 Floodplain Management

5.2.3.1 Alternative 1—No Action Alternative

Alternative 1 would result in no changes to floodplains.

5.2.3.2 Alternative 2—6,000-Acre-Foot Reservoir Alternative

Alternative 2 would have long-term beneficial impacts on downstream flooding, and long-term, minor impacts on floodplain management. The proposed reservoir would capture runoff generated by flash floods out of Cove Canyon, reducing the amount of water and sediment entering the EFVR and decreasing the potential for flood-related damage and loss of riparian vegetation. High-pulse

events (i.e., flash floods) originating from other tributaries and watershed within the EFVR basin would continue to occur under existing conditions. Although flash floods can cause localized damage, these disturbances can also provide ecological benefit to stream and associated riparian habitats. For example, willows are early successional species that benefit from periodic flood-related disturbances (PLPCO, 2026).

In the unlikely event of a dam breach, the project would create a projected breach inundation area of approximately 3,123 acres under sunny-day conditions or 3,893 acres under rainy-day conditions (Appendix E-3). The breach inundation area itself would not be expected to result in revisions to FEMA floodplains. However, the reservoir's attenuation of flood flows during larger storm events, including the 100-year flood event, could reduce downstream flood elevations and floodplain extents.

Portions of the new Glendale Irrigation Pipeline would be located within a FEMA-designated Zone A floodplain, which is periodically subject to flash flooding.

Construction and maintenance activities would have the potential to affect floodplain resources through accidental releases of hazardous materials or localized erosion. However, the applicant has committed to conservation measures and BMPs designed to minimize floodplain disturbance, reduce erosion, and prevent project-related pollutants from reaching the EFVR (Chapter 6.6).

5.2.3.3 Alternative 3—3,000-Acre-Foot Reservoir Alternative

Alternative 3 would have similar effects to floodplain and floodplain management as Alternative 2. The proposed reservoir would capture runoff produced by flash floods, causing a beneficial impact to downstream flooding. The construction of the reservoir and dam would create a new inundation area, which could cause changes to FEMA floodplains. Portions of the new Glendale Irrigation Pipeline would be constructed within a FEMA-designated Zone A floodplain, and potential risks to floodplains could occur during construction due to an accidental release of hazardous materials. BMPs would be followed to reduce these potential risks.

5.2.4 WOTUS, Wetlands, and Special Aquatic Sites

5.2.4.1 Alternative 1—No Action Alternative

There would be no impacts to WOTUS, wetlands, or other resource in the project area under Alternative 1. Intensity and frequency of precipitation events and snowmelt would continue to influence these water bodies throughout the project and planning areas.

5.2.4.2 Alternative 2—6,000-Acre-Foot Reservoir Alternative

Alternative 2 would temporarily impact 0.253 acres and permanently impact 0.021 acre of potentially jurisdictional intermittent and perennial streams, including the EFVR, and 3.056 acres of non-jurisdictional ephemeral streams. Additionally, Alternative 2 would impact wetland 2 where the ROW of the Glendale Pipeline portion of the survey area crosses through the wetland. However, after coordination with the USACE following initial review of the October 2018 survey results, it was determined that wetland 2 would not be considered jurisdictional or be included in the overall impact calculation for Alternative 2.

Therefore, the total possible temporary and permanent impacts to potentially jurisdictional WOTUS delineated in the survey area may be approximately 0.274 acres. Impacts to each potential WOTUS are summarized in Appendix E-1.

5.2.4.3 Alternative 3—3,000-Acre-Foot Reservoir Alternative

Alternative 3 would likely result in the same or very similar aquatic resource impacts and 404 permitting requirements as Alternative 2. The temporary impacts to aquatic features and wetlands from construction of the Glendale pipeline would be the same as described in Alternative 2.

5.2.5 Regional Water Resource Plans

5.2.5.1 Alternative 1—No Action Alternative

No changes to Kane County or Washington County's Water Resource Plans would occur under Alternative 1. Both counties would continue to seek water conservation goals and practices to enhance the efficiency and reliability of the current AWM.

5.2.5.2 Alternative 2—6,000-Acre-Foot Reservoir Alternative

5.2.5.2.1 Colorado River Compact of 1922

The Virgin River is a tributary of the Colorado River, which connects at Lake Mead approximately 120 river miles away from the Quail Creek Reservoir Diversion site. Refer to Appendix E-1 for the details of the Colorado River Compact. Alternative 2 would comply with the Colorado River Compact, as changes to the EFVR would not result in any reduction of flow to the Colorado River.

The requirements of the Compact, including "the equitable division and appointment of the use of the waters of the Colorado River system; establishment of the relative importance of different beneficial uses of water; promotion of interstate comity; the removal of causes of present and future controversies; the secure and expeditious agricultural and industrial development of the Colorado River Basin, the storage of its waters, and the protection of life and property from floods" (43 USC 617l), would continue to be met.

5.2.5.2.2 Regional and State Water Plans

Alternative 2 would support both Kane County and Washington County's Water Resource Plans by addressing the present and future water needs of the area while cooperating with the State of Utah water quality plan and Utah constitutional and statutory law, in regard to vested water rights and control of in-stream flow. Both the WCWCD and KCWCD have identified Alternative 2 as a key water development opportunity to serve as a buffer against droughts and climate variability.

5.2.5.2.3 Water Rights

Water-rights holders are encouraged to stay informed about the project and monitor their allocations closely. The State Engineer administers distribution systems in both the East Fork and Main Stem of the Virgin River to assure that water rights are delivered in priority and would continue to do the same after construction of the reservoir. Any potential changes to water rights are evaluated by the State Engineer and administered through their legislated authority.

5.2.5.2.4 Overall Impacts

Alternative 2 would be consistent with both regional water plans; therefore, long-term minor beneficial impacts would occur. Alternative 2 would comply with the Colorado River Compact because the Virgin River is a lower basin tributary.

5.2.5.3 Alternative 3—3,000-Acre-Foot Reservoir Alternative

Alternative 3 would have beneficial impacts on Regional Water Resource Plans for the reasons described in Section 5.2.5.2.

5.2.6 Wild and Scenic Rivers

5.2.6.1 Alternative 1—No Action Alternative

There would be no direct or indirect impacts to WSRs under Alternative 1. No changes to identified WSRs would occur.

5.2.6.2 Alternative 2—6,000-Acre-Foot Reservoir Alternative

Congress created the National Wild and Scenic Rivers system in 1968 to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations (rivers.gov). To preserve these values, an analysis of the proposed projects' impacts to water quantity, quality, and habitat is described below.

5.2.6.2.1 Water Quantity and Quality

Under Alternative 2, up to 5.7 cfs of water would be released from the proposed Cove Reservoir into the EFVR during wet years. During dry years, approximately 11.6 cfs of water would be removed from the EFVR to supplement the reservoir as shown in Table 5.6. Dry and wet years were identified as the driest or wettest August and December on record (Alpha Engineering, 2024).

Table 5.6. Anticipated Streamflow Changes.

Scenario	Water Diverted From the EFVR[1]	Water Released into the EFVR[2]
Dry Year	11.6 cfs (Maximum)	0 cfs (Minimum)
Wet Year	0 cfs (Minimum)	5.7 cfs (Maximum)

[1]Water would be diverted from the EFVR during the winter months.

[2]Water would generally be released back into the EFVR during wet summer months.

Water modeling shows these streamflow changes would be minor, particularly when the natural variation of EFVR flows are approximately 100 times the range of effect from proposed Cove Reservoir releases (Alpha Engineering, 2025) on river depth and channel width and, therefore, no impacts to downstream river values would be anticipated (Refer to Section 5.2.1.2.1 and Appendix E-1). Additionally, the ZNP Agreement (1996) stipulates that water releases from a new reservoir

cannot exceed 25 cfs over any 7-day period, with a long-term monthly average of no more than 15 cfs. The proposed project would comply with these stipulations, and these controlled releases are designed to mimic natural flow patterns, minimizing potential disruptions to the EFVR's hydrology and ecological functions.

5.2.6.2.1.1 Monitoring Requirements

The current monitoring system, as described in Section 3.2.2.1, would continue to be used. A weir at each diversion site would continue to electronically send information to a website to provide remote monitoring data. The data collected from these flow meters would continue to be used to determine the total amount of water diverted. A water commissioner would continue to monitor the diversions to ensure that companies are using the correct amount of water according to their water right.

Additional measuring devices would be installed to record flows into and out of the Cove Reservoir. Metering devices would be installed to record flows through the existing Orderville hydroelectric power plant that will release water rights owned by the WCWCD back into the EFVR, as well as water-right shortages being delivered from the reservoir to the Mt. Carmel and Orderville irrigation companies. These meter records would also be filed annually with the Utah State Division of Water Rights.

The change in water flow would not disrupt the ongoing research activities within the Research Natural Area. The ZNP agreement (1996) stipulations would protect natural hydrological cycles, ensuring that the area's research value remains intact, and no research plots or sites would be affected. Research activities permitted by the ZNP would continue as usual, with no loss of research value.

Overall, Alternative 2 would have negligible impacts on the EFVR's WSR values within the ZNP. By adhering to the strict flow release guidelines set forth in the ZNP Agreement (1996) and implementing appropriate mitigation measures, the project would not impact the free-flowing character, water quality, or ecological integrity of the EFVR in its designated wild section.

The NPS evaluates impacts on designated rivers in accordance with Section 7 of the WSRA. On August 29, 2025, via email, the NPS stated that they will not be conducting a Section 7 analysis for this project (Appendix A). Coordination with the ZNP as a cooperating agency has been ongoing throughout the life of the project and is summarized in Chapter 7.0 (Consultation).

5.2.6.3 Alternative 3—3,000-Acre-Foot Reservoir Alternative

Similarly to Alternative 2, Alternative 3 would have no impact on the WSR values of the EFVR within the ZNP, as it would also adhere to the stipulations required in the ZNP Agreement (1996). Therefore, the changes in flow to the EFVR would be minor, particularly when the natural variation of the EFVR is approximately 100 times greater than the releases associated with both Alternative 2 and Alternative 3 (Alpha Engineering, 2025).

5.2.7 Ecosystem Services

5.2.7.1 Alternative 1—No Action Alternative

Negative impacts to ecosystem services from water would occur under Alternative 1.

Provisioning services, agricultural water—In the summer months, water from the EFVR would continue to provide insufficient quantities of water for crop and feed irrigation, maintenance of agricultural lands in Kane County, and M&I purposes in Washington County.

Regulating services, water quality and quantity—No changes to water quality or quantity would occur under Alternative 1, and therefore, no changes to temperature, turbidity, sediment, or pollutants within the EFVR would occur. Instream flow would continue to regulate water temperature, decrease bank erosion/sedimentation, and dilute potential pollutants.

Supporting services, wildlife habitat—The EFVR would continue to provide habitat for plants and wildlife.

Cultural services, recreation—Water from the EFVR would continue to provide recreational opportunities to the public, including fishing, swimming, and intrinsic value from the natural scenic beauty.

5.2.7.2 Alternative 2—6,000-Acre-Foot Reservoir Alternative

Alternative 2 would provide positive benefits to ecosystem services from water.

Provisioning services, agricultural water—Alternative 2 would increase the available amount of irrigation and M&I water for Kane County and Washington County by approximately 2,148 acre-feet.

Provisioning services, livestock water—Alternative 2 would increase the available amount of livestock water for Kane and Washington County by approximately 2,148 acre-feet.

Regulating services, water quality and quantity—Alternative 2 would increase water quality in the EFVR by containing sediment within the reservoir during flash flooding events.

Supporting services, wildlife habitat—Alternative 2 would continue to provide habitat for plants and wildlife within the EFVR with the addition of new habitat within the Cove Reservoir.

Cultural services, recreation—Alternative 2 would have no impact on the recreational value of the EFVR while also providing new recreational opportunities at the Cove Reservoir site.

5.2.7.3 Alternative 3—3,000-Acre-Foot Reservoir Alternative

Alternative 3 would provide positive benefits to ecosystem services from water.

Provisioning services, agricultural water—Alternative 3 would increase the available amount of irrigation and M&I water for Kane County and Washington County by approximately 1,453 acre-feet.

Provisioning services, livestock water—Alternative 2 would increase the available amount of livestock water for Kane and Washington County by approximately 2,148 acre-feet.

Regulating services, water quality and quantity—Alternative 3 would increase water quality in the EFVR by containing sediment within the reservoir during flash flooding events.

Supporting services, wildlife habitat—Alternative 3 would continue to provide habitat for plants and wildlife within the EFVR with the addition of new habitat within the Cove Reservoir.

Cultural services, recreation—Alternative 3 would have no impact on the recreational value of the EFVR while also providing new recreational opportunities at the Cove Reservoir site.

5.3 Air

5.3.1 Air Quality

Refer to Section 3.2.3 for existing air quality conditions in the study area.

5.3.1.1 Alternative 1—No Action Alternative

Under Alternative 1, no direct or indirect effects to air quality would occur.

5.3.1.2 Alternative 2—6,000-Acre-Foot Reservoir Alternative

On-site construction activities and equipment traveling to and from the project area on gravel or dirt roads would generate localized fugitive dust. This impact would be short-term, lasting only during the estimated 15-month construction period. Conservation and protection measures, along with the BMPs outlined in Chapter 6.6 and Appendix E-3, would help minimize fugitive dust during the construction phase. Emissions from trucks and heavy-duty diesel-powered construction equipment would also be temporary and confined to the construction site. Beyond the 15-month construction period, there would be no long-term effects on local air quality from implementation of Alternative 2.

Similarly, the use of the three borrow pit sites would result in temporary, localized reductions in air quality due to fugitive dust and equipment emissions. However, these effects would be short-lived and limited to the 15-month construction period. Borrow pit use for unrelated activities may continue over the long term, but adherence to conservation measures and BMPs would ensure that air quality standards are not violated.

An estimation of fugitive dust was completed by the NRCS for the recently proposed Gould Wash project (Washington County) and shows the increase in fugitive dust from construction would be minor (NRCS, 2026). The calculations estimated a total increase in 48.85 tons of PM10 and 7.18 tons of PM2.5 for all construction (estimated 2 years). This is well under the threshold for violating air quality standards. The EPA classifies a “major source” of emissions from construction activities to be emitting more than 250 tons per year for PM10, and 10 tons per year for PM2.5 (EPA, 2024c). The Gould Wash project consists of a larger dam, larger surface disturbance, and longer construction timeline than that anticipated for the proposed Cove Reservoir. Additionally, the soils in the Gould Wash project consist of basalt (low erosion potential), alluvial stream deposits, and other loose and non-cohesive that are highly erosive (NRCS, 2026). The alluvial stream deposits and non-cohesive soils are similar to that found at the proposed Cove Reservoir site and would be

expected to emit similar rates of fugitive dust. Therefore, since the Cove Reservoir site would have a smaller surface disturbance area and a shorter construction period than the Gould Wash project, it is projected that Alternative 2 would have even less fugitive dust emissions, resulting in minor impacts. No air quality standards would be violated.

The construction activities are not expected to violate ambient air quality standards, contribute to any ongoing or future air quality violations, or expose sensitive species or humans to harmful pollutants. The project would fully comply with all relevant federal, state, and local air quality regulations. As a result, any short-term, localized impacts on air quality are expected to be minimal.

5.3.1.3 Alternative 3—3,000-Acre-Foot Reservoir Alternative

Construction activities under Alternative 3 would result in impacts like those described for Alternative 2. Construction activities would cause a minor and temporary increase in localized fugitive dust for the 15-month construction period. Alternative 3 would fully comply with all relevant federal, state, and local air quality regulations, and BMPs would be followed to decrease the production of fugitive dust.

5.3.2 Ecosystem Services

5.3.2.1 Alternative 1—No Action Alternative

Under Alternative 1, no changes to ecosystem services for air would occur.

Regulating Services, climate regulation—All air quality standards would be maintained at current levels. Air quality standards directly impact climate regulation, as many sources of air pollutants are also greenhouse gases.

Supporting service, nutrient cycling—Nutrient cycling would continue to occur, as living organisms breathe in the abiotic components in the air.

Cultural Services, health—No impacts to air quality would occur, and therefore, no changes in human health from air quality would occur.

5.3.2.2 Alternative 2—6,000-Acre-Foot Reservoir Alternative

Alternative 2 would have no changes to ecosystems services provided by air quality.

Regulating Services, climate regulation—All air quality standards would be maintained at current levels. Air quality standards directly impact climate regulation, as many sources of air pollutants are also greenhouse gases.

Supporting service, nutrient cycling—Nutrient cycling would continue to occur, as living organisms breathe in the abiotic components in the air.

Cultural Services, health—The use of BMPs during construction would ensure no negative impacts to human health are caused from air quality changes.

5.3.2.3 Alternative 3—3,000-Acre-Foot Reservoir Alternative

Alternative 3 would have no changes to ecosystems services provided by air quality.

Regulating Services, climate regulation—All air quality standards would be maintained at current levels. Air quality standards directly impact climate regulation, as many sources of air pollutants are also greenhouse gases.

Supporting service, nutrient cycling—Nutrient cycling would continue to occur, as living organisms breathe in the abiotic components in the air.

Cultural Services, health—The use of BMPs during construction would ensure no negative impacts to human health are caused from air quality changes.

5.4 Plants and Animals

Refer to Section 3.2.4 for information regarding the existing plants and animals in the study area.

5.4.1 Threatened and Endangered Species

5.4.1.1 Alternative 1—No Action Alternative

Implementing Alternative 1 would not directly or indirectly affect any federally listed or candidate plant or animal species. No changes to the current conditions would occur.

5.4.1.2 Alternative 2—6,000-Acre-Foot Reservoir Alternative

A Biological Assessment (BA) was completed for Alternative 2 to document the potential effects to federally listed and proposed listed species and designated critical habitat. A draft BA was initially submitted to the USFWS for informal review on July 1, 2021, and their comments were incorporated into the BA and draft Plan-EA. An updated Final BA was submitted to the USFWS for informal Section 7 consultation on September 3, 2026. USFWS concurred with the determinations described in Table 5.7 in a letter signed September 9, 2026. Refer to Appendix A for copies of all consultations with USFWS. For more information on how these determinations were made, refer to the BA in Appendix E-1 and E-2.

Table 5.7. Effects Determinations of Listed Threatened and Endangered Species.

Species	Species Effect Determination	Designated Critical Habitat Effect Determination
Bird California condor	Not Likely to Jeopardize the Continued Existence outside of ZNP; May Affect, but is Not Likely to Adversely Affect within ZNP	Critical habitat has not been designated
Bird MSO	May Affect, but is Not Likely to Adversely Affect	May Affect, but is Not Likely to Adversely Affect
Bird Southwestern willow flycatcher	May Affect, but is Not Likely to Adversely Affect	No designated critical habitat is located within the study area

Species	Species Effect Determination	Designated Critical Habitat Effect Determination
Bird Western yellow billed cuckoo	No Effect	No designated critical habitat is located within the study area
Reptile Desert tortoise	No Effect	No designated critical habitat is located within the study area
Fish Virgin River chub	May Affect, but is Not Likely to Adversely Affect	May Affect, but is Not Likely to Adversely Affect.
Fish Woundfin	May Affect, but is Not Likely to Adversely Affect	May Affect, but is Not Likely to Adversely Affect
Insect Monarch butterfly	Not Likely to Jeopardize the Continued Existence	Critical habitat has not been designated
Insect Suckley's cuckoo bumble bee	No Effect	Critical habitat has not been designated
Plant Jones cycladenia	No Effect	Critical habitat has not been designated
Plant Shivwits milk-vetch	No Effect	No designated critical habitat is located within the study area
Plant Siler's pincushion cactus	No Effect	Critical habitat has not been designated
Plant Ute ladies'-tresses	No Effect	Critical habitat has not been designated

5.4.1.2.1 Determination of Effects

An analysis of potential impacts to listed threatened, endangered, or proposed listed species resulting from project development is required by the ESA. Surveys conducted for this project revealed that six Threatened, Endangered, and Proposed listed species occur within the project area (See Table 5.7). Additional detail regarding the presence/absence of these species and potential effects arising from project development are found in the BA included in Appendices E-1 and E-2.

5.4.1.2.1.1 California Condor

Alternative 2 (construction, operations, and maintenance activities) would not result in any surface disturbance in occupied California condor habitat. California condors are known to inhabit Parunuweap Canyon and surrounding area in ZNP. No surface disturbance would occur beyond the reservoir site, and no surface disturbance would occur within the EFVR or occupied condor habitat. Changes in EFVR flows below the proposed reservoir site would be minor (Alpha Engineering, 2025). Based on these factors, implementation of Alternative 2 **May Affect, but is Not Likely to Adversely Affect** the California condor within ZNP and is **Not Likely to Jeopardize the Continued Existence** of the species outside of ZNP due to insignificant or discountable effects (Appendices E-1 and E-2). No critical habitat has been designated for the California condor.

5.4.1.2.1.2 Mexican Spotted Owl

Alternative 2 (construction, operations, and maintenance activities) would not result in any surface disturbance in MSO occupied habitat, including designated critical habitat and PACs. The nearest habitat within the project area is located approximately 16 river-miles downstream from the proposed reservoir site. No surface disturbance would occur beyond the reservoir site, and no surface disturbance would occur within the EFVR. Minor changes in EFVR flows below the proposed reservoir site would be minor (Alpha Engineering, 2025). These minor changes in flows would not be sufficient enough to affect riparian areas, including overstory (cottonwoods, etc. used by the MSO). Potential increases in flow from the proposed reservoir during the summer could benefit stressed downstream riparian areas. No changes in habitat would occur beyond a 100-foot buffer from the EFVR. Based on these factors, it has been determined that Alternative 2 **May Affect, but is Not Likely to Adversely Affect** the MSO or designated critical habitat including PACs.

5.4.1.2.1.3 Southwestern Willow Flycatcher

Alternative 2 would not result in destruction or damage to SWFL habitat in Parunuweap Canyon. Surface-disturbing activities would only occur in the Long Valley portion of the study area. Based upon EVFR streamflow data, minor changes in stream flow resulting from project development would not result in a significant adverse effect to or loss of SWFL habitat, including riparian vegetation and overstory (cottonwoods, willows, etc.) No changes in habitat would occur beyond a 100-foot buffer from the EFVR. No harm or harassment would occur to SWFL because of reservoir-related streamflow changes; therefore, it has been determined that the Proposed Action **May Affect, but is Not Likely to Adversely Affect** SWFL due to insignificant or discountable impacts. No SWFL designated critical habitat is located within the project area.

5.4.1.2.1.4 Virgin River Chub/Woundfin

Alternative 2 would not result in any surface disturbance in Virgin River chub and/or woundfin occupied habitat as it is located approximately 4.8 miles below the project area in Washington County. The nearest surface disturbance would be more than 50 miles upstream, in the Long Valley area. Furthermore, no surface disturbance would occur within the EFVR in Long Valley. Changes in Virgin River flows below the Quail Creek Reservoir Diversion are not anticipated as diversions would not exceed releases from the proposed reservoir. Any unanticipated flow changes would be short-term and negligible and would not affect any habitat characteristics. Based on these factors, the implementation of Alternative 2 **May Affect, but Not Likely to Adversely Affect** the Virgin River Chub and woundfin or their habitats due to insignificant or discountable effects. Furthermore, it has been determined that Alternative 2 **May Affect, but is Not Likely to Adversely Affect** designated critical habitat based on negligible impacts on water flow below the Quail Hollow Reservoir Diversion (Appendix E).

5.4.1.2.1.5 Monarch Butterfly

The Study Area is located within the monarch butterfly's migrating fly zone and native flowering plants are present in the area. Therefore, it is possible that the species could be found migrating through the area. The potential for effect is negligible due to the considerable size of the monarch butterfly habitat and the limited duration of construction activities (15 months). Development of the proposed reservoir could provide a small amount of habitat for the monarch butterflies.

Therefore, a determination of **Not Likely to Jeopardize the Continued Existence of the species** has been made for this species due to insignificant effects (Appendix E-1 and E-2).

5.4.1.2.1.6 Other Species

Alternative 2 would have ***No Effect*** on the following species due to lack of suitable habitat in the project area or the species-specific buffers identified within the study area (Appendix E-1 and E-2):

- Western yellow-billed cuckoo.
- Desert tortoise.
- Suckley's cuckoo bumble bee.
- Jones cycladenia.
- Shivwits milk-vetch.
- Siler's pincushion cactus.
- Ute ladies'-tresses.

Implementation of Alternative 2 would also have **No Effect** on designated critical habitat for any of these species due to the reasons as stated above.

5.4.1.3 Alternative 3—3,000-Acre-Foot Reservoir Alternative

The effects determinations made for Alternative 3 would be the same as identified in Alternative 2 (Table 5.7), as the location of the project is the same.

5.4.2 Migratory Birds

5.4.2.1 Alternative 1—No Action Alternative

Alternative 1 would have no direct or indirect impacts to migratory birds.

5.4.2.2 Alternative 2—6,000-Acre-Foot Reservoir Alternative

Construction activities would temporarily and directly disturb suitable breeding/nesting or foraging habitat for migratory birds. If present, foraging birds may be disturbed and displaced to adjacent foraging habitats during construction activities. See Chapter 6.6 for conservation measures and BMPs that would be implemented to avoid and minimize impacts.

Construction may overlap the nesting season for all 16 migratory birds potentially found in the project area, which could lead to nest abandonment and the loss of eggs or young. While it is difficult to quantify this impact, it is expected to be minimal given the project's limited scope (259.1 acres of permanent surface disturbance; 64 acres temporary disturbance) and the availability of abundant and adjacent alternative habitats. If construction occurs during the extended migratory bird breeding season (generally January 1 to August 31), site-specific surveys would be conducted within 5 days prior to any vegetation removal. Should active or occupied nests be found, buffer

zones would be established in consultation with the USFWS and UDWR. Nests containing eggs or young would remain undisturbed until fledglings have left, and follow-up surveys by a qualified, NRCS-approved biologist would confirm fledging before construction resumes in that area.

Similarly, the development and use of the three borrow pit sites are expected to have minor impacts on migratory birds. Birds may be displaced due to ongoing activity at these sites during the 15-month construction period or through long-term use. However, there is sufficient surrounding habitat to accommodate displaced birds, ensuring that the overall impact would remain localized and minor.

The long-term O&M activities for the reservoir, recreation area, and other facilities could disrupt foraging, nesting, and roosting habitats, potentially forcing birds to relocate to nearby areas. This impact is expected to be minor due to the limited extent of the disturbance and the amount of suitable habitat nearby.

Over time, the riparian vegetation surrounding the proposed reservoir is expected to provide a limited amount of additional cover and nesting opportunities for migratory birds and other wildlife. This new habitat could become a critical long-term refuge in the otherwise arid landscape of southern Utah.

5.4.2.3 Alternative 3—3,000-Acre-Foot Reservoir Alternative

Impacts under this alternative would be like those described under Alternative 2. Construction activities would cause minor, temporary effects to migratory birds, while the increased traffic and human presence at the reservoir may cause minor, permanent effects to migratory birds. The creation of the riparian area surrounding the reservoir would provide permanent, beneficial impacts to migratory birds through the creation of new habitat.

5.4.3 Bald and Golden Eagles

5.4.3.1 Alternative 1—No Action Alternative

Alternative 1 would have no direct or indirect impacts to bald and golden eagles.

5.4.3.2 Alternative 2—6,000-Acre-Foot Reservoir Alternative

Golden eagles have been observed foraging in and around the proposed project area. Due to the abundance of suitable foraging habitats, such as sagebrush, desert shrub, and agricultural fields, no significant loss of foraging grounds would be expected. Bald eagles pass through the area during migration and are likely to use the riparian zone of the EFVR as a winter roosting habitat. While construction activities may cause temporary disturbances to both species, the increased human presence in the area could result in longer-term disruption. However, the creation of the reservoir and surrounding riparian vegetation would offer new roosting opportunities for both bald and golden eagles.

5.4.3.3 Alternative 3—3,000-Acre-Foot Reservoir Alternative

Impacts under this alternative would be like those described under Alternative 2. Construction activities may temporarily affect bald and golden eagles; however, no significant loss of foraging grounds would occur.

5.4.4 Ecologically Critical Areas

5.4.4.1 Alternative 1

No direct or indirect impacts to designated wilderness, WSAs, or RNAs would occur under Alternative 1, as no changes to the existing environment would occur.

5.4.4.2 Alternative 2

Minor, beneficial, indirect impacts to designated wilderness, WSAs, or RNAs would occur under Alternative 2 due to the minor changes in downstream flows which would more closely align with the natural seasons (Section 5.2.1).

Water timing that is more closely aligned with the natural season would generally benefit the Parunuweap Canyon WSA, the Zion Wilderness, and the ZNP Parunuweap RNA by supporting more natural hydrologic and ecological processes along the EFVR. Seasonal flow patterns that better reflect natural runoff timing would help maintain riparian, fluvial, and aquatic habitats; sustain vegetation along the EFVR; and support moisture dependent communities within the Canyons.

5.4.4.3 Alternative 3

Similarly to Alternative 2, minor and beneficial indirect impacts to the designated wilderness, WSAs, or RNAs would occur under Alternative 3.

5.4.5 Invasive Species

5.4.5.1 Alternative 1—No Action Alternative

As no changes would take place under this alternative, no impacts involving invasive species would occur under Alternative 1.

5.4.5.2 Alternative 2—6,000-Acre-Foot Reservoir Alternative

Alternative 2 would have minor, temporary impacts due to invasive plant species during and immediately following construction. The creation of a new reservoir would potentially provide habitat for invasive animal species, such as quagga mussels. While unlikely, some species could potentially migrate from the reservoir to the EFVR. BMPs would be implemented during the construction and operational phases to prevent the spread of invasive species and comply with Executive Order 13112. During construction and until restoration areas are fully established, invasive plant species would be monitored on a regular basis to prevent the establishment. Non-desirable plant species would be controlled by cleaning equipment prior to delivery to the project site and eradicating these species before the start and during construction, as discovered. In addition, a Post Construction Rehabilitation Plan (PCRP) would be developed and would include mechanisms for addressing weed establishment and treatment. Following the completion of construction, disturbed areas would be restored to preconstructions conditions or better. The increased risk for invasion of noxious and invasive weeds is anticipated to be short term and minor. Compliance with Administrative Rule R657-60 would prevent and control the spread of any aquatic invasive species in the project area. To further reduce the potential for invasive aquatic species from entering the reservoir or the EFVR, prior to stocking the proposed reservoir with fish, a

management plan would be developed to ensure that non-native fish species do not escape from the reservoir into the EFVR. Any fish stocking would adhere to state and federal regulations and would be the responsibility of the UDWR. Cooperating Agencies would have an opportunity to review this plan prior to its implementation. Additionally, the proposed reservoir intake would include a fish screen with a 1-inch maximum pore opening to prevent fish and debris from entering the pipeline to the Orderville Hydroelectric Power Plant. The hydroelectric facility utilizes two Turgo Impulse turbines, which focus water through small nozzles at high pressure and velocity into the turbines. The combination of the small nozzle size, high velocity, and sudden pressure drop would make it highly unlikely that any fish that might make it to the pipeline would survive.

Should BMPS and the developed PCRP be implemented, no long-term adverse impacts are anticipated from the alternative actions.

5.4.5.3 Alternative 3—3,000-Acre-Foot Reservoir Alternative

This alternative would have similar direct impacts as Alternative 2, which would put the project area at risk for future invasion of invasive plant and animal species. BMPs would be implemented during construction and operational phases to prevent the spread of invasive species and comply with Executive Order 13112 (Chapter 6.6). During construction and until restoration areas are fully established, invasive plants and animals would be monitored on a regular basis to prevent the establishment. Prior to delivery to the project sites, non-desirable plant species would be controlled by cleaning equipment and eradicating these species before the start and during construction, as discovered. In addition, a PCRP would be developed and include mechanisms for addressing weed establishment and treatment. Following the completion of construction, disturbed areas would be restored to preconstructions conditions. Should BMPS and a developed PCRP be implemented no long-term adverse impacts are anticipated from alternative actions.

5.4.6 Fish and Wildlife

5.4.6.1 Alternative 1—No Action Alternative

No changes to fish and wildlife resources would occur under Alternative 1.

5.4.6.2 Alternative 2–6,000-Acre-Foot Reservoir Alternative

During the 15-month construction period, there would be an increase in noise and human activity, which is likely to drive local wildlife, including Species of Greatest Conservation Need, away from the project area. The long-term increase in human presence and activities following the development of the reservoir and adjacent recreation area could prevent some wildlife from returning. However, there is ample habitat adjacent to the project area, and both short- and long-term activities associated with Alternative 2 would cause minor impacts. The creation of a riparian zone around the reservoir would provide a small amount of new habitat for species dependent on riparian environments.

Direct, short-term impacts on the EFVR or intermittent streams would be limited to construction activities for the Glendale Irrigation Pipeline. Any temporary increase in sediment in the river would be minimal and unlikely to affect wildlife, including the Species of Greatest Conservation Need identified in Table 3.5 in Section 3.2.4.6. Species of Greatest Conservation Need (fish), including the desert sucker, flannelmouth sucker, and Virgin spinedace, are known to exist in the EFVR.

Changes in water flow from implementation of Alternative 2 would be minor, and therefore these species and their habitat would not be impacted (Refer to Section 5.2.1.2.1 for more detail).

5.4.6.3 Alternative 3—3,000-Acre-Foot Reservoir Alternative

Under Alternative 3, similar impacts to fish and wildlife species would occur as those identified in Alternative 2. Construction activities would cause temporary, minor impacts due to the increased human presence and noise. However, there is ample habitat surrounding the project area, and therefore, no long-term impacts are anticipated. Alternative 3 would also create a small riparian area surrounding the reservoir, providing additional habitat.

Species of Greatest Conservation Need may exist within the project area, and construction of the reservoir and pipelines may have temporary, minor, impacts on these species. For a full list of Species of Greatest Conservation Need that may exist in the project area, refer to Table 3.5. Species of Greatest Conservation Need (fish), including the desert sucker, flannelmouth sucker, and Virgin spinedace are known to exist in the EFVR. Changes in water flow from implementation of Alternative 3 would be minor, and therefore these species and their habitat would not be impacted (Refer to Section 5.2.1.2.1 for more detail).

5.4.7 Riparian Areas

5.4.7.1 Alternative 1—No Action Alternative

No direct or indirect effects to existing riparian areas in the study area would occur.

5.4.7.2 Alternative 2—6,000-Acre-Foot Reservoir Alternative

Alternative 2 would create additional riparian habitat surrounding the reservoir. No construction would occur in existing riparian habitats, and the seasonal changes to downstream flows could benefit existing riparian habitat surrounding the EFVR, as discussed in detail below.

5.4.7.2.1 Impacts on Riparian Vegetation

The EFVR riparian corridor is adapted to substantial natural variation in streamflow, including episodic flood events, spring runoff, and seasonal low flow periods. As described in Section 5.2.1.2.1, modeled project-related changes in flow, depth, and width would remain small relative to the river's existing natural variability, and no downstream reach of the EFVR would be dewatered as a result of the proposed project.

Reservoir operations would primarily change the timing of water availability rather than altering overall flow magnitude. Water would generally be diverted when flows are higher and released during lower-flow periods when irrigation demand and ecological water stress are greatest. Modeled summer releases would increase baseflows during the period when riparian vegetation is most vulnerable to drought stress and high evapotranspiration demand. Research indicates that increasing summer flows can support riparian vegetation (Holler, et al., 2025). Even small increases in summer flow can disproportionately improve riparian conditions by extending soil moisture availability and reducing drought stress (Stromberg, Beauchamp, Dixon, Lite, & Paradzick, 2007) (Rood, et al., 2005).

Mature overstory species, such as cottonwood and Russian olive, are generally supported by alluvial groundwater rather than direct uptake from short-term surface flows. Their deep root systems would not be affected by the minor changes in streamflow (Zimmerman, Pearce, Woodmnan, Rood, & Flanagan, 2023). Because the project would not dewater the EFVR and modeled changes in surface flow would be minor, the project is not expected to alter groundwater conditions supporting mature riparian vegetation. As a result, the project is not expected to adversely affect existing riparian overstory structure or associated habitat functions.

No new agricultural development is proposed as part of the project, and the project would not involve direct disturbance or vegetation removal within existing EFVR riparian habitat. Project effects would be limited to modeled changes in EFVR flow timing and magnitude. Because those changes would remain within the natural range of variability, would not cause dewatering, and would not decrease summer baseflows during low-flow conditions, adverse effects to riparian vegetation and riparian habitat are not anticipated.

5.4.7.3 Alternative 3—3,000-Acre-Foot Reservoir Alternative

Alternative 3 would create additional riparian habitat surrounding the reservoir. No construction would occur in existing riparian habitat, and the project would not impact downstream flows; therefore, no impacts on downstream riparian habitat would occur.

5.4.8 Ecosystem Services

5.4.8.1 Alternative 1—No Action Alternative

No changes to ecosystem services from plants and animals would occur under Alternative 1.

Provisioning Services, fishing—Alternative 1 would have no impact in aquatic habitat or species within the EFVR, and therefore, would have no impact on fishing opportunities within the EFVR.

Regulating services, Riparian zones—No impacts to riparian zones would occur under Alternative 1.

Cultural services, species conservation—Alternative 1 would have no impact on species habitat or existence.

5.4.8.2 Alternative 2—6,000-Acre-Foot Reservoir Alternative

Positive changes to ecosystem services from plants and animals would occur under Alternative 2.

Provisioning Services, fishing—Alternative 2 would have no impact in aquatic habitat or species within the EFVR, and therefore, would have no impact on fishing opportunities within the EFVR. The reservoir would provide an additional but minor sport fishing opportunity.

Regulating services, Riparian zones—The creation of riparian vegetation under Alternative 2 would positively impact the ecosystem services, as riparian vegetation provides benefits like water filtration, nutrient cycling, and wildlife habitat.

Cultural services, species conservation—Alternative 2 would have no impact on species conservation. Minor, temporary impacts may occur during construction but would not result in the loss of species existence or abundance of suitable habitat.

5.4.8.3 Alternative 3—3,000-Acre-Foot Reservoir Alternative

Positive changes to ecosystem services from plants and animals would occur under Alternative 3.

Provisioning Services, fishing—Alternative 3 would have no impact in aquatic habitat or species within the EFVR, and therefore, would have no impact on fishing opportunities within the EFVR.

Regulating services, Riparian zones—The creation of riparian vegetation under Alternative 3 would positively impact the ecosystem services, as riparian vegetation provides benefits like water filtration, nutrient cycling, and wildlife habitat.

Cultural services, species conservation—Alternative 3 would have no impact on species conservation. Minor, temporary impacts may occur during construction but would not result in the loss of species existence or abundance of suitable habitat.

5.5 Human

Refer to Section 3.2.5 for existing resources in the study area.

5.5.1 Cultural Resources and Tribal Consultation

5.5.1.1 Alternative 1—No Action Alternative

As no changes to the existing environment would occur, Alternative 1 would have no impacts on historic or cultural resources.

5.5.1.2 Alternative 2—6,000-Acre-Foot Reservoir Alternative

The three surveys of the Direct area of the APE identified 19 cultural resource sites and 19 IOs. The NRCS and SHPO concurrence on site eligibility are described in Table 3-6 in Section 3.2.5.1. Under Alternative 2, two historic ditches (Mt. Carmel East and West Ditches), both eligible for listing on the NRHP, would be converted from open ditch to buried pipe. The NRCS, in consultation with SHPO and Tribes/Tribal Historic Preservation Officers (THPOs), have determined that the conversion of the open ditch to pipe would result in an *Adverse Effect* to historic properties, per 36 CFR 800.5 (Table 5.8). An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the NRHP in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association (36 CFR 800.5).

Pursuant to 36 CFR 800.5 of the NHPA (1966, as amended in 2000) and regulations of the Advisory Council on Historic Preservation (ACHP) implementing Section 106 of the NHPA (54 USC 306108), federal agencies must consider the potential effect of an undertaking on "historic properties," which refers to cultural resources listed in, or eligible for listing in, the NRHP. Consultation with SHPO, THPO, and other consulting parties including tribes to fulfill Section 106 obligations were completed. The CRIR, and subsequent addendums, were submitted to the Utah SHPO on January 9, 2020, January 23, 2023, and May 20, 2024, for concurrence with the determinations of site

eligibility and project effects. The Utah SHPO concurred in letters dated January 17, 2020, February 6, 2023, and June 2, 2024. The CRIR and addendum for the Esplin Pit were sent to THPOs and Tribal representatives on January 23, 2023, and May 22, 2024. Refer to Section 7.1.10 for a summary of NRCS consultation on the determination of effects with the SHPO, Tribes, and agencies and their received responses.

Historic properties within the Tait and Esplin Pit sites, as well as near the reservoir site, would be fenced off with buffers of at least 50 feet and avoided, and no cultural monitor would be required. Figures showing the avoidance areas within the Tait and Esplin Pit sites and reservoir site are included as Figures C-6 through C-8 in Appendix C.

The ACHP was also notified of the finding of *Adverse Effect* in an email dated March 28, 2024 (Appendix A). A letter response was received by email on April 12, 2024, stating that the ACHP does not believe their participation in the consultation to resolve adverse effects is needed per 36 CFR 800 (Appendix A).

Indirect and cumulative effects could arise from the projected increase in visitor activity at the reservoir recreation area. Visitors might access nearby private lands in search of viewpoints or other recreational opportunities. This concern was raised by a Kaibab Paiute representative, and a site visit was completed on January 25, 2019. A summary of this site visit is included in Appendix A. During this site visit, the Tait Pit was also visited due to its proximity to a cultural site. The NRCS and Kaibab Paiute discussed avoidance options. A figure of the Tait Pit avoidance locations is included in Figure C-6 in Appendix C.

On June 5, 2025, concerns about effects to the acoustic characteristics of site 42KA7537 were also raised by the Moapa Band of Paiute Indian Tribe's THPO. Consultation to address these potential effects continued throughout 2026. Voicemails were left on June 10 and June 20, 2025, and on February 12, 2026. The NRCS followed up via email on June 18, 2025, with additional background information and proposed avoidance measures, and the email was read on June 18, 2025. A third email was sent on July 15, 2025, and read by the THPO on July 15, 2025. NRCS emailed and left a voicemail for the THPO on August 24, 2026. In this email, the NRCS presented the extended avoidance measures that have been incorporated into the project to ensure acoustics coming from the site remain undisturbed, and that any noise from construction equipment reaching the site would be minimized. See Appendix A for redacted consultation and Appendix C for avoidance maps.

The redacted CRIRs can be found in Appendix E-2. Table 5.8 summarizes the effects findings and protective measures to all eligible sites in the APE.

Table 5.8. Summary of Effect Findings and Protective Measures to Eligible Cultural Sites.

Site Number	NRHP Eligibility*	Effects	Site Protective or Avoidance Measures
42KA6331	Eligible–D	No Adverse Effect to Historic Properties	Site would be avoided by at least 50 feet by all project activities. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.

Site Number	NRHP Eligibility*	Effects	Site Protective or Avoidance Measures
42KA8785	Eligible–D	No Adverse Effect to Historic Properties	Site would be avoided by at least 50 feet by all project activities. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.
42KA8904	Eligible–D	No Adverse Effect to Historic Properties	Site would be avoided by at least 50 feet by all project activities. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.
42KA8974	Eligible–D	No Adverse Effect to Historic Properties if the site is avoided	Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.
42KA1157	Eligible–D	No Adverse Effect to Historic Properties	The portion of the site within the project APE is heavily disturbed by previous road construction/maintenance, plowing, livestock, and one sewer line. It has also been previously tested and is non-contributing to the overall eligibility of the site.
42KA9490	Eligible–A, C, D	Adverse Effect to Historic Properties	An inadvertent discovery plan would be prepared, as well as a Memorandum of Agreement (MOA) to mitigate the adverse effects to the site.
42KA9491	Eligible–A, D	Adverse Effect to Historic Properties	An inadvertent discovery plan would be prepared, as well as a MOA to mitigate the adverse effects to the site.
42KA7537	Eligible–D	No Adverse Effect to Historic Properties	Avoid all ground disturbing activities within 15 meters of the site boundary; a cultural monitor must be present during all ground disturbance within 15 meters of the site boundary, and avoidance flagging must be placed 15 meters from the site boundary prior to any construction activities near the site area.
42KA9789	Eligible–D	No Adverse Effect to Historic Properties	Avoid all ground disturbing activities within 15 meters of the site boundary; a cultural monitor must be present during all ground disturbance within 15 meters of the site boundary, and avoidance flagging must be placed 15 meters from the site boundary prior to any construction activities near the site area.

*See Section 3.2.5.1

Twenty-six cultural resources and nine historic structures have been identified within the partially overlapping The Direct, Indirect, and Visual sections of the project APE. Some sites overlap more than one section within the APE. Two sites are overlapped by the Direct section of the APE. Four

sites are overlapped by the Indirect section of the APE. Two sites are overlapped by both the Direct and Visual sections of the APE. And two sites are overlapped by the Indirect and Visual sections of the APE. Only one site (a prehistoric cave and lithic scatter) meets the site type criteria for inclusion in a visual impact assessment. Since it is located in the Direct section of the APE, potential impacts to this site have been analyzed, and it was determined that no effect to the site would occur as it would be avoided by project development. Therefore, project implementation would not impact the character defining characteristics of any sites that would prevent them from conveying their significance since visual components are not the character defining feature that makes sites eligible. Three historic structures within the Indirect section of the APE (Mt. Carmel School and Church; Dixon Maynard house and studio; and Steven's barn) are unlikely to be affected due to distance from the proposed reservoir, elevation, and implementation of safety features that would be implemented as part of the project (Eocene, 2025).

Per 36 CFR 800.6, the NRCS would resolve these adverse effects through the preparation and execution of a MOA. To avoid effects to cultural resources during construction, the NRCS would also prepare an inadvertent discovery plan to be supplied to construction crews. A draft MOA has been prepared by the NRCS, in consultation with the Utah SHPO, tribes, and cooperating agencies (Appendix A).

If any previously undiscovered cultural features or deposits are encountered during project activities, work must immediately stop in the affected area, and an NRCS archaeologist (and BLM or UTLA, if applicable) must be contacted and the applicable agencies post-review discovery procedures followed (Chapter 6.6 for a list of BMPs to be used to protect Cultural and Tribal resources).

5.5.1.3 Alternative 3—3,000-Acre-Foot Reservoir Alternative

Alternative 3 would implement the same proposed components, except with a smaller reservoir size than Alternative 2 and, therefore, would result in the same Adverse Effect to Historic Properties, mitigated with the execution of an associated MOA. Consultation was completed on the larger reservoir footprint, and therefore, the smaller reservoir footprint of Alternative 3 was included in that consultation. Refer to Section 5.5.1.2 for a summary of all consultations completed. Like Alternative 2, indirect and cumulative effects could arise from the increase in human activity at the reservoir site and recreation area.

5.5.2 Social Issues

5.5.2.1 Alternative 1—No Action Alternative

5.5.2.1.1 Population

Alternative 1 would have no immediate impacts on population in the study area; however, as water availability continues to decrease, community members who rely on farming and agriculture may move out of the study area, as they would eventually be unable to maintain farming operations.

5.5.2.1.2 Demographics

Alternative 1 would have no impact on demographics.

5.5.2.1.3 Employment and Income

Alternative 1 would have long-term negative impacts to employment and income. As water availability continues to decrease, farmers and agricultural water users would have to decrease crop production, which much of the population of the communities of Glendale, Orderville, and Mt. Carmel rely on for employment and income. The WCWCD projects that water demand will outstrip supply by 2060 (WCWCD, 2023; WCWCD, 2025). The WCWCD's 40-year plan submitted to the Division of Water Rights indicates that, even with water reuse, its demand is projected to outstrip supply. The 2023 WCWCD 40-year plan projects a shortage of 61,625 to 96,722 acre-feet per year by 2060, depending on the success of conservation efforts (PLPCO, 2026).

5.5.2.1.4 Housing

Alternative 1 would have no impact on housing availability or costs.

5.5.2.1.5 Economy

Alternative 1 would have long-term negative impacts to the economy in the study area, as livestock and farming consists of much of the economy for the communities of Glendale, Orderville, and Mt. Carmel. Due to the high costs of the limited amount of agricultural water in the area, the agricultural challenges currently faced by the communities would continue. If no project were to occur, the limited water is expected to decrease over time, as described in the Cove Water Model (Appendix E-1).

5.5.2.2 Alternative 2—6,000-Acre-Foot Reservoir Alternative

5.5.2.2.1 Population

Alternative 2 would have no direct impacts on population in the study area. An increase in recreation-based users would visit the area but would likely not stay long term. The proposed reservoir would indirectly provide an alternative recreation site for the increased population, as the existing recreation sites are becoming overcrowded (Section 2.2.1). The recreation area would support approximately 20 RV’s a night (Appendices E-2 and E-3).

5.5.2.2.2 Demographics

Alternative 2 would have no impact on the demographic breakdown within the project area, as all populations would be affected equally (whether negatively or positively) by the implementation of Alternative 2.

5.5.2.2.3 Employment and Income

Construction under Alternative 2 would create job opportunities for approximately 67 people, as described in the Plan of Development (Appendices E-2 and E-3). Development of the reservoir and recreation area would also provide long-term employment opportunities to the local communities. O&M activities would require regular inspection to maintain the equipment and keep the site free of debris and excessive vegetation. Approximately nine people would be needed for O&M activities. The increase in available water would support local farmers and other agricultural water users who rely on farming as their main source of income. Under Alternative 2, A yield of approximately 2,148 acre-feet could be met during each of the 54 years of record. The agricultural

fields in the study area are primarily alfalfa, which require 5 acre-feet of water per acre per growing season. Therefore, Alternative 2 would support approximately 430 additional acres per growing season. The proposed reservoir would provide needed water to Washington County for M&I uses. Studies project that demand will exceed availability in the future and that additional water sources are needed (WCWCD, 2023; WCWCD, 2025; PLPCO, 2026).

5.5.2.2.4 Housing

Housing within the inundation zone of the dam would be at an increased risk for inundation if a dam failure were to occur. A high-level review of parcel data that would be affected by a dam breach on a rainy day and sunny day are shown in Table 5.9. Up to 275 residential parcels could be impacted by a dam breach.

Table 5.9. Parcels Touching the Modeled Inundation Zones

Parcel Type	Rainy Day Count	Sunny Day Count
Vacant	393	261
Residential	275	249
Unknown	98	55
Commercial	65	60
Agricultural	32	17
Mixed Use	30	30
Other (tax exempt)	12	12
Personal	8	8
Total	913	692

5.5.2.2.5 Economy

The reservoir and its accompanying recreational facilities would attract more visitors to the area, leading to increased local spending and long-term revenue growth for businesses. Agricultural water users in Kane County would also be able to support more crops (approximately 430 additional acres) with the increased water supply, which would further increase the local economy. Additionally, releases from the reservoir would supplement energy provided by the existing Orderville hydroelectric plant during the summer months when it is normally inactive. It is anticipated that the Orderville plant would produce approximately 440,000 kilowatt hours per year resulting in an average gross revenue of $19,000.

5.5.2.3 Alternative 3—3,000-Acre-Foot Reservoir Alternative

5.5.2.3.1 Population

Alternative 3 would have no direct impacts on population. Recreation-based users visiting the area would likely increase due to implementation of the project, however they would not stay long-term. Indirectly, the proposed reservoir would provide an alternative recreation site for the

increased population, as the existing recreation sites are exceeding capacity (Section 2.2.1). The recreation area would support approximately 12 RVs a night.

The Utah Government Office of Planning and Budget estimates that the population of the Orderville and Mt. Carmel service area will increase by 26 percent by 2050. In 2023, the area reported 303 acre-feet of M&I water use to the Division of Water Rights. The two water providers in the area, Orderville and Glendale, have rights to 2,241 acre-feet per year from wells and springs. The Division of Water Rights data also indicates that none of the municipal supplies in that area depend on the EFVR, suggesting that the proposed reservoir would not benefit local municipal water providers in Long Valley (PLPCO, 2026).

5.5.2.3.2 Demographics

Alternative 3 would have no impact on demographics. Whether negative or positive, impacts from the project would impact all demographics in the study area equally.

5.5.2.3.3 Employment and Income

Construction under Alternative 3 would create job opportunities for approximately 40 people. Development of the reservoir and recreation area would also provide long-term employment opportunities for the local communities. O&M activities would require regular inspection to maintain the equipment and keep the site free of debris and excessive vegetation. Approximately nine people would be needed for O&M activities. The increase in available water would support local farmers and other agricultural water users who rely on farming as their main source of income. A yield of approximately 1,453 acre-feet could be met during each of the 54 years of record under Alternative 3. The agricultural fields in the study area are primarily alfalfa, which require 5 acre-feet of water per acre per growing season for full crop yield. However, there is insufficient water available to support the full crop yield on properties already under cultivation. Alternative 2 would provide additional water to support approximately 290 additional acres per growing season.

5.5.2.3.4 Housing

Housing within the inundation zone of the dam would be at an increased risk for inundation if a dam failure were to occur. Up to 275 residential parcels could be impacted by a dam breach.

5.5.2.3.5 Economy

The reservoir and its accompanying recreational facilities would attract more visitors to the area, leading to increased local spending and long-term revenue growth for businesses. The recreational facilities would provide an additional and needed water-based source of recreation in the area. Agricultural water users in Kane County would also be able to support more crops (approximately 290 more acres) with the increased water supply, which would further increase the local economy. Additionally, releases from the reservoir would supplement energy provided by the existing Orderville hydroelectric plant during the summer months when it is normally inactive. It is anticipated that the Orderville plant would produce approximately 300,000 kilowatt hours per year, resulting in an average gross revenue of approximately $13,000.

5.5.3 Public Health and Safety

5.5.3.1 Alternative 1—No Action Alternative

Residents in Long Valley would continue to have adverse, indirect impacts to their health and safety from the stress of water shortages, loss of income, and threat to electricity production. Additionally, unreliable water systems can drastically decrease the effectiveness of fire protection systems, posing a greater risk to public health and safety in the study area.

5.5.3.2 Alternative 2—6,000-Acre-Foot Reservoir Alternative

Under Alternative 2, short-term risks to public health and safety would occur during construction due to the increase in construction related traffic. However, BMPs to reduce impacts would be used and the increased risk would be minor.

Long-term risks to the residences within the proposed dam inundation zone would also occur. Private residences and other infrastructures, including crop fields and roads, are situated downstream of the proposed reservoir dam site and lie within the breach inundation zone (see Appendix E-1). Additionally, US-89 passes through the project area between the proposed dam site and the EFVR. The dam would be classified as a high-hazard structure to safeguard downstream infrastructure. Further detailed analyses would be conducted beyond the preliminary design phase, which would include strategies for improving downstream flood attenuation for 100- and 500-year flood events. Additional maps and information are provided in the Preliminary Design Report (Appendix E-1). However, like all dams, the risk of failure exists and would be mitigated by an Emergency Action Plan (EAP), as required by the Utah Dam Safety office. The inundation zone encompasses up to 275 residential parcels on a rainy day. If a dam breach were to occur, up to 3,893 acres would be inundated. Most of this area would be habitat surrounding the EFVR, identified as vacant parcels. A feasibility study for the proposed reservoir dam site concluded that the site is appropriate for a dam and reservoir (RB&G, 2004). Refer to Appendix E-1 for more information.

Long-term benefits to human health and safety would also occur for the agricultural water users in Long Valley and those serviced by the Hurricane Canal Company, and the M&I water users in Washington County. Improving the reliability of agricultural water supplies would help reduce economic hardship and associated public health concerns related to mental and emotional well-being for those who rely on water usage for agricultural income. Additionally, increasing water storage capacity would improve operational flexibility and support more consistent hydropower generation, thereby contributing to the overall resilience and reliability of local infrastructure that supports public safety.

The new recreation area may also provide direct, positive benefits to mental health by enhancing quality of life and offering visitors opportunities to enjoy scenic views, engage in recreational activities, and experience nature.

5.5.3.3 Alternative 3—3,000-Acre-Foot Reservoir Alternative

Under Alternative 3, short-term risks to public health and safety would occur during construction due to the increase in construction related traffic. However, BMPs to reduce impacts would be used and the increased risk would be minor.

Long-term risks to the residences within the proposed dam inundation zone (approximately 15) would also occur. Additionally, US-89 passes through the project area between the proposed dam site and the EFVR. The dam would be classified as a high-hazard structure to safeguard downstream infrastructure. Additional maps and information are provided in the Preliminary Design Report (Appendix E-1). However, like all dams, the risk of failure exists and would be mitigated by an EAP, as required by the Utah Dam Safety office. A feasibility study for the proposed reservoir dam site concluded that the site is appropriate for a dam and reservoir (RB&G, 2004)

Long-term benefits to human health and safety would also occur for the agricultural water users in Long Valley and those serviced by the Hurricane Canal Company, and the M&I water users in Washington County. Improving the reliability of agricultural water supplies would help reduce economic hardship and associated public health concerns related to mental and emotional well-being for those who rely on water usage for agricultural income. Additionally, increasing water storage capacity would improve operational flexibility and support more consistent hydropower generation, thereby contributing to the overall resilience and reliability of local infrastructure that supports public safety.

The additional recreation area may also provide direct, positive benefits to mental health by enhancing quality of life and offering visitors opportunities to enjoy scenic views, engage in recreational activities, and experience nature.

5.5.4 Scenic Beauty

5.5.4.1 Alternative 1—No Action Alternative

There would be no change to visual resources and scenic beauty under implementation of Alternative 1.

5.5.4.2 Alternative 2—6,000-Acre-Foot Reservoir Alternative

Alternative 2 would have a direct, long-term impact on scenic values. The construction of the reservoir and its associated facilities would significantly alter the visual character of the proposed project area. Currently, the landscape is arid, dominated by pinyon-juniper woodlands, sagebrush, rabbitbrush, desert forbs, and grasses. Ephemeral washes and unimproved dirt roads run through the area. The development of the reservoir would introduce a long-term transformation, converting 235 acres of dry, arid land into a water-dominated landscape. Additionally, riparian vegetation surrounding the reservoir would create a contrasting visual environment compared to the surrounding arid upland vegetation. The proposed dam, approximately 1,900 feet in length and 90 feet in height (Appendix E-1), would become a prominent new feature in the landscape. The adjacent recreation area, including a non-motorized boat ramp, campsites, and related facilities, would also result in a notable but localized change to the current landscape (4.1 acres). Other project facilities, such as pipelines, would be placed along existing roads/ROWs and would not significantly impact the visual character of the surrounding area. Even though no BLM-administered public lands are located within the project area, the BLM VRM rating system was used to determine the visual quality of the project area. A VRM study conducted for this proposed project determined the project area was a VRM Class IV which allowed for major modifications to the existing landscape character (BLM, 2026). Implementation of the Proposed Action would introduce a reservoir, dam, recreation facilities, and roads resulting in moderate, localized, and long-term visual change. Although the project would be visible in localized areas, these changes would

be consistent with the BLM VRM Class IV management intent and as they would be limited by topography and distance. Therefore, project implementation would comply with any VRM guidelines that may apply to the area. During the 15-month construction period, short-term visual impacts would occur due to the presence of construction equipment and materials. However, once construction is completed, areas not occupied by permanent structures or roads would be restored, and the temporary visual impacts would not result in a lasting or significant change to the overall landscape. Refer to the VRM in Appendix E-1 for more detail.

5.5.4.3 Alternative 3—3,000-Acre-Foot Reservoir Alternative

Alternative 3 would have a direct, long-term impact on scenic values. The reservoir and associated facilities would convert approximately 141 acres of dry, arid, land into a water dominated landscape. Additionally, riparian vegetation surrounding the reservoir would create a contrasting visual environment compared to the surrounding arid upland vegetation. The proposed dam, approximately 2,900 feet in length and 70 feet in height, would become a prominent new feature in the landscape. The adjacent recreation area, including a non-motorized boat ramp, campsites, and related facilities, would also result in a localized change to the current landscape (4.1 acres). Other project facilities, such as pipelines, would be placed along existing roads/ROWs and would not significantly impact the visual character of the surrounding area.

During the 15-month construction period, short-term visual impacts would occur due to the presence of construction equipment and materials. However, once construction is completed, the temporary visual impacts would not result in a lasting or significant change to the overall landscape.

5.5.5 Significant Scientific Resources

5.5.5.1 Alternative 1—No Action Alternative

Under Alternative 1, no impacts to paleontological or other significant scientific resources would occur.

5.5.5.2 Alternative 2—6,000-Acre-Foot Reservoir Alternative

Eocene paleontologists conducted a desktop review and subsequent paleontological field surveys for the EFVR Watershed Project. The desktop review identified PFYC 1–5 and Unknown potential geologic units within the project area. In coordination with the UGS and NRCS, it was determined that PFYC 4 to 5 (high to very high potential) units would be surveyed. The survey area included the Tropic Shale Formation (PFYC 4) and Naturita Formation (PFYC 5). A locality search was conducted with the UGS and there were no previously known paleontological localities within the project area, but there were known localities within 2 miles. Surveys were completed in the Tropic Shale Formation on November 21 and 22, 2024 and the Naturita Formation on February 10, 2025. While mapped within the Tait Pit area, there did not seem to be bedrock of the Naturita Formation present in the project area during the field survey. The paleontological survey documented 12 new localities in the survey area consisting of clams, oysters, gastropods, ammonites, petrified wood, and invertebrate burrows. These are all common invertebrates and plant fossils that are not considered scientifically significant. From what was observed during the field survey, no impacts to scientifically significant paleontological resources would occur from this project, but there is always the potential for underground paleontological resources to be unearthed during ground disturbing activities. If construction for the Mt. Carmel irrigation improvements stay within

previously disturbed areas, paleontological monitoring is not needed. If new disturbance is required outside of these boundaries, a paleontological monitor would be present. A preconstruction paleontological training course would occur prior to any construction activities within these areas.

5.5.5.3 Alternative 3—3,000-Acre-Foot Reservoir Alternative

Alternative 3 would implement the same proposed components, apart from the smaller reservoir size as Alternative 2, and therefore, would not result in any impacts to scientifically significant paleontological resources, as described in Section 5.5.5.2. Similarly to Alternative 2, the potential to unearth underground paleontological resources during ground disturbing activities exist, and therefore a paleontological monitor would present during ground disturbing activities in the Tropic Shale Formation and Naturita Formation. A preconstruction paleontological training course would occur prior to any construction activities within these areas.

5.5.6 Land Use

5.5.6.1 Alternative 1—No Action Alternative

There would be no change to land use under Alternative 1.

5.5.6.2 Alternative 2—6,000-Acre-Foot Reservoir Alternative

There would be no effect on land use designations under the implementation of Alternative 2, as the project would not affect how land use types are classified in Kane or Washington Counties. KCWCD is in the process of purchasing additional land, and property ownership for the properties downstream of the dam may occur, but there would be no change in downstream land use types. There would be minor, long-term changes to land use in the project footprint due to the development of the reservoir, dam embankment, recreation area, and access roads. Approximately 253.4 acres of undeveloped land would become developed.

5.5.6.3 Alternative 3—3,000-Acre-Foot Reservoir Alternative

There would be no effect on land use designations under implementation of Alternative 3, as the project would not affect how land use types are classified in Kane or Washington Counties. KCWCD is in the process of purchasing additional land, and property ownership for the properties downstream of the dam may occur; however, there would be no changes to downstream land use types. Alternative 3 would result in minor, long-term changes to land use in the project footprint due to the development of the reservoir, dam embankment, recreation area, and access roads. Approximately 159.6 acres of undeveloped land would become developed.

5.5.7 Ecosystem Services

5.5.7.1 Alternative 1—No Action Alternative

Cultural Services, non-material benefits—These include mental health, spiritual enrichment, aesthetic experiences, recreation, sense of place, heritage, and development. Alternative 1 would have negative impacts on mental health and recreation due to missed opportunities, such as the lack of an additional recreation opportunity, as they relate to ecosystem services as described in detail in Sections 5.5.2 and 5.5.3.

5.5.7.2 Alternative 2—6,000-Acre-Foot Alternative

Cultural Services, non-material benefits—Alternative 2 would benefit non-material ecosystem services such as mental health, aesthetic experiences, and recreation. The increase in available water would support the mental health of agricultural farmers in the Long Valley area who rely on agriculture for income. The reservoir and recreation area would provide a scenic landscape and recreation opportunities (fishing, boating, swimming) for visitors and residents to enjoy.

5.5.7.3 Alternative 3—3,000-Acre-Foot Alternative

Cultural Services, non-material benefits—Alternative 3 would benefit non-material ecosystem services such as mental health, aesthetic experiences, and recreation. The increase in available water would support the mental health of agricultural farmers in the Long Valley area who rely on agriculture for income. The reservoir and recreation area would provide a scenic landscape and recreation opportunities (fishing, boating, swimming) for visitors and residents to enjoy.

5.6 Cumulative Effects

A list of known past, present, or reasonably foreseeable future actions in the vicinity of the project area is provided below.

Cumulative effects result from "the incremental impact of an action when added to other past, present, or reasonably foreseeable actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (7 CFR 650). This chapter of the Plan-EIS evaluates potential impacts to the environment that may result from implementation of the proposed project when added to other past, present, and reasonably foreseeable future actions. The following projects in the area are currently occurring or have recently been completed and may result in cumulative effects when combined with the proposed project.

5.6.1 Past and Present Actions

5.6.1.1 Lake Powell Pipeline

The proposed Lake Powell Pipeline would transport water through an approximately 140-mile-long, buried pipeline from Lake Powell to Washington and Kane counties, Utah. At full capacity, the project would deliver 82,249 acre-feet of water per year to Washington County. While not directly connected to the proposed Cove Reservoir project, the pipeline construction could result in an increased demand for materials, fuel, and labor. However, due to delays in projected development it is unlikely that the Lake Powell Pipeline would be constructed at the same time as the proposed Cove Reservoir; therefore, competition for materials, fuel, and labor would not occur.

5.6.1.2 US-89 Rehabilitation Project from Mt. Carmel Junction to Glendale, Utah

This project involved maintenance of bridge structures and a new layer of asphalt and road shoulder improvement on approximately 8.6 miles of US-89 roads. New curbs and gutters were installed in Orderville, and new sidewalks and pedestrian ramps were installed in Glendale. These activities resulted in improved highway conditions and safety for residents. The improved highway would increase traffic efficiency during project development. The features installed in Orderville and Glendale would increase safety conditions. The need for materials for the proposed reservoir would be additive to those used for this project.

5.6.1.3 Jackson Flat Reservoir near Kanab, Utah

The Jackson Flat Reservoir was completed in 2012. Its purpose was, like that of the proposed Cove Reservoir, to provide additional irrigation and agriculture water for agricultural users in the Kanab area and local recreation opportunities. The existing Jackson Flat Reservoir is a 4,228-acre-foot reservoir located near Kanab in Kane County, Utah.

5.6.1.4 Local Population Growth

Continued future growth has been projected for southern Utah, especially for portions of Washington County in the study area. Population growth in Kane County is also expected to continue to grow at a slower rate. No direct cumulative impact from construction and use of the proposed reservoir is anticipated. Recreation-based visitors would likely increase due to implementation of the proposed project; however, they would not stay long-term. Indirectly, the proposed reservoir would provide an alternative recreation site for the projected increased population, as existing sites are becoming overcrowded as described in Section 2.2.1.

5.6.1.5 Other Tourism-Related Projects

Construction of the proposed Cove Reservoir would result in an additional recreation site for western Kane County. Kane County's economy largely depends on the tourism brought in by the national and state parks in the area, many of which are often at or exceed visitor capacity. For example, the nearby Coral Pink Sand Dunes State Park recorded over 279,979 visitors in Fiscal Year (FY) 2024, representing a 303 percent increase from the 69,553 visitors in 2014 (State of Utah, 2024). Development of sites such as the existing Jackson Flat Reservoir and the proposed Cove Reservoir would provide additional areas for visitors to visit and enjoy. These tourists would also likely purchase local goods and services, thus benefiting the local economy even further.

5.6.1.6 Borrow Pit Use

Three borrow pits could be used to provide gravel and riprap for the proposed project. All sites are existing private pits. These pits would continue to be used for the long term on other local projects not associated with the proposed reservoir. Impacts associated with the use of these pits on other projects (including dust, loss of native vegetation, increased traffic, etc.) would be cumulative to those that would result from the extraction of gravel and riprap for the proposed project. The Esplin and Tait pits contain cultural resources that are eligible on the NRHP. These areas of the borrow pits would not be used for this project; however, the continued use of these pits for borrow material for future projects would risk destroying these cultural sites. Embankment material would be taken from within the reservoir basin.

5.6.2 Cumulative Effects Summary

5.6.2.1 Alternative 1—No Action Alternative

Implementation of Alternative 1 would not result in any cumulative effects to natural or human resources above those currently occurring within the project area, as previously described. Several actions would continue to occur under Alternative 1. Local water users would continue to experience shortages during summer months. As a result, agriculture production would continue to decrease. An additional recreation area would not be constructed, and potential users would

need to continue to look to other areas for water-based recreation and camping opportunities. This may result in a cumulative recreation demand in nearby areas, such as the existing Jackson Flat Reservoir. The potential for the proposed reservoir to capture flash floodwater and sediment also would not be realized. As a result, intermittent increases in flows and sediment load in the EFVR would continue.

5.6.2.2 Alternative 2—6,000-Acre-Foot Reservoir Alternative

Eight resources would most likely experience cumulative effects from the totality of the reasonably foreseeable actions discussed here. Impacts resulting from the proposed Cove Reservoir project would be cumulative to these projects.

5.6.2.2.1 Soils

The implementation of Alternative 2 would result in an increase in soil disturbance. As a result, the potential for an undetermined, but likely minor, amount of soil loss would occur. The proposed Cove Reservoir project would contribute an additional approximately 259.1 acres of surface disturbance to the cumulative total of disturbance currently occurring or projected to occur in western Kane County.

5.6.2.2.2 Water Resources

The existing Jackson Flat Reservoir provides irrigation water for agricultural use near Kanab while the proposed Cove Reservoir would provide additional water for local irrigation and agriculture water use in the Orderville, Mt. Carmel and in Hurricane area. Shortages in water availability during summer months is a common occurrence in Kane County and the two reservoirs, while not connected, would provide a needed and reliable source of water for local agricultural water users.

5.6.2.2.3 Air Quality

Emissions resulting from construction of the proposed project would be cumulative to other activities currently affecting air quality in southern Utah. Substantial future growth has been projected for this area, especially in Washington County, which is located immediately west of Kane County. Emissions from outside sources could continue to increase and affect the air quality of Kane County. Work during the 15-month construction period would be cumulative to these existing sources.

5.6.2.2.4 Migratory Birds

Migratory birds would be affected by the loss of habitat through clearing of vegetation and noise due to construction activities associated with the proposed project activities previously described. If these actions occur during the nesting season, some nest abandonment is expected. This disturbance would be cumulative to activities currently occurring or those that may occur in the foreseeable future. New migratory bird habitat would result from the development of riparian areas surrounding the new reservoirs.

5.6.2.2.5 Invasive Species

Invasive and noxious weeds are an ongoing resource management concern in Kane County. The disturbance of approximately 259.1 acres resulting from implementation of the Cove Reservoir

project would contribute to number of disturbed acres being potentially susceptible to invasive and noxious weed establishment. Once established, these species become difficult to eradicate.

5.6.2.2.6 Cultural Resources

Cultural resources are widespread in this portion of Kane County. The use of the existing Jackson Flat Reservoir and the proposed reservoir would bring additional recreational sites to the county and potentially expose cultural resources to vandalism and looting. Over time, this could result in a loss of cultural knowledge and context. Any potential losses that would result from the proposed Cove Reservoir project would be cumulative to those resulting from other recreation-related projects in the area.

5.6.2.2.7 Social Issues

Project developments in western Kane County would result in additional workers and visitors frequenting the area. The economies of local towns, such as Glendale, Orderville, Mt. Carmel, Mount Carmel Junction, and Kanab, would benefit from increased purchasing of services and goods. The existing Jackson Flat Reservoir near Kanab, Utah is currently experiencing approximately 1,200 visitors per month. Visitation at the proposed Cove Reservoir could approach that number. Some of these visitors would purchase goods and services in the local communities. These purchases would be cumulative to those from other recreation sites in the region.

The cumulative demand for materials, such as gravel and riprap, could contribute to increased prices for these materials, resulting in projects becoming more expensive to complete. The need to open new areas to access these materials would increase. Opening new areas would result in increased traffic on local highways and roads, resulting in occasional traffic congestion and increased repair needs.

Use of the existing Jackson Flat Reservoir and proposed Cove Reservoir would provide much needed, additional recreation opportunities for western Kane County. Current recreation sites in the county consistently reach or exceed capacity, especially during the summer months. These sites would provide important water-based recreation opportunities.

5.6.2.2.8 Scenic Beauty

The presence of the proposed Cove Reservoir and associated facilities would contribute to a visual alteration of the landscape, changing it from an upland, semi-desert to a water-based landscape. This landscape change would be cumulative to the existing water-based landscape at the Jackson Flat Reservoir located near Kanab, Utah.

As vegetation and borrow materials are removed, the use of the three borrow pits would result in visual resource changes up to 5.7 acres, altering the local landscape.

5.6.2.3 Alternative 3—3,000-Acre-Foot Reservoir Alternative

Alternative 3 would have similar cumulative impacts to Alternative 2, at a smaller scale. Many of the construction related impacts would be lessened under Alternative 3 due to the smaller scale of the project; however, the benefits to increased water would also be lessened with a smaller yearly production (approximately 48 percent less water). The smaller reservoir would also provide less

opportunity for recreation, with half the number of RV sites and a smaller surface area (122 acres versus 187 acres) available for water-based activities.

5.7 Summary and Comparison of Alternative Plans

The alternatives proposed for consideration and analyzed in detail in this Plan-EIS have been compared against each other to discern the merits and disadvantages of each alternative. This includes a side-by-side comparison of environmental, social, and economic effects.

Alternatives were compared to select one alternative that best maximized public benefits (environmental, economic, and social goals) with appropriate consideration of costs, guiding principles, the federal objective, PL 83-566 general purposes, and ecosystem services. This alternative is known as the NRCS NEE Alternative. Based on the performed alternative analysis, the NEE Alternative for the project was determined to be the 6,000-Acre-Foot Reservoir Alternative. A PR&G Analysis was completed in support of decision-making for the NEE Alternative and is included in Appendix E-1.

5.7.1 Evaluation of Alternatives through the Planning Process

Table 5.10 compares the alternatives on how well they resolve the problems identified, performance against the project objectives, their constraints, and evaluation criteria of completeness, acceptability, efficiency, and effectiveness.

Table 5.10. Summary and Comparison of Alternatives.

Item or Concern	Alternative 1—No Action Alternative	Alternative 2—6,000-Acre-Foot Reservoir Alternative	Alternative 3—3,000-Acre-Foot Reservoir Alternative
Public Recreation Reservoir	-	Alternative 2 would provide 187 acres of surface area for water recreation on the reservoir.	Alternative 3 would provide 122 acres of surface area for water recreation on the reservoir.
Public Recreation Recreation Site	-	Alternative 2 would provide a non-motorized boat ramp, 2 pit toilets, a pavilion, and 20 RV sites (including a barbecue grill, table, and fire pit). No utilities would be extended to these facilities	Alternative 3 would provide a non-motorized boat ramp, a pit toilet, a pavilion, and 12 RV sites (including a barbecue grill, table, and fire pit). No utilities would be extended to these facilities
AWM Reservoir	-	The proposed reservoir would provide an additional 2,148 acre-feet of water a year	The proposed reservoir would provide an additional 1,453 acre-feet of water a year

Item or Concern	Alternative 1—No Action Alternative	Alternative 2—6,000-Acre-Foot Reservoir Alternative	Alternative 3—3,000-Acre-Foot Reservoir Alternative
M&I Water Supply Reservoir	-	The proposed reservoir would provide an additional 2,148 acre-feet of water a year	The proposed reservoir would provide an additional 1,453 acre-feet of water a year
Project Objectives Provide reliable source and long-term availability of agricultural water	Alternative 1 would not meet this project objective	Alternative 2 would provide 2,148 acre-feet of water for the 54 years evaluated	Alternative 3 would provide 1,453 acre-feet of water for the 54 years evaluated
Project Objectives Provide M&I water for Washington County	Alternative 1 would not meet this project objective	Alternative 2 would provide 2,148 acre-feet of water for the 54 years evaluated	Alternative 3 would provide 1,453 acre-feet of water for the 54 years evaluated
Project Objectives Provide a recreation opportunity for Kane County	Alternative 1 would not meet this project objective	Alternative 2 would provide a non-motorized boat ramp, pavilion, and 20 RV sites	Alternative 3 would provide a non-motorized boat ramp, pavilion, and 12 RV sites
Project Objectives Present economic prospects for the communities of Orderville, Glendale, and Mt. Carmel	Alternative 1 would not meet this project objective	Alternative 2 would support approximately 430 additional acres of farmland to support economic prospects	Alternative 3 would support approximately 290 additional acres of farmland to support economic prospects
Project Objectives Provide for maximum utilization of renewable energy for local communities	Alternative 1 would not meet this project objective	Releases of excess water and water delivered to WCWCD would supplement the energy provided by the existing Orderville hydroelectric plant	Releases of excess water and water delivered to WCWCD would supplement the energy provided by the existing Orderville hydroelectric plant

Item or Concern	Alternative 1—No Action Alternative	Alternative 2—6,000-Acre-Foot Reservoir Alternative	Alternative 3—3,000-Acre-Foot Reservoir Alternative
Project Objectives Comply with the ZNP Water Right Settlement of 1996	Alternative 1 would not meet this project objective	Alternative 2 would meet this project objective	Alternative 3 would meet this project objective
Constraints Siting limitations	N/A	The Cove Reservoir area is suitable for development	The Cove Reservoir area is suitable for development
Constraints Public safety	N/A	Alternative 2 would put up to 275 residential parcels in the breach inundation zone of the dam	Alternative 3 would put up to 275 residential parcels in the breach inundation zone of the dam
Constraints Environmental resources	N/A	The Cove Reservoir site would not require the direct loss of existing agricultural land or residences	The Cove Reservoir site would not require the direct loss of existing agricultural land or residences
Constraints Geotech restrictions	N/A	The Cove Reservoir site does not have geological structural limitations	The Cove Reservoir site does not have geological structural limitations
Constraints Engineering Challenges	N/A	Alternative 2 would not require extensive engineering	Alternative 3 would not require extensive engineering
Constraints Economic constraints	N/A	Construction of Alternative 2 would be approximately $39,730,000	Construction of Alternative 3 would be approximately $32,345,000
Evaluation Criteria Completeness	Evaluation criteria met	Evaluation criteria met	Evaluation criteria met
Evaluation Criteria Efficiency	Evaluation criteria met	Evaluation criteria met	Evaluation criteria met
Evaluation Criteria Effectiveness	Evaluation criteria met	Evaluation criteria met	Evaluation criteria met
Evaluation Criteria Acceptability	Evaluation criteria met	Evaluation criteria met	Evaluation criteria met

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5.7.2 Summary of Effects on Resource Concerns

A summary of effects for the resource concerns for the final array of alternatives is provided in Table 5.11. Those effects that are same across alternatives are grouped together; those that have different effects are separated. Impacts that were determined to be negligible, not measurable, or would not occur are not included in Table 5.11. Please refer to the detailed analysis in Chapters 5.1 through 5.6 for more detailed information on effects to resources.

Table 5.11. Summary and Comparison of Alternatives–Effects on Resource Concerns.

Resource Concern/Item	Alternative 1—No Action Alternative	Alternative 2—6,000-Acre-Foot Reservoir Alternative	Alternative 3—3,000-Acre-Foot Reservoir Alternative
Soil Resources	Upland erosion conditions would not change from existing conditions, and erosion would continue at the same rate it has historically occurred. Indirect long-term adverse impacts would occur from sediment deposition in the EFVR after flash flooding events.	Direct short-term impacts to erosion potential on disturbed areas during construction would occur. Impacts would be minimized through implementation of BMPs that would be installed during and after construction. The short-term impacts would be minor based on implementation of BMPs and restoration/stabilization of disturbed areas following project construction. Indirect long-term benefits are anticipated that would reduce sediment deposition in developed areas and the EFVR that are no longer exposed to flooding.	Direct short-term impacts to erosion potential on disturbed areas during construction would occur. Impacts would be minimized through implementation of BMPs that would be installed during and after construction. The short-term impacts would be minor based on implementation of BMPs and restoration/stabilization of disturbed areas following project construction. Indirect long-term benefits are anticipated that would reduce sediment deposition in developed areas and the EFVR that are no longer exposed to flooding.
Water Resources	No direct or indirect effects to water resources would occur from implementation of Alternative 1. Surface flows in the EFVR would continue to vary considerably as a response to spring runoff or intense storm events.	Alternative 2 would have direct, positive benefits on water resources by making 2,148 acre-feet of existing water available for water users in Kane and Washington County annually. Minor downstream impacts to the EFVR would occur due to changes in water timing.	Alternative 3 would have direct, positive benefits on water resources by making 1,453 acre-feet of existing water available for water users in Kane and Washington County annually. Minor downstream impacts to the EFVR would occur due to changes in water timing.
Water Quality	There would be no direct or indirect effects to water quality from implementation of Alternative 1. The existing water quality of the EFVR would not change, and the EFVR and its tributaries would continue to be designated as HQW.	Minor, direct, and negative impacts to water quality would occur during construction while crossing the EFVR; however, long-term, beneficial impacts would occur through the capturing of sediment in the reservoir during flash flooding events.	Minor, direct, and negative impacts to water quality would occur during construction while crossing the EFVR; however, long-term, beneficial impacts would occur through the capturing of sediment in the reservoir during flash flooding events.
Floodplain Management	No impacts to floodplains or floodplain management would occur.	The Action Alternatives would have long-term beneficial impacts on downstream flooding, and long-term minor impacts on floodplain management. The proposed reservoir would capture runoff produced by flash floods, thereby decreasing the amount of water and sediment entering the river and reducing potential loss of riparian vegetation. However, the proposed dam would also create a new inundation area, causing potential changes to FEMA floodplains.	The Action Alternatives would have long-term beneficial impacts on downstream flooding, and long-term minor impacts on floodplain management. The proposed reservoir would capture runoff produced by flash floods, thereby decreasing the amount of water and sediment entering the river and reducing potential loss of riparian vegetation. However, the proposed dam would also create a new inundation area, causing potential changes to FEMA floodplains.
WOTUS., Wetlands, and Special Aquatic Sites	There would be no impacts to WOTUS, wetlands, or other resource in the project area under Alternative 1.	Alternative 2 would impact approximately 0.21 acre of aquatic features and 0.17 acres of wetlands.	Alternative 3 would have the same or very similar impacts to aquatic features as Alternative 2.

Resource Concern/Item	Alternative 1—No Action Alternative	Alternative 2—6,000-Acre-Foot Reservoir Alternative	Alternative 3—3,000-Acre-Foot Reservoir Alternative
Regional Water Resource Plans	No changes to Kane County's or Washington County's Water Resource Plans would occur under Alternative 1. Both counties would continue to seek water conservation goals and practices to enhance the efficiency and reliability of the current AWM.	The Action Alternatives would comply with Regional Water Resource Plans through supporting both Kane County and Washington County's Water Resource Plans.	The Action Alternatives would comply with Regional Water Resource Plans through supporting both Kane County and Washington County's Water Resource Plans.
WSRs	There would be no direct or indirect impacts to WSRs under Alternative 1. No changes to identified WSRs would occur.	The Action Alternatives would have no impacts on the WSR values of the EFVR within ZNP, as it would also adhere to the stipulations required in the ZNP Agreement (1996). Therefore, changes in flow in the EFVR through ZNP would be minor, particularly when the natural variation of the EFVR is approximately 100 times the range of effect from proposed reservoir releases (Alpha Engineering 2025).	The Action Alternatives would have no impact on the WSR values of the EFVR within the ZNP, as it would also adhere to the stipulations required in the ZNP Agreement (1996). Therefore, changes in flow in the EFVR through ZNP would be minor, particularly when the natural variation of EFVR flows is approximately 100 times the range of effect from proposed reservoir releases (Alpha Engineering 2025).
Air Quality	There would be no change to air quality conditions.	Construction activities and the use of the borrow sites would cause minor, short-term, and direct increases in emissions concentrated around the construction site. Construction activities would not violate air quality standards, and BMPs would be implemented.	Construction activities and the use of the borrow sites would cause minor, short-term, and direct increases in emissions concentrated around the construction site. Construction activities would not violate air quality standards, and BMPs would be implemented.
Threatened and Endangered Species	No direct or indirect impacts to federally listed or candidate plant or animal species would occur.	The Action Alternatives would have **No Effect** on the WYBC, desert tortoise, Suckley's cuckoo bumble bee, Jones cycladenia, Shivwits milk-vetch, Siler's pincushion cactus, and Ute ladies'-tresses. The Action Alternatives are **Not Likely to Jeopardize the Continued Existence** of the monarch butterfly or the California condor outside of ZNP. The Action Alternatives **May Affect, but Not Likely to Adversely Affect** the California condor (within ZNP), MSO, SWFL, Virgin River chub, and woundfin. The Action Alternatives **May Affect, but Not Likely to Adversely Affect** designated critical habitat for the MSO, Virgin River chub, and woundfin. The Action Alternatives would have **No Effect** on designated critical habitat for the California condor or SWFL as none has been designated in the study area.	The Action Alternatives would have **No Effect** on the WYBC, desert tortoise, Suckley's cuckoo bumble bee, Jones cycladenia, Shivwits milk-vetch, Siler's pincushion cactus, and Ute ladies'-tresses. The Action Alternatives are **Not Likely to Jeopardize the Continued Existence** of the monarch butterfly or the California condor outside of ZNP. The Action Alternatives **May Affect, but Not Likely to Adversely Affect** the California condor (within ZNP), MSO, SWFL, Virgin River chub, and woundfin. The Action Alternatives **May Affect, but Not Likely to Adversely Affect** designated critical habitat for the MSO, Virgin River chub, and woundfin. The Action Alternatives would have **No Effect** on designated critical habitat for the California condor or SWFL as none has been designated in the study area.
Migratory Birds	Alternative 1 would have no direct or indirect impacts to migratory birds.	Construction disturbance would have minor, direct, and short-term impacts that would disturb suitable breeding/nesting or foraging habitat for migratory birds and foraging habitat for migratory birds. Conservation measures would be implemented to avoid and minimize impacts to these species and disturbed areas would be restored after construction completion. Potential impacts would be minor due to the ample surrounding habitat available. The O&M activities would have minor, beneficial, long-term impacts to migratory birds. The riparian habitat surrounding the reservoir would provide long-term habitat opportunities for migratory birds.	Construction disturbance would have minor, direct, and short-term impacts that would disturb suitable breeding/nesting or foraging habitat for migratory birds and foraging habitat for migratory birds. Conservation measures would be implemented to avoid and minimize impacts to these species and disturbed areas would be restored after construction completion. Potential impacts would be minor due to the ample surrounding habitat available. The O&M activities would have minor, beneficial, long-term impacts to migratory birds. The riparian habitat surrounding the reservoir would provide long-term habitat opportunities for migratory birds.

Resource Concern/Item	Alternative 1—No Action Alternative	Alternative 2—6,000-Acre-Foot Reservoir Alternative	Alternative 3—3,000-Acre-Foot Reservoir Alternative
Bald and Golden Eagles	Alternative 1 would have no direct or indirect impacts to bald and golden eagles.	Construction would cause temporary, minor impacts to bald and golden eagles; however, no significant loss of foraging grounds would be expected due to the availability of nearby suitable habitat. The new riparian area surrounding the reservoir would have long-term, beneficial impacts to bald and golden eagles by providing additional roosting opportunities.	Construction would cause temporary, minor impacts to bald and golden eagles; however, no significant loss of foraging grounds would be expected due to the availability of nearby suitable habitat. The new riparian area surrounding the reservoir would have long-term, beneficial impacts to bald and golden eagles by providing additional roosting opportunities.
Ecologically Critical Areas	No direct or indirect impacts to designated wilderness or WSA's would occur under Alternative 1, as no changes to the existing environment would occur.	Minor, beneficial, indirect impacts to ecologically critical areas would occur under the Action Alternatives.	Minor, beneficial, indirect impacts to ecologically critical areas would occur under the Action Alternatives.
Invasive Species	No impacts to invasive species would occur under Alternative 1, as no changes would take place under this alternative.	The Action Alternatives would have minor, temporary impacts on invasive plant species during and immediately following construction. Development of a new water source would potentially provide habitat for invasive aquatic species such as quagga mussels. However, BMPs would be implemented to prevent the spread of noxious weeds. A PCRP would be developed and include mechanisms for addressing weed establishment and treatment.	The Action Alternatives would have minor, temporary impacts to invasive plant and animal species during and immediately following construction; however, BMPs would be implemented to prevent the spread of noxious weeds. A PCRP would be developed and include mechanisms for addressing weed establishment and treatment.
Fish and Wildlife	No changes to fish and wildlife resources would occur under Alternative 1.	Construction activities would cause temporary, minor impacts to fish and wildlife species, including Species of Greatest Conservation Need, due to an increase in human presence and noise. There is ample surrounding habitat, and therefore, long-term impacts are not anticipated. The creation of the riparian area surrounding the reservoir would have beneficial, long-term impacts by providing new additional habitat for wildlife. State fish Species of Greatest Conservation Need, including the desert sucker, flannelmouth sucker, and Virgin spinedace are known to exist in the EFVR. Changes in water flow from implementation of Alternative 2 would be minor, particularly when the natural variation of EFVR flows are approximately 100 times the range of effect from proposed Cove Reservoir releases (Alpha Engineering 2025), and therefore these species and their habitat would not be impacted.	Construction activities would cause temporary, minor impacts to fish and wildlife species, including Species of Greatest Conservation Need, due to an increase in human presence and noise. There is ample surrounding habitat, and therefore, long-term impacts are not anticipated. The creation of the riparian area surrounding the reservoir would have beneficial, long-term impacts by providing new additional habitat for wildlife. State fish Species of Greatest Conservation Need, including the desert sucker, flannelmouth sucker, and Virgin spinedace are known to exist in the EFVR. Changes in water flow from implementation of Alternative 2 would be minor, particularly when the natural variation of EFVR flows are approximately 100 times the range of effect from proposed Cove Reservoir releases (Alpha Engineering 2025) and therefore these species and their habitat would not be impacted.
Riparian Areas	No direct or indirect effects to existing riparian areas in the study area would occur.	The Action Alternatives would have minor, positive impacts to riparian vegetation through the creation of additional riparian habitat. No impacts to existing riparian habitat would occur.	The Action Alternatives would have minor, positive impacts to riparian vegetation through the creation of additional riparian habitat. No impacts to existing riparian habitat would occur.
Cultural Resources and Tribal Consultation	Alternative 1 would have no impact on historic or cultural resources, as no changes to the existing environment would occur.	The Action Alternatives would result in **Adverse Effect to Historic Properties**. Indirect effects to cultural resources could also arise from the increase in human activity in the area.	The Action Alternatives would result in **Adverse Effect to Historic Properties**. Indirect effects to cultural resources could also arise from the increase in human activity in the area.

Resource Concern/Item	Alternative 1—No Action Alternative	Alternative 2—6,000-Acre-Foot Reservoir Alternative	Alternative 3—3,000-Acre-Foot Reservoir Alternative
Social Issues	Population Alternative 1 would have indirect, negative impacts on population, as farmers relocate due to the decreasing water availability. Demographics Alternative 1 would have no impact on demographics. Employment and Income Long-term, negative impacts to employment and income would occur, as water availability continues to decrease for agricultural farmers. Housing Alternative 1 would have no impact on housing. Economy Alternative 1 would have long-term, negative impacts to the economy, as water availability continues to decrease for agricultural farmers.	Population Alternative 2 would have indirect, positive benefits to the population by providing an additional needed recreation area. Demographics Alternative 2 would have no impact on demographics. Employment and Income Alternative 2 would provide 67 short-term jobs, 9 long-term jobs, and water to support 430 acres of agricultural land. Housing Direct impacts on up to 275 residential parcels would occur due to an increased risk of flooding from a dam breach. Economy Alternative 2 would have a direct, beneficial impacts on the economy by attracting more visitors and supporting an additional 430 acres of existing agricultural land.	Population Alternative 3 would have indirect, positive benefits to the population by providing an additional needed recreation area. Demographics Alternative 3 would have no impact on demographics. Employment and Income Alternative 3 would provide 40 short-term jobs, 9 long-term jobs, and water to support 290 acres of agricultural land. Housing Direct impacts on up to 275 residential parcels would occur due to an increased risk of flooding from a dam breach. Economy Alternative 3 would have direct, beneficial impacts on the economy by attracting more visitors and supporting 290 acres of agricultural land.
Public Health and Safety	Adverse, indirect impacts to public health and safety would occur from the stress of water shortages, loss of income, and threat to electricity production.	Short-term, minor risks to public health and safety would occur during construction due to an increase in traffic. Long-term risks to approximately 10 to 15 people would occur with properties in the new inundation zone of the dam. Long-term benefits to public health and safety include the reduction of stress from reliable water and the increased effectiveness of the fire suppression systems.	Short-term, minor risks to public health and safety would occur during construction due to an increase in traffic. Long-term risks to approximately 10 to 15 people would occur with properties in the new inundation zone of the dam. Long-term benefits to public health and safety include the reduction of stress from reliable water and the increased effectiveness of the fire suppression systems.
Scenic Beauty	There would be no change to visual resources and scenic beauty under Alternative 1.	Short-term visual impacts would occur from the presence of construction equipment. Direct, long-term impacts to scenic values would occur from the conversion of 235 acres of arid land to a reservoir.	Short-term visual impacts would occur from the presence of construction equipment. Direct, long-term impacts to scenic values would occur from the conversion of 141 acres of land to a reservoir.
Significant Scientific Resources	Under Alternative 1, no impacts to paleontological or other significant scientific resources would occur.	No impacts to significant paleontological resources are expected. A paleontological monitor would be present during new surface disturbing activities associated with the Mt. Carmel irrigation improvements. Preconstruction paleontological training with the construction contractor would occur prior to construction.	No impacts to significant paleontological resources are expected. A paleontological monitor would be present during new surface-disturbing activities associated with the Mt. Carmel irrigation improvements. Preconstruction paleontological training with the construction contractor would occur prior to construction.
Land Use	There would be no change to land use for this alternative.	Approximately 253.4 acres of land would be converted from undeveloped to developed resulting in minor, long-term impacts to land use within the project area.	Approximately 159.6 acres of land would be converted from undeveloped to developed resulting in minor, long-term impacts to land use within the project area.

5.7.3 Ecosystem Services Tradeoff

A comparison of ecosystem services covering long-term effects was performed for the final array of alternatives and is provided in Table 5.12. Ecosystem service effects overlap with the resource concerns effects. Refer to Table 3.2 of Chapter 3.1 for information on overlapping resource concerns used in determination of ecosystem service effects. Refer to Chapters 5.1 through 5.5 for detailed effects to resource concerns that include ecosystem services.

Table 5.12. Summary and Comparison of Alternatives - Ecosystem Services Tradeoff.

Resource Concern/Item	Alternative 1—No Action Alternative	Alternative 2—6,000-Acre-Foot Reservoir Alternative	Alternative 3—3,000-Acre-Foot Reservoir Alternative
Locally Preferred Alternative*	-	X	-
Non-structural Alternative*	X	-	-
Environmentally Preferred Alternative*	X	-	-
Maximum Net Monetized Benefits Plan Alternative*	-	X	-
Socially Preferred Alternative*		X	
Preferred Alternative (Maximum Net public benefits identified through tradeoff analysis)*	-	X	-
Healthy and Resilient Ecosystems	Alternative 1 would protect the functions of ecosystems by providing no change to current conditions	Alternatives 2 and 3 would protect and restore the functions of ecosystems by allowing water timing delivery to more naturally match the ecological needs of the seasons by storing water in the winter and releasing water in the summer	Alternatives 2 and 3 would protect and restore the functions of ecosystems by allowing water timing delivery to more naturally match the ecological needs of the seasons by storing water in the winter and releasing water in the summer
Sustainable Economic Development	Alternative 1 would not improve the economic well-being of the nation for current and future generations because agricultural users would continue to lose income due to the current water shortage and the monetized benefits from the recreation area would not be realized.	Alternative 2 would provide the highest economic well-being of the nation for current and future generations by providing job security for local agricultural users and by providing monetized benefits from the recreation area.	Alternative 3 would not improve the economic well-being of the nation for current and future generations because the smaller reservoir size would provide less water than is needed for the agricultural users and would provide less monetized benefits than costs ass discussed in Appendix D
Floodplains	Alternative 1 would not adversely affect self-sustaining floodplain function	Alternative 2 would not adversely affect self-sustaining floodplain function	Alternative 3 would not adversely affect self-sustaining floodplain function
Public Safety	Alternative 1 would not reduce the risks to public safety as the current local agricultural water users would continue to have stress and mental health problems from the uncertainty of the water availability and its impacts on income and food security	Alternative 2 would reduce the risks to public safety by providing water storage for agriculture, reducing stress related to income uncertainty.	Alternative 3 would reduce the risks to public safety by providing water storage for agriculture, reducing stress related to income uncertainty.

Resource Concern/Item	Alternative 1—No Action Alternative	Alternative 2—6,000-Acre-Foot Reservoir Alternative	Alternative 3—3,000-Acre-Foot Reservoir Alternative
Watershed Approach	Alternative 1 would have no impact on upstream or downstream impacts	Alternative 2 recognizes the potential upstream and downstream impacts as discussed throughout the Plan-EIS	Alternative 3 recognizes the potential upstream and downstream impacts as discussed throughout the Plan-EIS
Provisioning Services Agricultural land	Agricultural land users in the project area would continue to experience water shortages during the summer months at an increasing rate.	Approximately 430 acres of land would benefit from the increased water availability provided by the reservoir.	Approximately 290 acres of land would benefit from the increased water availability provided by the reservoir.
Provisioning Services Agricultural water	Water from the EFVR would continue to provide insufficient quantities of water in the summer for agricultural lands in Kane and Washington Counties and M&I purposes in Washington County.	Alternative 2 would increase the available amount of irrigation and M&I water by approximately 2,148 afy.	Alternative 3 would increase the available amount of irrigation and M&I water by approximately 1,453afy.
Provisioning Services Fishing	Alternative 1 would have no impact on aquatic habitat or species within the EFVR and, therefore, have no impact on fishing opportunities within the EFVR.	Alternative 2 would have no impact on aquatic habitat or species within the EFVR. The reservoir would provide a new fishing opportunity.	Alternative 3 would have no impact on aquatic habitat or species within the EFVR and, therefore, no impact on fishing opportunities within the EFVR. The reservoir would provide a new fishing opportunity.
Regulating Services Water quality and quantity	No changes to temperature, turbidity, sediment, or pollutants within the EFVR would occur. Instream flow would continue to regulate water temperature, decrease bank erosion/sedimentation, and dilute potential pollutants. No additional water would be available for agricultural use in Kane and Washington Counties or recreation use in Kane County.	Alternative 2 would improve water quality in the EFVR by containing sediment within the reservoir during flash flooding events. Additional water would be made available for agricultural use in Kane and Washington Counties and recreation use in Kane county.	Alternative 3 would improve water quality in the EFVR by containing sediment within the reservoir during flash flooding events. Additional water would be made available for agricultural use in Kane and Washington Counties and recreation use in Kane county.
Regulating Services Climate Regulation	All air quality standards would be maintained at current levels. Air quality standards directly impact climate regulation, as many sources of air pollutants are also greenhouse gases.	All air quality standards would be maintained at current levels. Air quality standards directly impact climate regulation, as many sources of air pollutants are also greenhouse gases.	All air quality standards would be maintained at current levels. Air quality standards directly impact climate regulation, as many sources of air pollutants are also greenhouse gases.
Regulating Services Riparian zones	No impacts to riparian zones would occur under Alternative 1.	The creation of riparian vegetation under Alternative 2 would benefit the ecosystem services that riparian habitat provides like water filtration, nutrient cycling, and wildlife habitat.	The creation of riparian vegetation under Alternative 3 would benefit the ecosystem services that riparian habitat provides like water filtration, nutrient cycling, and wildlife habitat.
Supporting Services Wildlife habitat	The EFVR would continue to provide habitat for plants and wildlife.	Alternative 2 would continue to provide habitat for plants and wildlife within the EFVR, while providing additional habitat within the Cove Reservoir.	Alternative 3 would continue to provide habitat for plants and wildlife within the EFVR, while providing additional habitat within the Cove Reservoir.

Resource Concern/Item	Alternative 1—No Action Alternative	Alternative 2—6,000-Acre-Foot Reservoir Alternative	Alternative 3—3,000-Acre-Foot Reservoir Alternative
Supporting Services Nutrient cycling	Nutrient cycling would continue to occur as living organisms breathe in the abiotic components in the air.	Nutrient cycling would continue to occur as living organisms breathe in the abiotic components in the air.	Nutrient cycling would continue to occur as living organisms breathe in the abiotic components in the air.
Cultural Services Recreation	Water from the EFVR would continue to provide recreational opportunities to the public, including fishing, swimming, and intrinsic value from the natural scenic beauty.	Alternative 2 would have no impact on the recreational value of the EFVR while providing new recreational opportunities at the Cove Reservoir site.	Alternative 3 would have no impact on the recreational value of the EFVR while providing new recreational opportunities at the Cove Reservoir site.
Cultural Services Health	No changes in human health from air quality would occur	The use of BMPs during construction would ensure no negative impacts to human health are caused from air quality changes. The additional recreation area may provide direct, positive benefits to mental health by enhancing quality of life and offering visitors opportunities to enjoy scenic views, engage in recreational activities, and experience nature.	The use of BMPs during construction would ensure no negative impacts to human health are caused from air quality changes. The additional recreation area may provide direct, positive benefits to mental health by enhancing quality of life and offering visitors opportunities to enjoy scenic views, engage in recreational activities, and experience nature.
Cultural Services Species conservation	Alternative 1 would have no impact on species' habitat or existence.	Alternative 2 would have no impact on species conservation. Minor, temporary impacts may occur during construction but would not result in the loss of species existence or abundance of suitable habitat.	Alternative 3 would have no impact on species conservation. Minor, temporary impacts may occur during construction but would not result in the loss of species existence or abundance of suitable habitat.
Cultural Services Non-material benefits	Alternative 1 would have negative impacts on mental health and recreation as they relate to ecosystem services, as described in detail in Sections 5.5.2 and 5.5.3.	Alternative 2 would benefit non-material ecosystem services such as mental health, aesthetic experiences, and recreation, as described in detail in Sections 5.5.2 and 5.5.3.	Alternative 3 would benefit non-material ecosystem services such as mental health, aesthetic experiences, and recreation, as described in detail in Sections 5.5.2 and 5.5.3.
Economic Analysis Costs Total Project Investment	-	$39,730,000	$32,345,000
Economic Analysis Costs Annual Project Investment	-	$1,346,000	$1,096,000
Economic Analysis Costs Annual O&M Costs	-	$13,000	$12,000
Economic Analysis Costs Total Annual Project Costs	-	$1,359,000	$1,108,000
Monetized Benefits for Ecosystem Services Provisioning	-	$1,397,000	$974,000

Resource Concern/Item	Alternative 1—No Action Alternative	Alternative 2—6,000-Acre-Foot Reservoir Alternative	Alternative 3—3,000-Acre-Foot Reservoir Alternative
Monetized Benefits for Ecosystem Services Regulating	-	-	-
Monetized Benefits for Ecosystem Services Cultural	-	-	-
Monetized Benefits for Ecosystem Services Supporting	-	-	-
Total Annual Monetized Costs for Ecosystem Services	-	$1,359,000	$1,108,000
Monetized Benefits for Ecosystem Services Benefit-Cost Ratio	-	1.03	0.89
Monetized Benefits for Ecosystem Services Annual Monetized Net Benefit	-	$37,000	-$127,000
Regional Economic Development/Economic Impact Assessment	-	-	-
Regional Economic Development/Economic Impact Assessment Regional Employment	-	-	-
Regional Economic Development/Economic Impact Assessment Regional Income	-	-	-
Regional Economic Development/Economic Impact Assessment Regional Impacts (Other)	-	-	-

*The alternative which best meets each identified criterion is indicated by an 'X'

Prepared: September 2026

6.0 PREFERRED ALTERNATIVE

6.1 Rationale for Preferred Alternative

Alternative 2—6,000-Acre-Foot Reservoir is the Preferred Alternative based on its ability to meet the project purpose and need, meet the federal objective, and provide the most beneficial effects on environmental, social, and economic resources. While both action alternatives meet the project purpose and need and funding requirements, the Preferred Alternative is the only alternative that meets the NEE benefit-cost ratio requirements (Appendix E-1). The Preferred Alternative is the alternative that would maximize net economic benefits. Refer to Figure B-7 in Appendix B for a figure showing the benefitted areas from the Preferred Alternative. The Cooperating Agencies and project sponsors support Alternative 2 as the Preferred Alternative. Refer to Appendix E-3 for Alternatives Memo prepared by Alpha.

Although the Preferred Alternative would have minor effects on various resources, those effects would be minimized or mitigated through implementation of BMPs and other compliance measures. As a tradeoff to those effects, the Preferred Alternative would permanently enhance the efficiency and reliability of AWM in Kane and Washington County. Additionally, as analyzed in the PR&G Analysis (Appendix E-1), there would be positive economic benefits to AWM, recreation, and M&I water supply. When compared to the No Action Alternative, which considers current conditions and future environmental changes, the Preferred Alternative would provide a more reliable and sustainable source of water for agricultural and M&I needs over the long term.

The UDWRe estimates that the proposed Cove Reservoir's average net evaporation (potential evaporation minus precipitation) would be 19.7 inches per year, as opposed to Quail Creek Reservoir’s 39.0 inches and Sand Hollow’s 40.5 inches net evaporation. This makes the proposed Cove Reservoir storage an efficient site for downstream and local uses (PLPCO, 2026).

6.2 Measures to be Installed

Alternative 2 consists of constructing a 6,000-acre-foot reservoir and dam, along with principal spillway with inlet structure and auxiliary spillway with control structure, a gated inlet/outlet control structure at the upstream toe of the dam with concrete encased outlet pipe, recreational facilities, and necessary infrastructure. The dam would feature a 1,900-foot earthen embankment with a central clay core, at a maximum height of 90 feet. Two spillways would be installed: a principal spillway to route the PSH and 100-year flood events through the reservoir without the use of the auxiliary spillway, and an auxiliary spillway to route larger design storm events through the reservoir without overtopping the dam (See Section 4.2.2.1.1.2 for details). The principal spillway pipeline would be 30 inches in diameter. The auxiliary spillway would comprise a trapezoidal, earthen channel, including a concrete weir structure. The project also includes the development of a 4.1-acre recreation area with amenities such as a non-motorized boat ramp, picnic facilities, and RV sites.

To support water conveyance, two pipelines would be constructed: the Reservoir Outlet Pipeline, extending approximately 700 feet, to facilitate water transfer from an existing irrigation system, and the Glendale Irrigation Pipeline, including 1.7 miles of new pipeline to replace old infrastructure. Additionally, the Mt. Carmel Irrigation Pipeline would be developed to provide pressurized agricultural water to areas within the Mt. Carmel area and would include approximately 24,000 linear feet of piping.

Approximately 3.2 miles of access roads would be constructed or improved to ensure mobility and connectivity around the reservoir. Material for construction would be sourced from three designated borrow pits. Refer to Appendices E-2 and E-3 for details on the access road construction.

More details on construction and O&M for the Preferred Alternative are provided in Section 4.2.2.1.

The proposed reservoir would be constructed in compliance with Title 210-TR-60. TR-60 identifies minimum design criteria for dams, with the exception of low-hazard potential dams and appurtenances (USDA, 1990).

Table 6.1. Alternative 2 Measures to be Installed

Project Measures	Description
Reservoir & Dam	Construct a 6,000-acre-foot reservoir and a 1,900-foot earthen embankment dam with a central clay core, max height 90 feet.
Spillways	Install two spillways: (1) principal spillway with 30-inch pipeline for excess flow, (2) auxiliary trapezoidal earthen channel with concrete weir.
Recreation Area	Develop a 4.1-acre recreation area with non-motorized boat ramp, picnic facilities, and RV sites.
Pipelines	Construct multiple pipelines: 700-foot Reservoir Outlet Pipeline; 1.7-mile Glendale Irrigation Pipeline replacement; 24,000-foot Mt Carmel Irrigation pipeline.
Access Roads	Construct or improve 3.2 miles of access roads for connectivity.
Borrow Pits	Source construction material from three designated borrow pits.
Design Standards	Construct in compliance with title 210-TR-60 dam criteria (USDA 1990).

6.3 Irreversible or Irretrievable Commitment of Resources

NEPA requires that environmental analyses include identification of any "…irreversible and irretrievable commitments of resource which would be involved in the Preferred Alternative should it be implemented" (7 CFR 650). Such commitments pertain to situations where environmental resources are dedicated to a specific use that cannot be reversed or recovered once the action is taken. Irreversible effects mainly arise from the use or destruction of specific resources that once used for a project or purpose are an irretrievable commitment and cannot be recovered for future use (e.g., fossil fuels or minerals). Irretrievable resource commitments refer to the loss of value in a

resource that cannot be restored due to an action taken (e.g., the extinction of a threatened species or the disturbance of a cultural site).

Choosing to implement the Preferred Alternative would entail a commitment to various natural, physical, human, and financial resources. Fossil fuels, labor, and construction materials would be consumed. Furthermore, labor and natural resources would be required for the production and preparation of construction materials, which are generally not recoverable. However, these materials are not in short supply, and their use is not expected to negatively impact their continued availability for other uses. Additionally, construction would necessitate a one-time expenditure of federal and cost-share funds that would also be non-recoverable. The commitment of these resources is predicated on the expectation that residents in the local area, state, and region would benefit from the improved conditions post-construction. These anticipated benefits are generally expected to outweigh the permanent commitment of resources described as irreversible or irretrievable. Refer to figure B-7 for a figure showing the benefitted areas from the Preferred Alternative.

6.4 Areas of Controversy

Implementation of the Preferred Alternative is not expected to result in any significant issues or controversies.

During the Plan-EA process, several areas of controversy were identified by the public and have been addressed throughout this Plan-EIS. They are summarized below.

- **Concern**: Plan-EA Adequacy - A more thorough analysis is required.
    - This Plan-EIS has been developed to further analyze the potential effects of the Preferred Alternative. Updates are found throughout the document.
- **Concern**: Purpose and Need - There is no need for a reservoir.
    - A water model was completed for the Preferred Alternative that shows the lack of available water in the summer months to meet the documented needs. Reference Chapter 2.0 and the Cove Water Model in Appendix E-1 for supporting information.
- **Concern**: Recreation - Necessity of recreational opportunities.
    - Current local recreational facilities often become overcrowded with tourists. Reference Section 2.2.1 and Section 3.2.5.2.5 for supporting information.
- **Concern**: Water Rights - Concern with water right ownership.
    - The combined water rights of the Glendale, Orderville, and Mt. Carmel Irrigation Companies allows for the diversion of water year-round. Refer to the Cove Water Model for details on water rights ownerships and consumptive use history. Reference the Cove Water Model in Appendix E-1 for supporting information.

- **Concern**: Dam Safety - Downstream home and property safety.
    - The Cove Reservoir site provides the least amount of damage to downstream properties as evaluated in the alternatives analysis. KCWCD is also in the process of purchasing downstream properties to mitigate public safety impacts. These purchased properties would not be affected by any project development. Reference Chapter 4.3 and Section 5.5.3 for supporting information.
- **Concern**: Downstream Impacts.
    - A water model was completed for the Preferred Alternative which shows minor impacts to downstream river flows. Reference Chapter 5.0, the BA. and the Cove Water Model in Appendix E-1 for supporting information.
- **Concern**: Water Availability - There is not enough water available for a reservoir.
    - A water model was completed for the Preferred Alternative which shows minor impacts to EFVR flows. Reference Chapter 5.0 and the Cove Water Model in Appendix E-1 for supporting information.
- **Concern**: Borrow Pits - Sedimentation in the EFVR from driving to the borrow pits.
    - Access to the existing borrow pits would be along existing roadways and would cause minor, temporary fugitive dust and sediment deposition during construction. Reference Section 5.2.2 and the Cove Plan of Development in Appendix E-1 for supporting information.
- **Concern**: WSR Values - Concern with effects to the W&S status of the river.
    - An analysis on impacts to the wild and scenic values of the EFVR are included in Section 5.2.6.
- **Concern**: Public Values of designated wilderness, WSA, or RNAs areas.
    - No impacts to designated wilderness, WSA's, or RNAs would occur from implementation of the Preferred Alternative. Reference Section 5.4.4 for supporting information.
- **Concern**: Riparian/Ecological Values - Changes to river flow may impact the downstream ecosystem.
    - The Preferred Alternative is anticipated to have positive benefits on riparian values due to the creation of new habitat surrounding the reservoir. Reference Section 5.4.7 and the Cove Water Model in Appendix E-1 for supporting information.
- **Concern**: Economic Issues - The costs outweigh the benefits.
    - A full cost-benefit analysis was completed per the DM 9500-013 and resulted in a cost-benefit ratio of greater than 1. Reference the PR&G in Appendix E-1 for supporting information.

- **Concern**: Threatened and Endangered Species and Species of Greatest Conservation Need - Damage to the Virgin spinedace.

    - The Virgin spinedace is a State fish Species of Greatest Conservation Need with potential to occur within the ZNP portion of the project area. Changes in water flow within the EFVR would be minor, particularly when the natural variation of EFVR flows are approximately 100 times the range of effect from proposed Cove Reservoir releases (Alpha Engineering 2025), and therefore, no long-term impacts are anticipated. Reference Section 5.4.6 for supporting information.

- **Concern**: Crop Production - Alfalfa uses too much water.

    - Alfalfa is a critical rotation crop in the U.S. as a major animal feed source and has numerous environmental benefits including high water use efficiency, low chemical inputs, high resiliency, crop rotation benefits, reduction in soil erosion, and agro-ecosystem benefits. Refer to the Importance of Alfalfa Hay memo in Appendix E-3 for supporting information. Alfalfa was selected to determine the benefits for this project because of its importance as a major feed source, its economic value, and its suitability to Utah's local climate and growing season.

- **Concern**: Climate Variation - Water flow in relation to climate variation.

    - Water availability is anticipated to continue to decrease over time as climate variation occurs. The Preferred Alternative would provide a reliable source of water for agriculture and M&I benefits and would not contribute to variations in climate. Reference the Cove Water Model in Appendix E-1 for supporting information.

6.5 Permits and Compliance

The federal, state, and local permits and compliance actions described in this chapter would be required for construction of the Preferred Alternative.

6.5.1 Federal

6.5.1.1 USFWS

The project area has been evaluated for the potential occurrence of federally listed threatened, endangered, or candidate plant and animal species or their habitat. The USFWS IPaC site was accessed, and a BA has been completed for the study area (Appendices E-1 and E-2). Thirteen federally listed species were identified as potentially occurring within or near the project area. Based on the analysis conducted in the BA, a determination of **May Affect, but is Not Likely to Adversely Affect** was made for five federally listed species from implementation of the Preferred Alternative (Appendices E-1 and E-2). A determination of **No Effect** was made for the remaining federally listed species and their habitat. Finally, a determination of **May Affect, but Not Likely to Adversely Affect** was made for designated critical habitat for three species. Informal consultation for Section 7 of the ESA was completed on September 9, 2026, with a concurrence from USFWS received (Appendix A). No permits from USFWS would be required.

6.5.1.2 USACE

Under Section 404 of the CWA, a USACE permit would be required for discharge of dredge or fill materials in WOTUS, including wetlands. Consultation with the USACE has determined that a Nationwide Permit and a Utah Stream Alteration Permit would be required for this project.

6.5.1.3 NPS

As a water resources project requiring federal assistance located upstream of a designated WSR, this project must be evaluated in accordance with Section 7 of the WSRs Act, to determine if it would invade the river area or unreasonably diminish the river's scenic, recreational, fish, or wildlife values. On August 29, 2025, via email, the NPS stated that they will not be conducting a Section 7 analysis for this project (Appendix A). Coordination with the ZNP as a cooperating agency has been ongoing throughout the life of the project and is summarized in Chapter 7.0 (Consultation).

6.5.2 State of Utah

6.5.2.1 Utah Division of Water Rights and Dam Safety

Approval would be required for the final design report, construction drawings, and specifications by the Utah State Assistant Engineer.

6.5.2.2 Utah Division of Water Quality

Under Section 401 of the CWA, approval would be required from the UDWQ so that the project does not violate state water quality standards. Additionally, certification is obtained as part of the Section 404 Permit review process with USACE. Under Section 402 of the CWA, a Utah Pollutant Discharge Elimination System (UPDES) Storm Water General Permit for Construction Activities is required for construction activities that disturb more than 1.0 acre and discharge pollutants to surface waters. A Stormwater Pollution Prevention Plan (SWPPP) would be developed, including submitting an NOI to the Utah Division of Water Quality.

6.5.2.3 Utah State Historic Preservation Office

Consultation has been performed with the Utah SHPO during this Plan-EIS process, and the results are summarized in Section 7.1.10. If, during construction, previously unevaluated cultural resources are discovered, work would be stopped, the area of discovery would be given adequate protection, and the NRCS and SHPO would be notified immediately. Procedures for discoveries outlined in the cultural resources USDA NRCS State Level Agreement (NRCS Agreement No. A-8D43-15-15) would be followed (Appendix E-3).

6.5.2.4 Utah Division of Oil, Gas, and Mining

If riprap for dam and spillway construction would be obtained from a source that does not have an existing mining permit, then a mining operations permit would be required to mine the riprap.

6.5.3 Local

A Watershed Agreement and an MOU would be completed and signed by the NRCS and SLOs prior to the obligation of construction funds for the Preferred Alternative. Any additional county and local permits that would be required for this project would be obtained prior to construction.

6.6 Mitigation of Potential Effects

The following are applicant-committed mitigation and protection measures that would be implemented as part of the Preferred Alternative. Additional BMPs and Standard Operating Procedures are identified in Appendix E-3. The impact analysis in Chapter 5.0 assumes that all these measures would be fully implemented during construction and maintenance of the Preferred Alternative.

6.6.1 General Measures

- Implementation of the Preferred Alternative would comply with all applicable federal and state laws and regulations, as well as local zoning and building ordinances during all phases of the project.
- Construction activities would be limited to the smallest extent practicable within the project area.
- During construction activities, vehicle parking and material stockpiles would be located within designated staging areas.
- Construction personnel would adhere to state and NRCS fire prevention and suppression requirements; construction personnel will always have fire tools and extinguishers available.
- Disturbed areas not used as part of the reservoir dam, recreation site, road or dam infrastructure would be restored to preconstruction conditions after construction was completed.
- Borrow sites would be cleaned, recontoured, and any debris removed, per instructions of the owner.
- An Emergency Action Plan would be developed prior to construction of the Proposed Action.

6.6.2 Soil

- No ground disturbance would occur during or immediately following precipitation events or under any wet conditions that would create deep ruts.
- Upon completion of construction activities, the disturbed areas would be recontoured to:
    - Minimize erosion and compaction.
    - Restore natural ground cover.

  - Reestablish plant growth.
  - Allow natural surface drainage.

- Silt fences, straw bales, and/or other appropriate BMPs (Appendix E-3) would be used to minimize erosion of disturbed areas, as needed.

6.6.3 Water

- A SWPPP that contains erosion and sediment control/pollutant prevention BMPs would be required and implemented. The BMPs would include, but are not limited to:
  - Silt fences.
  - Fiber wattles.
  - Earth berms.
- Construction and staging areas would be assessed to determine the feasibility of appropriate sediment control BMPs to prevent entry of sediment and other contaminants into downstream drainages.
- Petroleum-based fuels and other hazardous materials (including fuel for construction machinery) would be restricted to approved, designated staging/batch plant areas to ensure that accidental spills do not enter waters.
- Federal and state water quality standards and toxic effluent standards would be implemented to minimize potential adverse effects from discharges into WOTUS.
- Fueling of vehicles and equipment would be prohibited within 100 feet of any riparian area.
- The amount of waste material would be minimized to the furthest extent possible. Any excess material would be transported to an approved landfill at the earliest opportunity.
- Additional measuring devices would be installed to record flows into and out of the Cove Reservoir. Metering devices would be installed to record flows through the existing Orderville hydroelectric power plant that will release water rights owned by the WCWCD back into the EFVR, as well as water-right shortages being delivered from the reservoir to the Mt. Carmel and Orderville irrigation companies. These meter records would also be filed annually with the Utah State Division of Water Rights.

6.6.4 Air Quality

- Water or an approved dust suppression/soil binder would be applied to areas disturbed during construction activities, as necessary, to reduce fugitive dust and to limit visual and air quality impacts.
- Adequate freeboard in all trucks transporting material would be maintained to reduce dust during transportation/handling. Additionally, watering or covering loads to reduce emissions during material transportation/handling would be used, as necessary.

- A stabilized construction entrance (track-out pad), wheel washers, and/or other similar BMPs at construction site access points would be provided to reduce track-out of site materials onto the adjacent roadway network.

- Material stockpiles would be watered, as necessary, to prevent windblown dust.

- Vegetation cover would be established in disturbed areas as soon as possible to reduce windblown dust.

- Appropriate emission control devices on all construction equipment would be required.

- Use of clean burning fuels would be required.

- Only properly operating, well-maintained, construction equipment would be used.

6.6.5 Plants and Animals

- The minimum vegetation necessary would be removed for construction or maintenance activities.

- An NRCS-approved, weed-free, native seed mix would be used where seeding is required.

- Established cottonwood trees in riparian areas would be left in place for fish and wildlife habitat.

- A detailed weed control plan would be provided by the NRCS for approval before construction.

- All equipment would be cleaned of soil, seeds, vegetation matter, and other debris prior to entering or reentering the project area to avoid any introduction of non-native plants and weeds.

- Vegetation would be monitored periodically for the potential establishment of noxious weeds.

- Use of herbicides would comply with NRCS requirements.

- A post-construction period weed control plan would be developed by KCWCD.

- Any use of herbicides would comply with all federal and state requirements.

- Prior to stocking the proposed reservoir with fish, a management plan will be developed to ensure that non-native fish species do not escape from the reservoir into the EFVR. The management plan would meet nonnative stocking and control requirements. Cooperating Agencies would have an opportunity to review this plan prior to its implementation.

- Any fish stocking would adhere to state and federal regulations and would be the responsibility of the Utah Division of Wildlife Resources.

- Any unexpected encounters with a protected species would be immediately reported to UDWR, USFWS, and NRCS.

- Coordination would be maintained with WCWCD regarding construction activities and potential impacts to downstream Virgin River habitat.

- Native milkweed (*Asclepias* spp.) and other monarch butterfly (*Danaus plexippus*) pollinator-friendly native plant species would be included in reclamation seed mixes per NRCS and USFWS guidance.

- Disturbance of any encountered milkweed habitat would be avoided to the extent possible.

- All open pits or trenches would be monitored throughout construction to prevent entrapment of wildlife.

- Excavated holes more than 2 feet deep would be covered at the close of each day or provided with one or more escape ramps. Alternatively, fencing may be erected around open pits or trenches.

- Before pits or trenches are filled, they would be inspected for trapped animals. If found, they would be moved by a qualified biologist approved by the UDWR and NRCS.

- No rodenticides would be used on the project site.

- Where possible, construction activities, including habitat alteration and noise, would be conducted outside of Utah's migratory bird primary nesting season (April 1 to July 15). In Utah, the migratory bird nesting season can extend from January 1 to August 31 (especially for raptors). Therefore, a preconstruction survey for nesting birds would be conducted by a qualified biologist approved by the UDWR and NRCS no more than 5 days prior to the beginning of on-site work. If an active nest is identified, a no-activity buffer, as approved by the UDWR and NRCS, would be established around the nest site and would remain in place until the young have fledged and/or the nest becomes non-active (USFWS 2002a). Follow-up surveys to confirm that all young have successfully fledged would be conducted by a qualified biologist prior to construction in that area.

- After such surveys are performed and disturbance occurs, no additional disturbance during the avian breeding season would occur without first conducting an additional avian survey.

- If the existing topography limits line-of-sight between an active nest and construction activities, spatial and seasonal buffers may be reduced.

- Should an active migratory bird nest be discovered, the appropriate UDWR and NRCS agency biologist would be notified, and an appropriate buffer would be established around the nest until the migratory bird nesting period is over or young have fledged.

- No mature riparian trees would be removed during construction activities unless approved by UDWR and NRCS.

- No machinery would be permitted in the EFVR except for along existing roadways.

- Refuse and trash, including stakes and flags, would be removed and properly disposed of on a regular basis.

6.6.6 Human

- To resolve adverse effects to NRHP eligible sites, an inadvertent discovery plan will be prepared and supplied to construction crews, in addition to the preparation and execution of a MOA.

- If cultural resources are discovered during construction activities, all ground disturbing activities within 50 feet of the discovery shall cease and the NRCS and/or BLM or UTLA archaeologist would be notified.

- Avoidance fencing will be installed using a 50-foot buffer around existing sites.

- If the location of any ground disturbing activities changes be beyond those previously surveyed/analyzed, a new cultural resources evaluation would be conducted, and the NRCS and/or BLM or UTLA archaeologist would be consulted.

- If human remains are discovered under any circumstances, all work in the immediate vicinity (100 feet) would immediately halt, and the Kane County Sheriff, the NRCS and/or BLM or UTLA archaeologist, and the Utah State History's Human Remains Program would be contacted. The location of the discovery would be secured and monitored to prevent further impacts, and the location would be kept confidential. The remains would be treated in accordance with the requirements of the Native American Graves Protection and Repatriation Act (25 USC 3001 et seq.) and its implementing regulations (43 CFR 10). The NRCS and/or BLM or UTLA shall consult, pursuant to 43 CFR 10.5, to develop a written plan of action to manage the discovery. After approval of the plan by the consulting parties, mitigation would proceed. Construction near the remains may need to be halted throughout the review process. Continuation of work following a discovery would be contingent upon approval by the NRCS archaeologist in consultation with the Utah SHPO, Native American Tribes, and other consulting parties. Construction at this location would not resume until NRCS and/or BLM or UTLA consultation has been completed and approval to proceed has been given.

- Construction personnel would be instructed to be observant for cultural/historic objects. Training would be conducted by a qualified archaeologist approved by the NCRS.

- Visible structures (including metal structures) would be painted or otherwise treated to not be shiny or reflective. Facilities would be of a color that blends into the surrounding landscape (no bright colors such as red, yellow, or orange would be used).

- Areas disturbed during construction activities would be restored to preconstruction conditions. This would be accomplished by grading to match natural contours and stabilizing through establishment of ground cover. These areas would be reestablished by seeding with an herbaceous plant seed mixture and revegetation with NRCS-approved plant species to match the surrounding native plant community.

- Signs would be posted in local communities regarding the schedule for construction in the project area.
- Construction haul trucks would use caution and maintain safe travel speeds and distances.
- Construction noise levels would be minimized to the extent possible with proper maintenance of construction equipment and the use of approved noise mufflers.
- All federal, state, and local laws/regulations pertaining to pollution and contamination of the environment would be followed to prevent pollution of surface water, groundwater, soil, and air with any hazardous materials.
- Construction sites, staging areas, and access roads would be kept orderly during construction.
- Refuse and trash, including stakes and flags, would be removed and properly disposed of on a regular basis.
- Portable toilets would be used on-site and maintained on a regular schedule.
- No equipment oil or fuel would be drained on the ground; oils or chemicals would be hauled to an approved site for disposal.
- Diesel fuel, hydraulic fluids, and engine oil products would be the only hazardous material liquids used on site.
- All toxic substances (e.g., oil, gas, antifreeze) would be always stored in closed containers.
- Accidental spills would be cleaned immediately.
- NRCS and other regulatory agencies would be immediately notified in the event of a fuel/oil or hazardous material spill. Actions would be taken to minimize the amount of, and spread of, the spill material including straw bale plugs, earthen berms, and the use of absorbent materials. If necessary, soil remediation would be conducted including the removal of contaminated soils to an approved facility and soil sampling to verify successful site remediation.
- The KCWCD would be responsible for compliance with applicable local, state, and federal regulations related to the use, handling, storing, transporting, and disposing of hazardous materials on non-federal lands.
- During construction, all personnel would be required to conform to contractor safety procedures.
- All personnel would be adequately trained to perform their tasks.
- Heavy equipment would be outfitted with Occupational Safety and Health Administration-required safety devices such as backup warnings and seat belts.

- Hard hats, safety boots, ear/eye protection, and other personal protective equipment would be used on-site.

- All accidents and injuries would be reported to the appropriate contractor safety officer.

- The KCWCD would work with the Southwest Utah Public Health Department and Southwest Mosquito Abatement District regarding the testing of waters or habitat areas for presence of disease vectors. The KCWCD would notify the public regarding any such concerns.

- If significant scientific resources are discovered during construction activities, all ground-disturbing activities within 100 feet of the discovery shall cease, and the project paleontologist would be notified.

- Construction personnel would be instructed to observe for fossils. Training would be conducted by the project paleontologist.

6.7 Costs and Cost-Sharing

Table 6.3 presents the total project cost of $39,730,000 for the Preferred Alternative. The PL 83-566 funds would support $24,889,000 (62.6%) of the total project cost, whereas the remaining $14,841,000 (37.4%) amount would be contributed by other, non-federal funds. Table 6.4 itemizes the costs for each project measure and the distribution of how the costs would be shared by the sponsors and NRCS for each cost item.

- Construction costs account for all material, labor, and equipment necessary for the installation of piping associated with the Preferred Alternative. These costs were estimated based on similar installations at irrigation districts in Southern Utah. The planning construction costs are estimated using the best available information about the project without having detailed design information.

- Engineering costs were estimated as a percentage of construction costs.

- The costs presented are planning level estimates and do not reflect final costs. Detailed designs and construction cost estimates would be completed prior to initiating the project. Final construction costs would only reflect the time and materials to perform the work.

6.8 Ecosystem Services Benefits

The Preferred Alternative would provide the following ecosystem services benefits:

- **Provisioning services, agricultural land**—Approximately 430 acres of land would benefit from the increased water availability provided by the reservoir.

- **Provisioning services, agricultural water**—The Preferred Alternative would increase the available amount of agricultural, and M&I water by a maximum of approximately 2,148 afy.

- **Regulating services, water quality and quantity**—The Preferred Alternative would improve water quality in the EFVR indirectly by containing sediment within the reservoir during flash flooding events.

- **Regulating services, riparian zones**—The creation of riparian vegetation under Alternative 2 would benefit the ecosystem services that riparian habitat provides like water filtration, nutrient cycling, and wildlife habitat.

- **Supporting services, wildlife habitat**—The Preferred Alternative would continue to provide habitat for plants and wildlife within the EFVR while providing additional habitat within the Cove Reservoir.

- **Cultural services, recreation**—The Preferred Alternative would provide new recreational opportunities at the Cove Reservoir site.

- **Cultural services, non-material benefits**—The Preferred Alternative would benefit non-material ecosystem services such as mental health, aesthetic experiences, and recreation.

See Chapter 5.0 for detail on ecosystem service benefits from the Preferred Alternative.

6.9 Installation and Financing

This chapter provides further details regarding installation and financing for the Preferred Alternative.

6.9.1 Installation

The Preferred Alternative would be implemented in a planned sequence as discussed in the Cove Reservoir Plan of Development (Appendices E-2 and E-3). The NRCS and sponsor responsibilities of the project are outlined in Section 6.9.2. No preconditions are anticipated for installing the project.

6.9.2 Responsibilities

The NRCS is responsible for leading the planning efforts, providing engineering design and construction oversight assistance, and certifying project completion. The KCWCD along with the WCWCD are responsible for engineering design, project administration, environmental permitting, contracting, and construction implementation. The KCWCD and WCWCD have the needed authority as water irrigation districts, governed by Utah Code 17B-2A-1002, and has agreed to exercise those authorities to implement the actions described in this Plan-EIS.

6.9.3 Contracting

The water delivery pipelines would be completed using NRCS funding mechanisms. The KCWCD and WCWCD would be primarily responsible for overseeing and administering project construction in coordination with NRCS.

6.9.4 Real Property Rights

Approximately $840,000 would be spent on real property rights, with 16 percent of funding covered by PL 83-566 and the remaining 84 percent covered by other funds. Real property acquisition or relocations would be required for the Preferred Alternative. All construction would be completed within existing ROWs or easements.

6.9.5 Financing

The NRCS would provide 62.6 percent of the total project cost for the Preferred Alternative through PL 83-566. The KCWCD along with WCWCD are responsible for the remaining 37.4 percent of the costs, including funds that are not eligible under the National Watershed Program (e.g., administration and technical assistance). Table 6.1 includes annual installation costs and the proportion of funding through PL 83-566.

The required match funding would be expected to be provided through a mix of grants, loans, and patron assessments. For financing, the project sponsor would apply for funding. The KCWCD and WCWCD do not anticipate changing per-acre annual rates or the overall base assessment fee because of any capital improvement project that is fully funded through grants.

The O&M costs after project completion would be provided through the revenues of Cove Reservoir. The O&M costs would not increase due to the project and would be budgeted on an annual basis.

The NRCS reserves the authority and right to discontinue or reduce program benefits based on changes in agency priorities, funding availability, or the failure of the irrigation districts to fulfill the provisions of their agreement.

6.10 Operation, Maintenance, and Replacement

Operation includes the administration, management, and performance of other actions needed to keep the proposed Cove Reservoir and associated facilities safe and functioning as planned. Maintenance includes performance of work, preventing deterioration, and repairing damage or replacement of structures if one or more of their components fail. Damage to any of the completed structures caused by normal deterioration, droughts, flooding, or vandalism, is considered maintenance.

Measures in this Plan-EIS would be operated and maintained by the KCWCD with technical assistance from appropriate federal, state, and local agencies in accordance with their delegated authority. A specific O&M Plan would be prepared using the NRCS National O&M Manual. The KCWCD's liability for O&M would extend throughout the actual life of the structure.

A separate O&M Agreement would be developed before construction that would provide inspections, reports, and procedures for performing the maintenance items. The agreement would include specific provisions for retention, use, and disposal of property acquired or improved with PL 83-566 assistance. The term of this new O&M Agreement would be for a period of 100 years, which is the life expectancy of the project. The overall average amortization and O&M costs after initial construction would be approximately $13,000 annually.

The structures would be inspected by the KCWCD on a regularly scheduled basis and during, or immediately following, major storms, earthquakes, or other occurrences that may adversely affect the structures and appurtenant works.

6.11 Emergency Action Plan

Due to the high-hazard classification of the proposed dam, an EAP would be developed by the sponsor and other local groups before initiating construction.

6.12 Economic Tables and Structural Tables

The installation cost estimate for the Preferred Alternative is $39,730,000 as indicated in Table 6.2 (Economic Table 1). The following economic and structural tables include information relevant to the costs and benefits that would result from the implementation of the Preferred Alternative. Total costs are rounded to the nearest $1,000.

Table 6.2. (Economic Table 1) Estimated Installation Cost—East Fork Virgin Watershed, Utah, 2026 Dollars.

Works of Improvement	Units	Number of Federal Land	Number of Non-Federal Land	Number Total	PL 83-566 Funds Federal Land (Dollars)	PL 83-566 Funds Non-Federal Land (Dollars)	PL 83-566 Funds Total (Dollars)	Other Funds Federal Land (Dollars)	Other Funds Non-Federal Land (Dollars)	Other Funds Total (Dollars)	Grand Total (Dollars)
Reservoir and Dam[1]	Cubic Yards	-	1	1	-	$20,889,301	$20,889,301	-	$13,206,200	$13,206,200	**$34,096,000**
Glendale Irrigation Pipeline	Linear Feet	-	1	1	-	$597,537	$597,537	-	$174,475	$174,475	**$772,000**
Mt. Carmel Irrigation Pipeline	Linear Feet	-	1	1	-	$2,170,775	$2,170,775	-	$633,844	$633,844	**$2,805,000**
Recreational Facilities	Cubic Yards	-	1	1	-	$416,207	$416,207	-	$335,069	$335,069	**$751,000**
Access Roads	Linear Feet	-	1	1	-	$815,109	$815,109	-	$490,991	$490,991	**$1,306,000**
Total Project	-	-	**5**	**5**	-	**$24,889,000**	**$24,889,000**	-	**$14,841,000**	**$14,271,000**	**$39,730,000**

Prepared: September 2026

The Estimated Cost Distribution (Table 6.3 Economic Table 2) shows the estimated costs to be charged to the PL 83-566 funds along with other costs. These costs include those that would be associated with the reservoir and dam, Glendale Irrigation Pipeline, Mt. Carmel Irrigation Pipeline, recreational facilities, and access roads. No cost would be associated with the Washington County portion of the project. Total costs are rounded to the nearest $1,000.

[1] Includes Dam Construction and Land Rights ($840,000)

Table 6.3 (Economic Table 2). Estimated Cost Distribution—Water Resource Project Measures—East Fork Virgin Watershed, Utah, 2026 Dollars

Works of Improvement	Installation Cost—PL 83-566 Construction[2]	Installation Cost— PL 83-566 Engineering[3]	Installation Cost— PL 83-566 Real Property Rights	Installation Cost— PL 83-566 Project Admin	Installation Cost— PL 83-566 Total	Installation Cost—Other Funds Construction	Installation Cost—Other Funds Engineering	Installation Cost—Other Funds Real Property Rights	Installation Cost—Other Funds Project Admin	Installation Cost—Other Funds Total	Grand Total Cost
Reservoir and Dam	$16,962,912	$3,591,594	$135,261	$199,534	**$20,889,000**	$12,301,927	$0.00	$704,739	$199,534	**$13,206,000**	**$34,096,000**
Mt. Carmel Irrigation Pipeline	$1,851,048	$302,899	$0.00	$16,828	**$2,171,000**	$617,016	$0.00	$0.00	$16,828	**$634,000**	**$2,805,000**
Glendale Irrigation Pipeline	$509,528	$83,377	$0.00	$4,632	**$598,000**	$169,843	$0.00	$0.00	$4,632	**$174,000**	**$772,000**
Recreational Facilities	$330,561	$81,138	$0.00	$4,508	**$416,000**	$330,561	$0.00	$0.00	$4,508	**$335,000**	**$751,00**
Access Roads	$666,213	$141,059	$0.00	$7,837	**$815,000**	$483,154	$0.00	$0.00	$7,837	**$491,000**	**$1,306,00**
Total	**$20,320,000**	**$4,200,000**	**$135,000**	**$233,000**	**$24,889,000**	**$13,903,000**	$0.00	**$705,000**	**$233,000**	**$14,841,000**	**$39,730,000**

Prepared: September 2026

Cost allocation and cost sharing summary for the Preferred Alternative are presented in Table 6.4 (Economic Table 2a). The proposed dam and associated recreation facilities are included.

[2] Includes $175,000 of PL 83-566 funds and $0 of other funds for cultural resource protection and mitigation measures.
[3] Engineering services contract cost to be borne: $4,200,000 by PL 83-566 funds and $0 by other funds.

Table 6.4 (Economic Table 2a). Cost Allocation and Cost Sharing Summary for Multipurpose Watershed Project Plans—East Fork Virgin Watershed, Utah, 2026 Dollars.

Works of Improvement*	Cost Allocation Purpose Ag Water Mgmt.	Cost Allocation Purpose Recreation	Cost Allocation Purpose M&I Water Supply	Cost Allocation Purpose Total	Cost Sharing PL 83-566 Ag Water Mgmt.	Cost Sharing PL 83-566 Recreation	Cost Sharing PL 83-566 M&I Water Supply	Cost Sharing PL 83-566 Total	Cost Sharing Other Ag Water Mgmt.	Cost Sharing Other Recreation	Cost Sharing Other M&I Water Supply	Cost Sharing Other Total
Multi-Purpose Structure Reservoir and Dam	32%	32%	36%	**100.0%**	-	-	-	**-**	-	-	-	**-**
Multi-Purpose Structure Construction	$9,321,970	$9,424,742	$10,518,128	**$29,265,000**	$6,991,477	$4,712,371	$5,259,064	**$16,963,000**	$2,330,492	$4,712,371	$5,259,064	**$12,302,000**
Multi-Purpose Structure Project Admin	$127,118	$128,519	$143,429	**$399,000**	$63,559	$64,260	$71,715	**$200,000**	$63,559	$64,260	$71,715	**$200,000**
Multi-Purpose Structure Engineering	$1,144,060	$1,156,673	$1,290,861	**$3,592,000**	$1,144,060	$1,156,673	$1,290,861	**$3,592,000**	$0.00	$0.00	$0.00	**$0.00**
Multi-Purpose Structure Real Property Rights	$267,572	$270,522	$301,906	**$840,000**	$0.00	$135,261	$0.00	**$135,000**	$267,572	$135,261	$301,906	**$705,000**
Multi-Purpose Structure Subtotal	**$10,861,000**	**$10,980,000**	**$12,254,000**	**$34,096,000**	**$8,199,000**	**$6,069,000**	**$6,622,000**	**$20,889,000**	**$2,662,000**	**$4,912,000**	**$5,633,000**	**$13,206,000**
Mt. Carmel Pipeline Construction[43]	$2,468,065	$0.00	$0.00	**$2,468,000**	$1,851,048	$0.00	$0.00	**$1,851,000**	$617,016	$0.00	$0.00	**$617,000**
Mt. Carmel Pipeline Project Admin	$33,655	$0.00	$0.00	**$34,000**	$16,828	$0.00	$0.00	**$17,000**	$16,828	$0.00	$0.00	**$17,000**
Mt. Carmel Pipeline Engineering	$302,899	$0.00	$0.00	**$303,000**	$302,899	$0.00	$0.00	**$303,000**	$0.00	$0.00	$0.00	**$0.00**
Mt. Carmel Pipeline Subtotal	**$2,805,000**	**$0.00**	**$0.00**	**$2,805,000**	**$2,171,000**	**$0.00**	**$0.00**	**$2,171,000**	**$634,000**	**$0.00**	**$0.00**	**$634,000**
Glendale Irrigation Pipeline Construction[5]	$679,371	$0.00	$0.00	**$679,000**	$509,528	$0.00	$0.00	**$510,000**	$169,843	$0.00	$0.00	**$170,000**

[4] Includes $175,000 of PL 83-566 funds and $0 of other funds for cultural resource protection and mitigation measures.

[5] Includes $10,000 for permits.

Works of Improvement*	Cost Allocation Purpose Ag Water Mgmt.	Cost Allocation Purpose Recreation	Cost Allocation Purpose M&I Water Supply	Cost Allocation Purpose Total	Cost Sharing PL 83-566 Ag Water Mgmt.	Cost Sharing PL 83-566 Recreation	Cost Sharing PL 83-566 M&I Water Supply	Cost Sharing PL 83-566 Total	Cost Sharing Other Ag Water Mgmt.	Cost Sharing Other Recreation	Cost Sharing Other M&I Water Supply	Cost Sharing Other Total
Glendale Irrigation Pipeline Project Admin	$9,264	$0.00	$0.00	**$**9,000	$4,632	$0.00	$0.00	**$5,000**	$4,632	$0.00	$0.00	**$5,000**
Glendale Irrigation Pipeline Engineering	$83,377	$0.00	$0.00	**$83,000**	$83,377	$0.00	$0.00	**$83,000**	$0.00	$0.00	$0.00	**$0.00**
Glendale Irrigation Pipeline Subtotal	**$772,000**	**$0.00**	**$0.00**	**$772,000**	**$598,000**	**$0.00**	**$0.00**	**$598,000**	**$174,000**	**$0.00**	**$0.00**	**$174,000**
Recreational Facilities Construction	$0.00	$661,122	$0.00	**$661,000**	$0.00	$330,561	$0.00	**$331,000**	$0.00	$330,561	$0.00	**$331,000**
Recreational Facilities Project Admin	$0.00	$9,015	$0.00	**$9,000**	$0.00	$4,508	$0.00	**$5,000**	$0.00	$4,508	$0.00	**$5,000**
Recreational Facilities Engineering	$0.00	$81,138	$0.00	**$81,000**	$0.00	$81,138	$0.00	**$81,000**	$0.00	$0.00	$0.00	**$0.00**
Recreational Facilities Subtotal	**$0.00**	**$751,000**	**$0.00**	**$751,000**	**$0.00**	**$416,000**	**$0.00**	**$416,000**	**$0.00**	**$335,000**	**$0.00**	**$335,000**
Access Roads Construction	$366,117	$370,154	$413,096	**$1,149,000**	$274,588	$185,077	$206,548	**$666,000**	$91,529	$185,077	$206,548	**$483,000**
Access Roads Project Admin	$4,993	$5,048	$5,633	**$16,000**	$2,496	$2,524	$2,817	**$7,837**	$2,496	$2,524	$2,817	**$8,000**
Access Roads Engineering	$44,933	$45,428	$50,698	**$141,000**	$44,933	$45,428	$50,698	**$141,000**	$0.00	$0.00	$0.00	**$0.00**
Access Roads Subtotal	**$416,000**	**$421,000**	**$469,000**	**$1,306,000**	**$322,000**	**$233,000**	**$260,000**	**$815,000**	**$94,000**	**$188,000**	**$209,000**	**$491,000**
Grand Total	**$14,853,000**	**$12,152,000**	**$12,724,000**	**$39,730,000**	**$11,289,000**	**$6,718,000**	**$6,882,000**	**$24,889,000**	**$3,564,000**	**$5,435,000**	**$5,842,000**	**$14,841,000**

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Details of the estimated costs for the recreational facilities are presented in Table 6.5 (Economic Table 2b).

Table 6.5 (Economic Table 2b). Recreational Facilities—Estimated Construction Costs—East Fork Virgin Watershed, Utah, 2026 Dollars[6].

Works of Improvement	Number	Estimated Unit Cost	Total Construction Cost
Mobilization at 5%	1 (lump sum)	$28,620.00	$28,620
Excavation and Subgrade Prep	88,000 SF[8]	$2.00	$176,000
6" Reinforced Concrete (non-motorized Boat Ramp)	6,500 SF	$12.50	$81,250
6" Untreated Base Course (non-motorized Boat Ramp)	6,500 SF	$1.50	$9,750
6" Untreated Base Course (Parking)	28,500 SF	$1.50	$42,750
6" Untreated Base Course (Roads)	53,000 SF	$1.50	$79,500
Camp/RV Site Facilities (Barbeque Grill, Table, Fire Pit)	20 (each)	$1,320.00	$26,400
Pavilion	1 (each)	$66,000.00	$66,000
Signage	5 (each)	$550.00	$2,750
Restroom Facility (Assume Pit Toilet System)	2 (each)	$44,000.00	$88,000
Subtotal	-	-	$601,020
Contingency (10%)	-	-	$60,102
Project Administration (1.5%)	-	-	$18,031
Engineering, legal, and fiscal (13.5%)	-	-	$72,122
Total Recreation	-	-	$751,275

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Table 6.6 depicts important physical characteristics for the proposed Cove Reservoir.

[6] Price base: FY 2026
[7] Estimated Quantity, subject to minor variation at the time of detailed planning
[8] Square Feet

Table 6.6. Structural Data—Dams with Planned Storage Capacity—East Fork Virgin Watershed, Utah.

Item	Unit	Total
Class of structure	-	High
Peak Ground acceleration	G	0.41
Uncontrolled drainage area	$Mile^2$	4.7
Controlled drainage area	$Mile^2$	0
Total drainage area	$Mile^2$	4.7
Runoff curve no. (1-day) (AMC II)	-	78
Time of concentration	Hours	1.58
Elevation top dam	Feet	5,552.0
Elevation crest auxiliary spillway	Feet	5,549.0
Elevation crest high stage inlet	Feet	5,545.5
Elevation crest low stage inlet	Feet	N/A
Auxiliary spillway type	-	Earth, trapezoidal
Auxiliary spillway bottom width	Feet	30
Auxiliary spillway exit slope	Percent	15
Maximum height of dam	Feet	90
Volume of fill	$Yard^3$	1,806,900
Total capacity[9]	Acre-feet	6,775
Sediment submerged	Acre-feet	403
Sediment aerated	Acre-feet	15
Beneficial use Irrigation	Acre-feet	4,618 (1,360 Yield)
Beneficial use M&I	Acre-feet	1,019 (300 Yield)
Beneficial use Recreation	Acre-feet	300
Floodwater retarding	Acre-feet	720
Between high and low stage	Acre-feet	n/a
Surface Area–Sediment pool[10]	Acre	39
Surface Area–Beneficial use pool Irrigation, M&I, Recreation	Acre	90
Surface Area–Floodwater retarding	Acre	201
Principal Spillway Design–Rainfall volume (1-day)	Inches	3.5
Principal Spillway Design–Rainfall volume (10-day)	Inches	6.8
Principal Spillway Design–Runoff volume (10-day)	Inches	2.9

[9] Crest of auxiliary spillway

[10] If reservoir contains beneficial storage or if sediment capacity will not store water, show area in parenthesis and footnote accordingly.

Item	Unit	Total
Principal Spillway Design–Capacity of low stage (maximum)	Cubic feet/second	N/A
Principal Spillway Design–Capacity of high stage (maximum)	Cubic feet/second	127
Principal Spillway Design–Dimensions of conduit	Feet/inch	30
Principal Spillway Design–Type of conduit	-	Concrete encased welded steel
Principal Spillway Design–Frequency operation-auxiliary spillway	Percent chance	0.2% annually
Auxiliary Spillway Hydrograph–Rainfall volume	Inches	5.8
Auxiliary Spillway Hydrograph–Runoff volume	Inches	3.4
Auxiliary Spillway Hydrograph–Storm duration	Hours	24
Auxiliary Spillway Hydrograph–Velocity of flow	Feet/second	6.5
Auxiliary Spillway Hydrograph–Max. reservoir water surface elevation	Feet	5,549.6
Freeboard Hydrograph–Rainfall volume	Inches	10.2
Freeboard Hydrograph–Runoff volume	Inches	7.4
Freeboard Hydrograph–Storm duration	Hours	72
Freeboard Hydrograph–Max. reservoir water surface elevation	Feet	5,551.8
Capacity Equivalents–Sediment volume	Inches	1.7
Capacity Equivalents–Floodwater retarding volume	Inches	2.9
Capacity Equivalents–Beneficial volume (identify use)	Inches	6.5

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The estimated Average Annual National Economic Development Costs in Table 6.7 (Economic Table 4) are the anticipated annual costs of the Preferred Alternative facilities.

Table 6.7 (Economic Table 4). Estimated Average Preferred Alternative Annual Costs—East Fork Virgin Watershed, Utah, 2026 Dollars.[11]

Works of Improvement	Amortization of Installation Costs	O&M and Replacement Cost[12]	Other Direct Costs	Total
AWM Proportion of Reservoir and Dam	$367,999	$367	-	**$368,000**
AWM Mt. Carmel Pipeline	$95,030	-	-	**$95,000**
AWM Glendale Irrigation Pipeline	$26,158	-	-	**$26,000**
AWM Proportion of Access Roads	$14,097	-	-	**$14,000**
Total AWM	**$503,000**	**$367**	**-**	**$504,000**
Recreation Proportion of Reservoir and Dam	$359,059	-	-	**$359,000**
Recreation Facilities	$38,322	$13,000	-	**$51,000**
Recreation Proportion of Road	$14,252	-	-	**$14,000**
Total Recreation	**$412,000**	**$13,000**	**-**	**$425,000**
M&I Water Proportion of Reservoir and Dam	$415,351	-	-	**$415,000**
M&I Water Proportion of Access Roads	$15,906	-	-	**$16,000**
Total M&I Water	**$431,000**	**-**	**-**	**$431,000**
Grand Total	**$1,346,000**	**$13,000**	**-**	**$1,360,000**

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[11] Price base: Fiscal year 2026, amortized over 100 years at a discount rate of 3.25%
[12] Includes $13,000 for operation, maintenance, and replacement for recreation development

Table 6.8 (Economic Table 6) compares the benefits and costs for different works of improvements under the Preferred Alternative.

Table 6.8 (Economic Table 6). Comparison of Preferred Alternative Benefits and Costs—East Fork Virgin Watershed, Utah 2026 Dollars.

Works of Improvement	**Average Annual Benefits Ag Water Management**	**Average Annual Benefits Recreation**	**Average Annual Benefits M&I Water Supply**	**Total Average Annual Benefits**	**Average Annual Costs**[13]	**Benefit Cost Ratio**
Ag Water Management Proportion of Reservoir and Dam	-	-	-	-	$367,999	-
Ag Water Management Mt. Carmel Irrigation Pipeline	-	-	-	-	$95,030	-
Ag Water Management Glendale Irrigation Pipeline	-	-	-	-	$26,158	-
Ag Water Management Proportion of Access Roads	-	-	-	-	$14,097	-

[13] From Table 6-3 and 6-5

Works of Improvement	Average Annual Benefits Ag Water Management	Average Annual Benefits Recreation	Average Annual Benefits M&I Water Supply	Total Average Annual Benefits	Average Annual Costs[13]	Benefit Cost Ratio
Ag Water Management Annual OM&R	-	-	-	-	$367	-
Total Ag Water Management	**$389,000**	**-**	**-**	**$389,000**	**$504,000**	**0.77**
Recreation Proportion of Reservoir and Dam	-	-	-	-	$359,056	-
Recreation Facilities	-	-	-	-	$38,322	-
Recreation Proportion of Access Road	-	-	-	-	$14,252	-
Recreation Annual OM&R	-	-	-	-	$13,000	-
Total Recreation	**-**	**$414,000**	**-**	**$414,000**	**$425,000**	**0.97**
M&I Water Proportion of Reservoir	-	-	-	-	$415,351	-
M&I Water Proportion of Access Road	-	-	-	-	$15,906	-
Total M&I Water	**-**	**-**	**$594,000**	**$594,000**	**$431,000**	**1.38**
Total Project	**$389,000**	**$414,000**	**$594,000**	**$1,397,000**	**$1,360,000**	**1.03**

Prepared: September 2026

7.0 CONSULTATION, COORDINATION, AND PUBLIC PARTICIPATION

This chapter describes the coordination efforts with the public, agencies, Tribes, stakeholders, and the SLO for the proposed project. Communication with these agencies and groups has been ongoing since 2018 when early coordination was initiated by the NRCS for the project Plan-EA. Input from these agencies and organizations has been incorporated into the Plan-EIS analysis. All consultations, comments, and responses, including a Scoping Summary Report and the Cooperating Agency MOU are included in Appendix A. A summary of consultation, key action, and dates is provided in Table 7.1. A summary of consultation efforts specific to the NHPA Section 106 process is included as Table 7.2.

Table 7.1. Summary of Consultation Efforts.

Key Action	Date
USACE Cooperating Agency Plan-EA Request and Acceptance	February 12, 2018; June 7, 2018
USACE Cooperating Agency Plan-EIS Request and Acceptance	October 15, 2021; November 15, 2021
USACE Request submitted for concurrence with jurisdictional determinations	Memorandum dated July 21, 2022, and updated February 18, 2026
USACE Site Visit	September 28, 2022
USACE Agency Scoping Meeting Attendance	May 24, 2018
USACE Preliminary Aquatic Resource Report Submittal	October 2020
USACE Coordinated EFVR water flow aspects; comments addressed pre-Draft Plan-EIS	July 2026
USACE Draft 404(b)(1) Alternatives Analysis Submittal	July 11, 2025
USACE Concurrence with aquatic resources' delineation for the Project area.	Memorandum dated April 23, 2026
USFWS Cooperating Agency Plan-EA Request (no response received)	February 12, 2018; no response
USFWS Cooperating Agency Plan-EIS Request (no response received)	October 15, 2021; no response
USFWS Informal consultation initiated	February 2018
USFWS Initial IPaC list received	2018

Key Action	Date
USFWS Threatened, endangered and migratory species letter from the USFWS	December 13, 2018
USFWS Meeting between USFWS, NRCS, and Eocene to discuss potential effects	April 2019
USFWS Biological Evaluation for Plan-EA	February 2020
USFWS IPaC list updated	July 2022
USFWS Site visit	September 28, 2022
USFWS BA for Plan-EIS submitted (Informal Section 7 Consultation)	September 3, 2026
USFWS Concurrence with BA Determinations Issued	September 9, 2026
WCWCD Cooperating Agency Plan-EA Request and Acceptance	February 4, 2019; February 8, 2019 (MOU)
WCWCD Cooperating Agency Plan-EIS Request and Acceptance	January 27, 2022; August 16, 2022 (MOU)
WCWCD Site visit	September 28, 2022
WCWCD Coordinated EFVR water flow aspects; comments addressed pre-Draft Plan-EIS	July 2026
EPA Cooperating Agency Plan-EIS Request and Acceptance	October 15, 2021; October 29, 2021
EPA Site visit	September 28, 2022
EPA Comments addressed pre-Draft Plan-EIS issuance	July 2026
BLM Cooperating Agency Plan-EA Request and Acceptance	February 11, 2019; February 27, 2019 (MOU)
BLM Cooperating Agency Plan-EIS Request and Acceptance	October 15, 2021; August 16, 2022 (MOU)
BLM Site visit	September 28, 2022
BLM Interdisciplinary Team Analysis Record Checklist prepared	September 24, 2019

Key Action	Date
BLM Borrow site evaluation completed for Plan-EA; removed for Plan-EIS	2019 through 2024
NPS Cooperating Agency Plan-EA Request and Acceptance	February 12, 2019; February 12, 2019 (MOU)
NPS Cooperating Agency Plan-EIS Request and Acceptance	October 15, 2021; April 18, 2022 (MOU)
NPS Site visit	September 28, 2022
NPS Comments addressed pre-Draft Plan-EIS issuance	July 2026
NPS Cooperating Agency Coordination	Ongoing
USFS Cooperating Agency Plan-EIS Request (no response received)	October 15, 2021; no response
USFS Coordination throughout planning	Ongoing
PLPCO Cooperating Agency Plan-EIS Requests and Acceptance	October 20, 2021, and February 2, 2022; April 18, 2022 (MOU)
PLPCO Site visit	September 28, 2022
PLPCO Comments addressed pre-Draft Plan-EIS issuance	July 2026
UTLA Cooperating Agency Plan-EIS Request and Acceptance	October 15, 2021; October 25, 2021
UTLA Site visit	September 28, 2022
UTLA Comments addressed pre-Draft Plan-EIS issuance	July 2026

7.1 Consultation

7.1.1 U.S. Army Corp of Engineers

The NRCS sent a formal request to be a Cooperating Agency for the project Plan-EA to the USACE on February 12, 2018 (Appendix A). The agency accepted Cooperating Agency status on the project Plan-EA in a letter dated June 7, 2018 (Appendix A).

A formal request to be a Cooperating Agency for the project Plan-EIS was sent on October 15, 2021 (Appendix A). The USACE accepted Cooperating Agency status in a letter dated November 15, 2021 (Appendix A). This letter also requested consultation on the study area for the purposes of Section 106 and Section 7 determination. USACE was provided with an opportunity to conduct a site visit on September 28, 2022, along with NRCS project staff, KCWCD, project consultants,

and other cooperating agencies. Resource concerns, project purpose and need, alternatives for detailed study, and selection of the Preferred Alternative were coordinated with input and approval from the USACE. The USACE was provided with copies of the preliminary Plan-EIS for review prior to the issuance of the Draft Plan-EIS to the public. The USACE's report comments or concerns were addressed prior to the issuance of the Draft Plan-EIS to the public.

The USACE representatives attended the agency scoping meeting held on May 24, 2018, in Kanab, Utah. The agency indicated the presence of intermittent and ephemeral streams within the footprint of the proposed project, which likely holds jurisdictional status as WOTUS. Eocene confirmed this finding during a desktop and subsequent field study conducted in fall 2018 to delineate all potential WOTUS. Following the completion of field studies, Eocene and the NRCS personnel attended a meeting at the USACE Bountiful Field Office on November 15, 2018, with USACE to discuss the preliminary findings and to inquire about expected permitting and reporting requirements. Following agency guidance and using all data gathered, Eocene wetland specialists developed a Preliminary Aquatic Resource Delineation Report (Appendix E-1). The NRCS submitted the report to the USACE Bountiful Field Office in October 2020.

It is anticipated that a Nationwide Permit would be required for potential impacts that could occur to jurisdictional features which traverse the project area. A revised version of the Aquatic Resource Delineation Report with updated determinations of impacts was submitted to the USACE on July 3, 2025, and a request for an Approved Jurisdictional Determination was submitted on August 21, 2025. Consultation with the USACE for the Nationwide Permit and Approved Jurisdictional Determination is ongoing.

Under Section 404 of the CWA, the USACE must identify the Least Environmentally Damaging Practicable Alternative which represents the alternative with the least adverse impact on the aquatic ecosystem, while still fulfilling the project Purpose and Need. A Draft 404(b)(1) Alternatives Analysis was submitted to the USACE on July 11, 2025. The USACE responded August 13, 2025, stating that no additional detailed alternatives analysis would be necessary for the project. This email is included in Appendix A.

USACE has concurred with the aquatic resources' delineation made for the project area and has verified that the location and boundaries of wetlands were delineated consistent with agency manuals and guidance (See Section 4.2.2.4 WOTUS, Wetlands, ad Special Aquatic Sites).

7.1.2 U.S. Fish and Wildlife Service

The NRCS sent a formal request to be a Cooperating Agency to USFWS on February 12, 2018, for the project Plan-EA (Appendix A), and October 15, 2021 (Appendix A), for the project Plan-EIS, but no responses were received. Informal consultation with USFWS was initiated in February 2018 for the Plan-EA. On December 13, 2018, the USFWS submitted a letter regarding the project containing a list of threatened and endangered species and migratory bird species that may occur in the project area or may be affected by the implementation of the project (USFWS, 2018a). This letter confirmed the findings of a desktop review previously conducted using the USFWS IPaC web site (USFWS, 2018b). As part of continuing consultation efforts, an updated IPaC list was accessed in July 2022. In April 2019, a follow-up meeting between USFWS, NRCS, and Eocene biologists provided additional information regarding potential impacts to federally listed species within and downstream of the project area. Using this information, a Biological Evaluation was compiled to support the analysis for the project Plan-EA in February 2020. This information has been included

in Chapter 3.0 of the Plan-EIS, refer to Section 3.2.4 and Chapter 5.4 for a detailed analysis. The USFWS was provided with an opportunity to conduct a site visit on September 28, 2022, along with NRCS project staff, KCWCD, project consultants, and other cooperating agencies.

Section 7 consultation under the ESA has continued during Plan-EA and Plan-EIS development. A letter dated June 26, 2025, containing a list of threatened and endangered species that may occur in the proposed project area was submitted to the team preparing the Plan-EIS. The data contained in this letter has formed the basis of the development of the project BA. The BA was completed for the project Plan-EIS and was submitted for informal consultation to the USFWS in compliance with Section 7 of the ESA on September 3, 2026, with concurrence received in a letter signed September 9, 2026 (Appendix A).

7.1.3 Washington County Water Conservancy District

The WCWCD was sent a formal request to be a Cooperating Agency for the project Plan-EA via letter on February 4, 2019 (Appendix A), and the Cooperating Agency MOU was signed on February 8, 2019 (Appendix A). On January 27, 2022, the WCWCD requested Cooperating Agency Status for the Plan-EIS via email (Appendix A), and the Cooperating Agency MOU was signed in August 2022 (Appendix A). The WCWCD was provided with an opportunity to conduct a site visit on September 28, 2022, along with NRCS project staff, KCWCD, project consultants, and other cooperating agencies. Coordination has been maintained with WCWCD personnel regarding aspects of the project that could affect the EFVR water flow in Washington County. WCWCD's report comments or concerns were addressed prior to the issuance of the Draft Plan-EIS to the public.

7.1.4 U.S. Environmental Protection Agency

The NRCS sent a formal request to the EPA for Cooperating Agency status for the project Plan-EIS on October 15, 2021 (Appendix A). The EPA accepted Cooperating Agency status in a letter dated October 29, 2021 (Appendix A). The EPA was provided with an opportunity to conduct a site visit on September 28, 2022, along with NRCS project staff, KCWCD, project consultants, and other cooperating agencies. Resource concerns, project purpose and need, alternatives for detailed study, and selection of the preferred alternative were coordinated with input and approval from the EPA. The EPA was provided with copies of the preliminary Plan-EIS for review prior to the issuance of the Draft Plan-EIS to the public. The EPA's report comments or concerns were addressed prior to the issuance of the Draft Plan-EIS to the public.

7.1.5 U.S. Bureau of Land Management

The NRCS submitted a letter to the BLM Kanab Field Office Manager to formally request Cooperating Agency status for the Plan-EA on February 11, 2019 (Appendix A). On February 27, 2019, the BLM Kanab Field Office Manager signed an MOU, formalizing Cooperating Agency status for the project (Appendix A). A formal request to be a Cooperating Agency for the project Plan-EIS was submitted to the BLM on October 15, 2021 (Appendix A). On August 16, 2022, the BLM signed an MOU accepting Cooperating Agency status for the Plan-EIS (Appendix A). The BLM was provided with an opportunity to conduct a site visit on September 28, 2022, along with NRCS project staff, KCWCD, project consultants, and other cooperating agencies.

Three of the six potential borrow sites that were identified during preliminary development to supply aggregate material for project construction are located on BLM-administered public lands, two existing pits (Elbow and Bald Knoll) and one new pit (Black Knoll). A Kanab Field Office BLM Interdisciplinary Team Analysis Record Checklist was prepared for the BLM portion of the project during the Plan-EA (Appendix E-3). The use of the borrow sites on BLM lands was eliminated from the project for the Plan-EIS; however, the BLM has remained a Cooperating Agency. Resource concerns, project purpose and need, alternatives for detailed study, and selection of the preferred alternative were coordinated with input and approval from the BLM. The BLM was provided with copies of the preliminary Plan-EIS for review prior to issuance of the Draft Plan-EIS to the public. The BLM's report comments or concerns were addressed prior to issuance of the Draft Plan-EIS to the public. During the Plan-EA process, a Kanab Field Office BLM Interdisciplinary Team Analysis Record Checklist was prepared for the BLM portion of the project on September 24, 2019. The Plan-EIS no longer includes a BLM portion of the project, and therefore an updated Interdisciplinary Team Analysis Record Checklist was not required.

7.1.6 National Park Service through Zion National Park

The EFVR is a designated WSR where it flows through ZNP. The river enters the Park approximately 20 river miles downstream from the proposed reservoir site. Because of potential changes in streamflow, a formal request to be a Cooperating Agency for the project Plan-EA was submitted to the NPS on February 12, 2019 (Appendix A); the NPS signed the Cooperating Agency MOU on the same date (Appendix A). The NRCS sent a formal request to be a Cooperating Agency for the project Plan-EIS on October 15, 2021 (Appendix A). The NPS accepted Cooperating Agency status in a letter dated April 18, 2022 (Appendix A). The NPS also provided comments on the NOI for the Plan-EIS in that same letter. The NPS was provided with an opportunity to conduct a site visit on September 28, 2022, along with NRCS project staff, KCWCD, project consultants, and other cooperating agencies. Resource concerns, project purpose and need, alternatives for detailed study, and selection of the Preferred Alternative were coordinated with input and approval from the NPS.

The NPS was provided with copies of the preliminary Plan-EIS for review prior to issuance of the Draft Plan-EIS to the public. In a letter dated March 6, 2026, the NPS provided comments on the preliminary Plan-EIS. The NPS Western Region submitted an updated comment letter dated June 12, 2026, which superseded previous correspondence. On August 18, 2026, via email, the NRCS provided a comment response table and updated preliminary Plan-EIS to the NPS. On August 31, 2026, NPS acknowledged receipt and stated that they had no further comments. See Appendix A for all consultations between NRCS and the NPS.

The NPS evaluates impacts on designated rivers in accordance with Section 7 of the WSRA. On August 29, 2025, via email, the NPS stated that they will not be conducting a Section 7 analysis for this project (Appendix A). Coordination with the ZNP as a cooperating agency has been ongoing throughout the life of the project.

7.1.7 U.S. Forest Service

A formal request to be a Cooperating Agency for the project Plan-EIS was submitted to the USFS on October 15, 2021, and no response was received. Although the USFS did not elect to accept the request to participate as a Cooperating Agency, coordination with the USFS has been ongoing throughout the planning process for the project.

7.1.8 Utah Public Lands Policy Coordinating Office

The PLPCO is the state agency responsible for coordinating, promoting, and implementing Utah's public land priorities. The PLPCO requested Cooperating Agency status on the Plan-EIS by two memoranda, the first dated October 20, 2021 (Appendix A), and the second dated February 2, 2022 (Appendix A). The PLPCO was provided with an opportunity to conduct a site visit on September 28, 2022, along with NRCS project staff, KCWCD, project consultants, and other cooperating agencies. Resource concerns, project purpose and need, alternatives for detailed study, and selection of the Preferred Alternative were coordinated with input and approval from the PLPCO. The PLPCO was provided copies of the preliminary Plan-EIS for review prior to issuance of the Draft Plan-EIS to the public. The PLPCO's report comments or concerns were addressed prior to the issuance of the Draft Plan-EIS to the public.

7.1.9 Utah Trust Lands Administration

UTLA manages lands located within the proposed project area. UTLA is the steward of Utah's trust lands and is responsible for generating revenue from them for the benefit of public schools and other state institutions now and for future generations. A formal request to be a Cooperating Agency for the project Plan-EIS was submitted to the UTLA on October 15, 2021 (Appendix A), and the UTLA accepted Cooperating Agency status on the Plan-EIS by email correspondence dated October 25, 2021 (Appendix A). The UTLA was provided with an opportunity to conduct a site visit on September 28, 2022, along with NRCS project staff, KCWCD, project consultants, and other cooperating agencies. Resource concerns, project purpose and need, alternatives for detailed study, and selection of the Preferred Alternative were coordinated with input and approval from UTLA. UTLA was provided copies of the preliminary Plan-EIS for review prior to the issuance of the Draft Plan-EIS to the public. UTLA's report comments or concerns were addressed prior to the issuance of the Draft Plan-EIS to the public.

7.1.10 NHPA Section 106 Consultation

Consultation with various agencies, including Utah SHPO, the ACHP, USACE, BLM, Utah Department of Transportation (UDOT), and Tribes was completed to comply with 36 CFR 800 – Protection of Historic Properties. Consultation is ongoing throughout the life of the Plan-EIS, and this section will be updated as consultation occurs. The following sections detail the efforts completed for each section of 36 CFR 800. Table 7.2 summarizes all Section 106 consultations for the Plan-EA and Plan-EIS. All consultation letters and responses are included in Appendix A.

Table 7.2. Summary of Section 106 Consultation.

Agency/Tribe	Date	Type of Consultation
Ute Indian Tribe of the Uintah & Ourary Reservation	May 23, 2018	Tribal Scoping Letter for Plan-EA
Paiute Indian Tribe of Utah	May 23, 2018	Tribal Scoping Letter for Plan-EA
Kaibab band of Paiute Indians of the Kaibab Indian Reservation	May 23, 2018	Tribal Scoping Letter for Plan-EA
Moapa Band of Paiute Indians of the Moapa River Indian Reservation	May 23, 2018	Tribal Scoping Letter for Plan-EA

Agency/Tribe	Date	Type of Consultation
Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony	May 23, 2018	Tribal Scoping Letter for Plan-EA
Navajo Nation	May 23, 2018	Tribal Scoping Letter for Plan-EA
Ute Mountain Ute Tribe	May 23, 2018	Tribal Scoping Letter for Plan-EA
Councilwoman, White Mesa	May 23, 2018	Tribal Scoping Letter for Plan-EA
San Juan Southern Paiute Tribe of Arizona	May 23, 2018	Tribal Scoping Letter for Plan-EA
Pueblo of Zuni	May 23, 2018	Tribal Scoping Letter for Plan-EA
Hopi Tribe	May 23, 2018	Tribal Scoping Letter for Plan-EA
Hualapai Tribe	May 23, 2018	Tribal Scoping Letter for Plan-EA
Hopi Tribe	June 11, 2018	Response to Plan-EA Scoping Letter requesting hard copies of the Plan-EA
SHPO	January 9, 2020	First CRIR and finding of effect
BLM	January 9, 2020	First CRIR and finding of effect
USACE	January 9, 2020	First CRIR and finding of effect
Pueblo of Zuni	January 9, 2020	First CRIR and finding of effect
Kaibab band of Paiute Indians of the Kaibab Indian Reservation	January 9, 2020	First CRIR and finding of effect
Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony	January 9, 2020	First CRIR and finding of effect
San Juan Southern Paiute Tribe of Arizona	January 9, 2020	First CRIR and finding of effect
Moapa Band of Paiute Indians of the Moapa River Indian Reservation	January 9, 2020	First CRIR and finding of effect
Navajo Nation	January 9, 2020	First CRIR and finding of effect
Councilwoman, White Mesa (Ute Council)	January 9, 2020	First CRIR and finding of effect
Ute Indian Tribe of the Uintah & Ourary Reservation	January 9, 2020	First CRIR and finding of effect
Hualapai Tribe	January 9, 2020	First CRIR and finding of effect
Ute Mountain Ute Tribe	January 9, 2020	First CRIR and finding of effect
Hopi Tribe	January 9, 2020	First CRIR and finding of effect
Paiute Indian Tribe of Utah	January 9, 2020	First CRIR and finding of effect
SHPO	January 17, 2020	SHPO Concurrence with the First CRIR and finding of effect
Paiute Indian Tribe of Utah	January 21, 2020	Paiute Concurrence with the First CRIR and finding of effect
Hopi Tribe	January 28, 2020	Hopi Tribe Concurrence with the First CRIR and finding of effect
Moapa Band of Paiute Indians of the Moapa River Indian Reservation	November 20, 2020	NOA of Plan-EA
Navajo Nation	November 20, 2020	NOA of Plan-EA
Councilwoman, White Mesa (Ute Council)	November 20, 2020	NOA of Plan-EA

Agency/Tribe	Date	Type of Consultation
Ute Indian Tribe of the Uintah & Ourary Reservation	November 20, 2020	NOA of Plan-EA
Hualapai Tribe	November 20, 2020	NOA of Plan-EA
Ute Mountain Ute Tribe	November 20, 2020	NOA of Plan-EA
Pueblo of Zuni	November 20, 2020	NOA of Plan-EA
Hopi Tribe	November 20, 2020	NOA of Plan-EA
Paiute Indian Tribe of Utah	November 20, 2020	NOA of Plan-EA
Kaibab band of Paiute Indians of the Kaibab Indian Reservation	November 20, 2020	NOA of Plan-EA
Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony	November 20, 2020	NOA of Plan-EA
San Juan Southern Paiute Tribe of Arizona	November 20, 2020	NOA of Plan-EA
Kaibab band of Paiute Indians of the Kaibab Indian Reservation	December 1, 2020	NRCS email to Tribe with NOA of Plan-EA and invitation to the public meeting on December 9, 2020
Navajo Nation	December 4, 2020	Response to NOA stating no concern with the project
Hopi Tribe	December 7, 2020	Response to NOA requesting hard copies of the Plan-EA and a request for a Plan-EIS to be prepared
Hopi Tribe	December 15, 2020	NRCS delivery of hard copies per request
Hopi Tribe	January 4, 2021	Tribal concern with riprap from Bald Knoll borrow pit site and request for the preparation of a Plan-EIS
Hualapai Tribe	March 1, 2021	Hualapai Tribe stated this project is outside of their area of interest and requested to be removed from project consultation
Kaibab band of Paiute Indians of the Kaibab Indian Reservation	January 14, 2022	Tribal Scoping Letter for Plan-EIS
Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony	January 14, 2022	Tribal Scoping Letter for Plan-EIS
Ute Indian Tribe of the Uintah & Ourary Reservation	January 14, 2022	Tribal Scoping Letter for Plan-EIS
Pueblo of Zuni	January 14, 2022	Tribal Scoping Letter for Plan-EIS
Ute Mountain Ute Tribe	January 14, 2022	Tribal Scoping Letter for Plan-EIS
Hopi Tribe of Arizona	January 14, 2022	Tribal Scoping Letter for Plan-EIS
White Mesa Ute Council	January 14, 2022	Tribal Scoping Letter for Plan-EIS
Paiute Indian Tribe of Utah	January 14, 2022	Tribal Scoping Letter for Plan-EIS

Agency/Tribe	Date	Type of Consultation
Navajo Nation	January 14, 2022	Tribal Scoping Letter for Plan-EIS
Moapa Band of Paiute Indians of the Moapa River Indian Reservation	January 14, 2022	Tribal Scoping Letter for Plan-EIS
San Juan Southern Paiute Tribe of Arizona	January 14, 2022	Tribal Scoping Letter for Plan-EIS
Hopi Tribe	February 7, 2022	Response to Plan-EIS Scoping requesting hard-copies
Moapa Band of Paiutes	March 31, 2022	Response to Plan-EIS Scoping stating no comments
Ute Indian Tribe of the Uintah & Ourary Reservation	May 3, 2022	NOI for the Plan-EIS
San Juan Southern Paiute Tribe of Arizona	May 3, 2022	NOI for the Plan-EIS
Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony	May 3, 2022	NOI for the Plan-EIS
Paiute Indian Tribe of Utah	May 3, 2022	NOI for the Plan-EIS
Kaibab band of Paiute Indians of the Kaibab Indian Reservation	May 3, 2022	NOI for the Plan-EIS
Moapa Band of Paiutes	May 3, 2022	NOI for the Plan-EIS
Navajo Nation	May 3, 2022	NOI for the Plan-EIS
Pueblo of Zuni	May 3, 2022	NOI for the Plan-EIS
White Mesa Ute Council	May 3, 2022	NOI for the Plan-EIS
Ute Mountain Ute Tribe	May 3, 2022	NOI for the Plan-EIS
Hopi Tribe of Arizona	May 3, 2022	NOI for the Plan-EIS
BLM	May 5, 2022	Draft SHPO Package review for the second CRIR and finding of effect
UTLA	May 5, 2022	Draft SHPO Package review for the second CRIR and finding of effect
UDOT	May 5, 2022	Draft SHPO Package review for the second CRIR and finding of effect
UDOT	June 1, 2022	Cultural and Paleo clearance with Tier 1 screening form
SHPO	January 23, 2023	Second CRIR and finding of effect with preparation of an MOA
Navajo Nation	January 23, 2023	Second CRIR and finding of effect with preparation of an MOA
Ute Indian Tribe of the Uintah & Ourary Reservation	January 23, 2023	Second CRIR and finding of effect with preparation of an MOA
Moapa Band of Paiutes	January 23, 2023	Second CRIR and finding of effect with preparation of an MOA
Pueblo of Zuni	January 23, 2023	Second CRIR and finding of effect with preparation of an MOA
Hopi Tribe of Arizona	January 23, 2023	Second CRIR and finding of effect with preparation of an MOA
Ute Mountain Ute Tribe	January 23, 2023	Second CRIR and finding of effect with preparation of an MOA

Agency/Tribe	Date	Type of Consultation
Kaibab band of Paiute Indians of the Kaibab Indian Reservation	January 23, 2023	Second CRIR and finding of effect with preparation of an MOA
White Mesa Ute Council	January 23, 2023	Second CRIR and finding of effect with preparation of an MOA
Paiute Indian Tribe of Utah	January 23, 2023	Second CRIR and finding of effect with preparation of an MOA
San Juan Southern Paiute Tribe of Arizona	January 23, 2023	Second CRIR and finding of effect with preparation of an MOA
Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony	January 23, 2023	Second CRIR and finding of effect with preparation of an MOA
SHPO	February 6, 2023	SHPO Concurrence with Second CRIR and finding of effect with preparation of an MOA
ACHP	March 28, 2024	Section 106 consultation and notification of Adverse Effect to Historic Properties
ACHP	April 12, 2024	Email response declining interest in consultation
SHPO	May 20, 2024	Third CRIR with finding of effect
Navajo Nation	May 22, 2024	Third CRIR with finding of effect
Kaibab band of Paiute Indians of the Kaibab Indian Reservation	May 22, 2024	Third CRIR with finding of effect
Ute Indian Tribe of the Uintah & Ourary Reservation	May 22, 2024	Third CRIR with finding of effect
Moapa Band of Paiute Indians of the Moapa River Indian Reservation	May 22, 2024	Third CRIR with finding of effect
Pueblo of Zuni	May 22, 2024	Third CRIR with finding of effect
Paiute Indian Tribe of Utah	May 22, 2024	Third CRIR with finding of effect
Ute Mountain Ute Tribe	May 22, 2024	Third CRIR with finding of effect
Hopi Tribe of Arizona	May 22, 2024	Third CRIR with finding of effect
White Mesa Ute Council	May 22, 2024	Third CRIR with finding of effect
Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony	May 22, 2024	Third CRIR with finding of effect
San Juan Southern Paiute Tribe of Arizona	May 22, 2024	Third CRIR with finding of effect
Kaibab band of Paiute Indians of the Kaibab Indian Reservation	May 24, 2024	Response to Third CRIR stating no comments
SHPO	June 2, 2024	SHPO Concurrence with Third CRIR and finding of effect
Hopi Tribe of Arizona	June 4, 2025	Indirect/Visual Memorandum with finding of no effect
Kaibab Band of Paiute Indians of the Kaibab Indian Reservation	June 4, 2025	Indirect/Visual Memorandum with finding of no effect
Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony	June 4, 2025	Indirect/Visual Memorandum with finding of no effect

Agency/Tribe	Date	Type of Consultation
Moapa Band of Paiute Indians of the Moapa River Indian Reservation	June 4, 2025	Indirect/Visual Memorandum with finding of no effect
White Mesa Ute Council	June 4, 2025	Indirect/Visual Memorandum with finding of no effect
Navajo Nation	June 4, 2025	Indirect/Visual Memorandum with finding of no effect
Paiute Indian Tribe of Utah	June 4, 2025	Indirect/Visual Memorandum with finding of no effect
Pueblo of Zuni	June 4, 2025	Indirect/Visual Memorandum with finding of no effect
San Juan Southern Paiute Tribe of Arizona	June 4, 2025	Indirect/Visual Memorandum with finding of no effect
Utah Division of Indian Affairs	June 4, 2025	Indirect/Visual Memorandum with finding of no effect
Ute Indian Tribe of the Uintah & Ouray Reservation	June 4, 2025	Indirect/Visual Memorandum with finding of no effect
Ute mountain Ute Tribe	June 4, 2025	Indirect/Visual Memorandum with finding of no effect
USACE	June 4, 2025	Indirect/Visual Memorandum with finding of no effect
U.S. EPA	June 4, 2025	Indirect/Visual Memorandum with finding of no effect
ZNP	June 4, 2025	Indirect/Visual Memorandum with finding of no effect
SHPO	June 4, 2025	Indirect/Visual Memorandum with finding of no effect
UTLA	June 4, 2025	Indirect/Visual Memorandum with finding of no effect
Navajo Nation	June 5, 2025	Response to Indirect/Visual Memorandum stating no comments and request to proceed with the project without further consultation with the Navajo Nation
Moapa Band of Paiute Indians of the Moapa River Indian Reservation	June 5, 2025	Response to Indirect/Visual Memorandum stating concern about the effects to the acoustic characteristics of site 42KA7537
Moapa Band of Paiute Indians of the Moapa River Indian Reservation	June 10, 2025	A voicemail was left by the NRCS to the Moapa Band of Paiute Indian Tribe's THPO proposing avoidance measures for site 42KA7537
Moapa Band of Paiute Indians of the Moapa River Indian Reservation	June 18, 2025	An email was sent by the NRCS to the Moapa Band of Paiute Indian Tribe's THPO proposing avoidance measures for site 42KA7537

Agency/Tribe	Date	Type of Consultation
Moapa Band of Paiute Indians of the Moapa River Indian Reservation	June 20, 2025	A second voicemail was left by the NRCS to the Moapa Band of Paiute Indian Tribe's THPO proposing avoidance measures for site 42KA7537
Moapa Band of Paiute Indians of the Moapa River Indian Reservation	July 15, 2025	A second email was sent by the NRCS to the Moapa Band of Paiute Indian Tribe's THPO proposing avoidance measures for site 42KA7537
Moapa Band of Paiute Indians of the Moapa River Indian Reservation	February 12, 2026	A third voicemail was left by the NRCS to the Moapa Band of Paiute Indian Tribe's THPO proposing avoidance measures for site 42KA7537
Moapa Band of Paiute Indians of the Moapa River Indian Reservation	August 24, 2026	A final email and voicemail were left by the NRCS to the Moapa Band of Paiute Indian Tribe's THPO presenting the extended avoidance measures that have been incorporated into the project to ensure acoustics coming from the site remain undisturbed

7.1.10.1 Initiation of the Section 106 process

As part of the project's initial planning for both the Plan-EA and Plan-EIS, NRCS initiated consultation with appropriate Tribal representatives/THPOs during the scoping process (Appendix A). Tribes who hold ancestral land, traditional use, and/or TCP claims in and near the project area were identified using the Native American Graves Protection and Repatriation Act, Native American Consultation Database, a database through which any federally recognized Tribe could identify those counties in Utah where they have consultation interests. The BLM Kanab Field Office Tribal Consultation List, the U.S. Department of Housing and Urban Development Tribal Directory Assessment Tool, the U.S. Bureau of Indian Affairs, and the Utah Division of Indian Affairs websites were also used as supplemental sources to identify Tribes with consultation interests. The assembled list of Tribes is included in Table 7.2 and individual THPOs consulted with are included in Appendix A.

Tribes were consulted to comply with EO 13007 (American Indian Religious Freedom Act) (May 24, 1996), EO 13175 (Consultation and Coordination with Indian Tribal Governments) (November 6, 2000), the American Indian Religious Freedom Act of 1978, and the NHPA. A reasonable and good faith effort was made per 36 CFR pt. 800(f)(2) to consult with these Tribes via letter, email, and telephone. During the scoping process, the NRCS communicated with the Tribes regarding known historic properties or places of traditional religious and cultural importance near the project area.

Tribes were invited to comment on the project during the Plan-EA scoping period in letters dated May 23, 2018, and one response was received from the Hopi Tribe on June 11, 2018, requesting

hard copies of the Plan-EA and requesting the preparation of a Plan-EIS for the project (Appendix A). The Hopi Tribe re-requested their preference for a Plan-EIS in letters dated December 7, 2020 (Appendix A), and January 4, 2021 (Appendix A). A list of specific Tribes and THPOs consulted with, and the dates letters were sent and received is included in Appendix A.

On January 18, 2019, the Kaibab Paiute indicated concern about the effects of the increase in visitors to nearby private lands, and a site visit was completed on January 25, 2019, by a representative from the Kaibab Paiute, NRCS, and Eocene. The group examined site 42KA8904 near the proposed project activities, and the Kaibab Paiute stated that they were not concerned about the effects to the site from the proposed project. The group also visited site 42KA8785 due to its proximity to a proposed gravel source. A summary of this site visit is included in Appendix A, and a figure of the gravel pit avoidance area is included in Figure C-6 in Appendix C.

Tribes were also invited to comment on the project during the Plan-EIS scoping period in letters dated January 14, 2022, and responses from the Hopi and Moapa Tribes were received (Appendix A). The Hopi Tribe responded by letter dated February 7, 2022, requesting consultation on the project, including being provided with a copy of any proposed treatment plans for review and comment (Appendix A). The Moapa Band of Paiutes responded by email dated March 31, 2022, stating that they do not have any questions or comments concerning the project (Appendix A).

As part of compliance with 36 CFR 800, a Cultural and Paleo Clearance with Tier 1 Screening Form was completed on June 1, 2022, by the UDOT and to keep them informed of proposed project activities that may take place within the UDOT ROW or affect its transportation facilities through the NHPA Section 106 notification process.

7.1.10.2 Identification of historic properties

Per 36 CFR 800.16(d), the NCRS established the project's APE to include all potential direct and indirect effects. During the Plan-EA planning, the original project APE consisted of a total of 791.68 acres. A survey of this area was completed in October 2018 with supplemental field work completed in June, July, and September of 2019. The Class III (intensive pedestrian) survey was conducted by Eocene archaeologists, meeting 36 CFR 61 SOI qualification standards and was conducted in 15- meter-wide transects. This survey identified a total of 9 new cultural resource sites, 1 previous cultural resource site, and 15 IOs in the project APE (Appendix E-2). Four of these cultural resource sites are eligible for listing on the NRHP. As part of NHPA Section 106 compliance, this CRIR was submitted to the Utah SHPO, Tribes, THPOs, and other stakeholders for concurrence with the determinations of site eligibility (Table 7.2). SHPO, Tribes, THPOs, and other stakeholders were consulted with in a letter dated January 9, 2020. SHPO concurred in a letter dated January 17, 2020, the Paiute Tribe concurred in a letter dated January 21, 2020, and the Hopi Tribe concurred in a letter dated January 28, 2020.

In 2021, as part of the EIS, an Addendum project APE of 68.83 acres was added to include the addition of the Mt. Carmel pipeline. A Class III (intensive) and Class II (reconnaissance) inventory of the Addendum project APE was conducted in November 2021 and March 2022 by Eocene archaeologists, meeting 36 CFR 61 SOI qualification standards. This survey identified a total of 1 previously identified and 4 newly recorded cultural resource sites, and 3 IOs located within the Addendum project APE (Appendix E-2). Three of these cultural resource sites are eligible for listing on the NRHP. As part of NHPA Section 106 compliance, this CRIR was submitted to the Utah SHPO, Tribes, THPOs, and other stakeholders for concurrence with the determinations of site

eligibility (Table 7.2). SHPO, Tribes, THPOs, and other stakeholders were consulted with in a letter dated January 23, 2023. SHPO concurred in a letter dated February 6, 2023.

In 2023, a second Addendum project APE of 13.72 acres was identified to include the addition of the Esplin Pit. A Class III (intensive) and Class II (reconnaissance) inventory of the second Addendum project APE was conducted in October 2023 by Eocene archaeologists, meeting 36 CFR 61 SOI qualification standards. This survey identified a total of one previously identified and one newly recorded cultural resource site, and 1 IO was identified within the second Addendum project APE (Appendix E-2). Both cultural resource sites are eligible for listing on the NRHP. As part of NHPA Section 106 compliance, this CRIR was submitted to the Utah SHPO, Tribes, THPOs, and other stakeholders for concurrence with the determinations of site eligibility (Table 7.2). SHPO, Tribes, THPOs, and other stakeholders were consulted with in a letter dated May 20, 2024. The Kaibab Band of Paiute Indians of the Kaibab Indian Reservation responded with no comments in a letter dated May 24, 2024, and SHPO concurred in a letter dated June 2, 2024.

Table 3.6 summarizes the cultural resource findings and the NRCS' determination of site eligibility for all three surveys, and Table 7.2 summarizes the consultation that was completed for all three surveys.

A total of 874.23 acres was surveyed for the Project APE. In 2024, the project extent changed to remove 3 borrow pits, reducing the total Direct section of the APE to 712.46 acres. Figure C-2 in Appendix C shows the areas surveyed and the current Direct section of the APE. This section of the APE encompasses all areas under the current project extents that may be disturbed or changed from their current conditions with potential to affect cultural resources. See Section 1.4.3 for a detailed description of the APE development process, Appendix E-2 for the redacted CRIRs, and Figure C-2 in Appendix C for the APE figure.

In April 2025, Eocene completed a Cultural Resources Review Memorandum to identify potential impacts to the Indirect and Visual sections of the APE within the project area. This desktop review identified 26 cultural resources and nine historic structures within the overlapping sections. The NRCS determined that none of these resources would require a formal Visual Effects Analysis, as they would not be subject to adverse visual or indirect impacts (Eocene, 2025). Refer to Appendix E-2 for the Redacted Cultural Resources Review Memorandum.

Consultation was completed with the applicable Tribes, agencies, and the SHPO on June 4, 2025. Copies of the letters sent, and concurrences received are included in Appendix A. Consultation with the Moapa Band of Paiutes is ongoing.

7.1.10.3 Assessment of adverse effects

The 3 cultural resource surveys revealed a total of 9 historic properties within the original project APE. CRIRs for each survey have been prepared and redacted versions are included in Appendix E-2. Table 5.4 summarizes the effects findings and protective measures on all eligible sites in the APE. Implementation of the proposed project would result in Adverse Effect to Historic Properties. As part of NHPA Section 106 compliance, the CRIR, and subsequent addendums, were submitted to the Utah SHPO, Tribes, THPOs, and other stakeholders for concurrence with the project effects (Table 7.2).

The proposed project would have an Adverse Effect to historic properties, as concurred with by SHPO on February 6, 2023, and June 2, 2024. The ACHP was notified of the finding of Adverse Effect to historic properties in an email dated March 28, 2024 (Appendix A). A letter response was received via email on April 12, 2024, stating that the ACHP does not believe participation in the consultation to resolve adverse effects is needed per 36 CFR 800 (Appendix A).

7.1.10.4 Resolution of adverse effects

To resolve adverse effects, a draft MOA was prepared in July of 2026 and a final MOA will be executed following the public comment period for this project. The draft MOA was prepared in consultation with the Utah SHPO, KCWCD, WCWCD, interested THPOs, Tribes, and other organizations, and is included in Appendix A.

On private land, the NRCSs inadvertent discovery procedures, as described in the Prototype Programmatic Agreement with the Utah SHPO, would be followed. For non-private land, the applicable land managing agency's inadvertent discovery plan would be followed. If undocumented cultural/archaeological resources are found during construction activities, construction would stop, and the appropriate agency officials would be notified, per procedures described in the NRCS Prototype Programmatic Agreement (Appendix E-3).

7.2 Coordination

7.2.1 Stakeholders

Coordination was conducted with private landowners having a stake in the project. These include landowners of parcels where temporary and permanent easements are required to install alternative measures, Non-Government Organizations (NGOs) with interest in the project Area, and National, state, and local agencies who may be impacted by the project. A list of all stakeholders coordinated with for the project is included in Appendix A. Coordination included invitation to comment on the scoping process for both the Plan-EA and the Plan-EIS, public scoping meetings held on December 5, 2019, and October 20, 2021.

Contact has been ongoing with local private landowners and NGOs throughout the Plan-EA and Plan-EIS development process. The gravel would come from the Lamb and Tait borrow sites located on private lands. The KCWCD has been negotiating with the owners of these sites for use of this material. During the public scoping process for the Plan-EIS, letters were sent to 35 agency representatives, 8 NGOs, 212 private landowners, and 24 Tribal representatives. See Chapter 1.5 and the Scoping Summary Report for details (Appendix A).

7.2.2 Sponsoring Local Organizations

The SLOs for the proposed project are KCWCD and WCWCD. Financial assistance for the project was requested by the SLOs from NRCS through Standard Form 424-Application for Federal Assistance. Initial coordination was conducted with the SLOs regarding the project and the proposed measures. Meetings were conducted throughout the planning and engineering process to discuss the project measures and identify potential concerns. The SLOs were provided copies of the preliminary Plan-EIS for review prior to issuance of the Draft Plan-EIS to the public. The SLOs report comments or concerns were addressed prior to issuance of the Draft Plan-EIS to the public.

7.2.3 Utah Department of Transportation

The UDOT was notified during early coordination for the project Plan-EA in June 2018 and for the project Plan-EIS in June 2021. As part of compliance with 36 CFR 800, a Cultural and Paleo Clearance with Tier 1 Screening Form was completed on June 1, 2022, for the UDOT to keep them informed of proposed project activities that may take place within the UDOT ROW or affect its transportation facilities through the NHPA Section 106 notification process.

7.2.4 Utah Division of Wildlife Resources

During the Plan-EA analysis, the UDWR was consulted regarding a proposed conservation pool and fishery at the proposed reservoir. Additionally, negotiations with UDWR resulted in the maintenance of a continuous streamflow between existing Glendale hydroelectric power plant site and the return flow site near the existing Orderville hydroelectric power plant (KCWCD, 2001). Neither of these two project components are included in the current proposed project, and their discussion is not included in this Draft Plan-EIS.

Coordination with the UDWR was conducted in 2018 to identify state-sensitive species of concern relevant to the Plan-EA analysis for the project. The UDWR did not have any immediate concerns for species or habitat for the project. The UDWR was also invited to review the project purpose and need on October 4, 2024, via email. A virtual agency meeting was held on October 17, 2024, to discuss comments on the project purpose and need. Any comments received were addressed prior to the issuance of the Draft Plan-EIS to the public.

7.2.5 Utah Division of Emergency Management

Coordination with the Utah Division of Emergency Management (UDEM) was conducted throughout the planning process of the Plan-EA and Plan-EIS. The UDEM provided comments during the scoping period that a Letter of Map Revision or Conditional Letter of Map Revision may be required for the project and that it should be reviewed by Washington County and Hurricane City floodplain administrators. Project information and floodplain modeling data was shared with the UDEM for their coordination with Hurricane City. The UDEM was also invited to review the project purpose and need on October 4, 2024, via email. A virtual agency meeting was held on October 17, 2024, to discuss comments on the project purpose and need. Any comments received were addressed prior to the issuance of the Draft Plan-EIS to the public.

7.2.6 U.S. Bureau of Reclamation

Coordination with the U.S. Bureau of Reclamation (BOR) was conducted throughout the planning process of the Plan-EA and Plan-EIS. The BOR requested copies of the draft Plan-EA via email on June 22, 2018. The BOR was also invited to review the Plan-EIS purpose and need on October 4, 2024, via email. A virtual agency meeting was held on October 17, 2024, to discuss comments on the project purpose and need. Any comments received were addressed prior to the issuance of the Draft Plan-EIS to the public.

7.2.7 Utah Natural Heritage Program

A letter was sent to UNHP on September 25, 2018, requesting a list of species of special concern for the project Plan-EA. A letter was received from the UNHP on October 1, 2018, confirming that

no federally listed species were documented as potentially occurring within 0.5-2.0 miles of the Long Valley portion of the project area. An online species search report was obtained from the UNHP on July 21, 2022, that identified three state species of concern that have been documented within a 0.5–2.0-mile radius of the project area, including the Arizona toad, bald and golden eagles, band-tailed pigeon, desert sucker, and northern leopard frog (UNHP, 2024). These species are analyzed in Section 5.4.1 and 5.4.6. The UNHP was also invited to review the purpose and need of the project on October 4, 2024, via email. A virtual agency meeting was held on October 17, 2024, to discuss comments on the project purpose and need. Any comments received were addressed prior to the issuance of the Draft Plan-EIS to the public.

7.2.8 Utah Department of Natural Resources, Utah Geological Survey

A Paleontological Resources Locality Search was requested from the Utah Department of Natural Resources, UGS on September 25, 2024, to identify potential paleontological resources in the project area. The request was completed on September 26, 2024, via email and a recommendation to complete surveying/monitoring of the PFYC areas was given. Surveying was completed in November 2024 and February 2025 and a summary of findings is included in Section 5.5.5.

7.2.9 Federal Emergency Management Agency

Coordination with FEMA was conducted throughout the planning process of the Plan-EA and Plan-EIS. FEMA was also invited to review the project purpose and need on October 4, 2024, via email. A virtual agency meeting was held on October 17, 2024, to discuss comments on the project purpose and need. Any comments received were addressed prior to the issuance of the Draft Plan-EIS to the public.

7.2.10 Utah State Clearinghouse

Coordination with the Utah State Clearinghouse was conducted throughout the planning process of the Plan-EA and Plan-EIS. State Notification per Executive Order 12372 – Funding for start of PL 566 Planning was posted on November 17, 2017. The Utah State clearinghouse was also invited to review the purpose and need of the project on October 4, 2024, via email. A virtual agency meeting was held on October 17, 2024, to discuss comments on the project purpose and need. Any comments received were addressed prior to the issuance of the Draft Plan-EIS to the public.

7.2.11 Utah Division of Water Resources

Coordination with UDWRe was conducted throughout the planning process of the Plan-EA and Plan-EIS. UDWRe was invited to review the project purpose and need on October 4, 2024, via email. A virtual agency meeting was held on October 17, 2024, to discuss comments on the project purpose and need. Any comments received were addressed prior to the issuance of the Draft Plan-EIS to the public.

7.2.12 Utah Department of Environmental Quality

Coordination with Utah Department of Environmental Quality (UDEQ) was conducted throughout the planning process of the Plan-EA and Plan-EIS. UDEQ was invited to review the purpose and need of the project on October 4, 2024, via email. A virtual agency meeting was held on October

17, 2024, to discuss comments on the project purpose and need. Any comments received were addressed prior to the issuance of the Draft Plan-EIS to the public.

7.2.13 Utah Division of Water Quality

Under Section 401 of the CWA, approval would be required so that the project does not violate state water quality standards. Certification is obtained as part of the USACE Section 404 Permit review process. Under Section 402 of the CWA, a UPDES Storm Water General Permit for Construction Activities is required for construction activities that disturb more than 1 acre and discharge pollutants to surface waters. A SWPPP will be developed, including submitting an NOI to the Utah Division of Water Quality.

Coordination with the UDWQ was conducted throughout the planning process of the Plan-EA and Plan-EIS. UDWQ was invited to review the project purpose and need on October 4, 2024, via email. A virtual agency meeting was held on October 17, 2024, to discuss comments on the project purpose and need. Any comments received were addressed prior to the issuance of the Draft Plan-EIS to the public.

7.2.14 Utah Division of Water Rights

Coordination with the Utah Division of Water Rights was conducted throughout the planning process of the Plan-EA and Plan-EIS. Utah Division of Water Rights was invited to review the project purpose and need on October 4, 2024, via email. A virtual agency meeting was held on October 17, 2024, to discuss comments on the project purpose and need. Any comments received were addressed prior to the issuance of the Draft Plan-EIS to the public.

Approval will also be required for the final design report, construction drawings, and specifications by the Utah State Assistant Engineer.

7.2.15 Utah Department of Cultural and Community Engagement

The Utah Department of Cultural & Community Engagement was invited to review the project purpose and need on October 4, 2024, via email. A virtual agency meeting was held on October 17, 2024, to discuss comments on the project purpose and need. Any comments received were addressed prior to the issuance of the Draft Plan-EIS to the public.

7.2.16 Utah Department of Agriculture and Food

The Utah Department of Agriculture and Food was invited to review the project purpose and need on October 4, 2024, via email. A virtual agency meeting was held on October 17, 2024, to discuss comments on the project purpose and need. Any comments received were addressed prior to the issuance of the Draft Plan-EIS to the public.

7.2.17 Utah Department of Public Safety

Coordination with the Utah Department of Public Safety was conducted throughout the planning process of the Plan-EA and Plan-EIS. The Utah Department of Public Safety was invited to review the purpose and need of the project on October 4, 2024, via email. A virtual agency meeting was held on October 17, 2024, to discuss comments on the project purpose and need. Any comments received were addressed prior to the issuance of the Draft Plan-EIS to the public.

7.3 Public Involvement

7.3.1 Public Outreach Plan

A Public Outreach Plan was prepared to outline effective procedures for engaging with the public, recreationists, Tribes, local businesses and associations, stakeholders, affected landowners, and affected government agencies. The main goal of public participation is to involve a diverse group of public and government agency participants to solicit input and provide timely information throughout the NEPA review process. As part of the public participation process, the plan seeks to meaningfully engage minority, low-income, and traditionally under-represented populations during the NEPA review process.

7.3.2 Project Scoping

Public participation is a vital component of the project that provides those who are interested in or potentially affected by proposed alternatives with an opportunity to share their concerns and provide input regarding the project during the planning stages of the Plan-EIS.

Project scoping questions, comments, and concerns were requested from the public and government agencies during the preliminary scoping period, both orally at public meetings, and via written submittal of comments. The project Scoping Summary Report outlines the efforts and comments received from the agencies and public during the scoping process. Refer to Chapter 1.5 for a description of the projects planning process.

7.3.3 Public Outreach

Table 7.3 lists the project's public outreach activities. The public, Tribes, agencies, and organizations were notified of activities as described below and provided with opportunities to comment on the project. See Appendix A for a copy of all public outreach activities

Table 7.3. Public Outreach Activities.

Date	Item
November 21, 2017	Utah State Clearinghouse Notification
October 29, 2019	Project Kickoff Meeting
February 12, 2018	NRCS sent formal requests to be a Cooperating Agency for the project Plan-EA to agencies (Appendix A)
May 23, 2018	Tribal Scoping Letter mailed to 21 representatives of 12 Tribes (Appendix A)
May 24, 2018	Public and Agency Scoping Letters mailed (sent to 21 private landowners and 31 agency reps)
May 24, 2018, and May 31, 2018	Scoping Notice, Meeting Announcements, and Scoping Notice Posted in the Southern Utah News
May 24, 2018	Scoping – Public Comment Period Open

Date	Item
May 24, 2018	Agency Scoping Meeting #1 held in Kanab, Utah
June 6, 2018	Public Scoping Meeting held in Orderville, Utah
June 6, 2018	Agency Scoping Meeting #2 held in Kanab, Utah
June 7, 2018	Early Coordination - Agencies
June 25, 2018	Scoping – Public Comment Period Close (4 public comments and 5 agency comments received)
July 2018	Scoping Summary Report
January 9, 2020	Tribal scoping letters mailed to 18 representatives of 12 Tribes for Plan-EA Scoping Outreach Process (Appendix A)
November 20, 2020	Plan-EA NOA letters mailed to 21 representatives of 12 Tribes (Appendix A)
June 7, 2021	Email announcement of NOI and updated comment period close date sent
February 2021	Scoping letter and fact sheet sent to landowners within or adjacent to the project area (Appendix A)
October 7, 2021-April 28, 2022 (209 days)	Scoping Public Comment Period Open: October 7, 2021 Close: April 28, 2022
October 7, 2021, and October 14, 2021	Notice published in the Southern Utah News on October 7, 2021, and October 14, 2021. Project press releases were sent to the Salt Lake Tribune, The Spectrum, and the Desert Sun News. NGOs were also contacted. (Appendix A)
October 20, 2021	Scoping Public Meeting (virtual) was held in Orderville
January 14, 2022	Plan-EIS Tribal Scoping letters sent to 17 representatives of 11 Tribes. The Hualapai Tribe was removed from consultation for the Plan-EIS per their request on March 1, 2021 (Appendix A)
March 29, 2022	NOI to Prepare an EIS for the Cove-EFVR Watershed Plan, Kane County, Utah (Docket No. NRCS–2022–0002) published.
May 3, 2022	Copy of NOI sent to 18 representatives of 11 Tribes (Appendix A)
January 23, 2023	Second CRIR and notification of Adverse Effect and the preparation of an MOA sent to 21 representatives of 11 Tribes (Appendix A)
May 22, 2024	Third CRIR sent to 21 representatives of 11 Tribe (Appendix A)
October 17, 2024	Agency Meeting (virtual) to provide comment on the draft purpose and need
September 18, 2026	Draft Plan-EIS Open Comment Period and NOA
September 30, 2026	Draft Plan-EIS Public Meeting

Date	Item
November 2, 2026	Draft Plan-EIS Comment Period Closed
November 2026	Final Plan-EIS and NOA
November 2026	Record of Decision (ROD)

7.4 Plan Development and Review

7.4.1 Cooperating Agencies

The Cooperating Agencies, consisting of the EPA, NPS, USACE, UTLA, PLPCO, and BLM, were involved in the development of the Plan-EIS and provided technical expertise where appropriate. Concurrence was received from Cooperating Agencies during the scoping process and Plan-EIS development on the project purpose and need, resource concerns, alternatives included/eliminated from detailed study, and selection of the preferred alternative. A preliminary Plan-EIS was provided to Cooperating Agencies for review, and all comments or concerns were addressed prior to issuance of the Draft Plan-EIS to the public.

7.4.2 NRCS Plan-EIS Reviews

The following NRCS reviews occurred prior to issuance of the Draft Plan-EIS to the public, in accordance with the NWPM process.

1) NRCS Utah review.
2) NRCS National Water Management Center review.
3) NRCS Headquarters review.
4) Issue the Draft Plan-EIS for public review.

7.4.3 Draft Plan-EIS Public Comment

This portion will be completed in the Final Plan-EIS to document the Draft Plan-EIS public comment process. Comments and responses on the Draft Plan-EIS will be included in Appendix A of the Final Plan-EIS.

7.4.4 Final Plan-EIS and Record of Decision Public Comment

When the Final Plan-EIS and ROD are issued, an NOA will be published in the *Federal Register* and locally to notify the public of the finding and copies made available on the project website.

7.4.5 Distribution List

Table 7.4 lists the government agencies and organizations that are included on the project distribution list for scoping notice and/or NOA for the Draft Plan-EIS. Private parties are not listed to maintain privacy for those individuals.

Table 7.4. Distribution List–Federal Government

USDA-NRCS	USACE
USFWS	EPA
BLM	NPS/ZNP
USFS	BOR
FEMA	Utah U.S. House of Representatives
U.S. Senators Mike Lee and John Curtis	-

Table 7.5. Distribution List–State Government

Utah PLPCO	UTLA
Utah SHPO	UDOT
UDWR	UDEM
UNHP	Utah Department of Natural Resources
Utah State Clearinghouse	UDWRe
UDEQ	UDWQ
Utah Division of Water Rights	Utah Department of Cultural and Community Engagement
Utah Department of Agriculture and Food	Utah Department of Public Safety
Utah House of Representatives, District 2	Utah State Senate, District 2

Table 7.6. Distribution List–Local Government

Orderville, Utah	Mt. Carmel, Utah
Glendale, Utah	Kane County Commission
Kane County, Utah	Washington County, Utah
KCWCD	WCWCD

Table 7.7. Distribution List–Business and Organizations

Orderville Irrigation Company	Glendale Irrigation Company
Mt. Carmel Irrigation Company	-

Table 7.8. Distribution List–Non-Governmental Organizations

Utah Rivers Council	Utah Council of Trout Unlimited
American Rivers	Grand Canyon Trust
Conserve Southwest Utah	National Parks Conservation Association
American Whitewater	Great Basin Water Network
The Center for Biological Diversity	Living Rivers

Table 7.9. Distribution List–Tribes

Hopi Tribe of Arizona	Kaibab Band of Paiute Indians of the Kaibab Indian Reservation
Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony	Moapa Band of Paiute Indians of the Moapa River Indian Reservation
Navajo Nation	Paiute Indian Tribe of Utah
Pueblo of Zuni	San Juan Southern Paiute Tribe
Ute Indian Tribe of the Uintah & Ouray Reservation	Ute Mountain Ute Tribe
White Mesa, Ute Council	-

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9.0 LIST OF PREPARERS

Table 9.1 lists the people who participated in the preparation of this document.

Table 9.1. List of Preparers.

Name	Organization	Title	Education	Professional Experience (years)	Area Responsible For
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Derek Hamilton	NRCS–Utah	Water Resources Coordinator	B.S., Geography M.S., Environmental Science	25 plus	Review, Concept Design, Engineering, and Coordination
Tara Hoffmann	NRCS–Utah	Water & Cultural Resources Specialist	B.S., Natural Resources M.A., Anthropology	20 plus	Review, Concept Design, Engineering, and Coordination
Lance Smith	NRCS–Utah	Civil Engineer	B.S., Engineering	20 plus	Review, Concept Design, Engineering, and Coordination

Name	Organization	Title	Education	Professional Experience (years)	Area Responsible For
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Name	Organization	Title	Education	Professional Experience (years)	Area Responsible For
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Glen Carnahan	Alpha Engineering, Inc.	Project Engineer	B.S., Civil and Environmental Engineering	23 plus	Engineering
Todd Gardner	Alpha Engineering, Inc.	Engineer	B.S., Civil Engineering A.A., Arts	25 plus	Engineering
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Name	Organization	Title	Education	Professional Experience (years)	Area Responsible For
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Mike Noel	Kane County Water Conservancy District	General Manager	B.S., Zoology M.S. Plant Ecology Matriculated PhD Studies, Biology	39 plus	Sponsor Review
Dirk Clayson	Kane County Water Conservancy District	Board Member	Utah Valley University	30 plus	Sponsor Review
Zach Renstrom	Washington County Water Conservancy District	General Manager	University of Utah and Washburn Law School	20 plus	Sponsor Review
Corey Cram	Washington County Water Conservancy District	Associate General Manager	B.A., Geology/Physical Science M.S., Hydrogeology	30 plus	Sponsor Review
Morgan Drake	Washington County Water Conservancy District	Reuse Program Manager	B.S., Business Administration J.D., Law	10 plus	Sponsor Review
George Elliott	Washington County Water Conservancy District	Project Manager	B.A., English M.S., Civil Engineering	10 plus	Sponsor Review

Name	Organization	Title	Education	Professional Experience (years)	Area Responsible For
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Angelique Diaz	U.S. Environmental Protection Agency	Acting Director	Ph.D., Environmental Science and Engineering M.S., Environmental Science and Engineering	16 plus	Cooperating Agency Review
Robyn Henderek	National Park Service Through Zion National Park	Physical Science Program Manager	B.A., Geology and Anthropology	16 plus	Cooperating Agency Review
Jeff Bradybaugh	National Park Service Through Zion National Park	Superintendent	B.S., Wildlife and Fisheries Management M.S., wildlife biology	40 plus	Cooperating Agency Review
Hollis Jencks	U.S. Army Corps of Engineers	Project Manager	Unknown	unknown	Cooperating Agency Review
Jason Gipson	U.S. Army Corps of Engineers	Utah Section Chief	B.S., Biology/Ecology	17 plus	Cooperating Agency Review
Michael A. Pectol	U.S. Army Corps of Engineers	Regulatory Project Manager	B.S., Geology/Earth Science M.S., Environmental Science	15 plus	Cooperating Agency Review
Ron Torgerson	Utah Trust Lands Administration	Assistant Deputy Director	Unknown	25 plus	Cooperating Agency Review

Name	Organization	Title	Education	Professional Experience (years)	Area Responsible For
Sindy Smith	Utah Public Lands Policy Coordinating Office	RDCC Coordinator	Unknown	Unknown	Cooperating Agency Review
Dillon Hoyt	Utah Public Lands Policy Coordinating Office	Deputy Director	M.S., Natural Resources, Public Administration, Policy, and Planning B.S., Wildlife and Wildlands Science and Management	13 plus	Cooperating Agency Review
Nicole Nielson	Utah Public Lands Policy Coordinating Office	Wildlife Impact Analysis Coordinator	Unknown	Unknown	Cooperating Agency Review
Whit Bunting	Bureau of Land Management	Kanab Field Office Manager	Unknown	Unknown	Cooperating Agency Review
William Bate	Bureau of Land Management	Assistant Field Manager	Unknown	Unknown	Cooperating Agency Review

10.0 ACRONYMS

Table 10.1. List of Acronyms.

ACHP	Advisory Council on Historic Preservation
afy	Acre-Feet per Year
amsl	Above mean sea level
APE	Area of Potential Effects
BA	Biological Assessment
BCC	Birds of Conservation Concern
BCNP	Bryce Canyon National Park
BGEPA	Bald and Golden Eagle Protection Act
BLM	U.S. Bureau of Land Management
BMPs	Best Management Practices
BOR	U.S. Bureau of Reclamation
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
CRIR	Cultural Resources Inventory Report
CWA	Clean Water Act of 1972
DM	Departmental Manual
EAP	Emergency Action Plan
EFVR	East Fork Virgin River
Eocene	Eocene Environmental Group, Inc.
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act of 1973
F	Fahrenheit
FEMA	Federal Emergency Management Agency
HQW	High-Quality Waters
IOs	Isolated occurrences
IPaC	Information for Planning and Conservation
KCWCD	Kane County Water Conservancy District
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MSO	Mexican Spotted Owl
M&I	Municipal and Industrial
NAAQS	National Ambient Air Quality Standards
NEE	National Economic Efficiency
NEPA	National Environmental Policy Act
NGOs	Non-Government Organizations

NHPA	National Historic Preservation Act of 1966
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPPH	National Planning Procedures Handbook
NPS	U.S. National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
NWPH	National Watershed Program Handbook
NWPM	National Watershed Program Manual
O&M	Operation and Maintenance
PCRP	Post Construction Rehabilitation Plan
PFYC	Potential Fossil Yield Classification
PHMA	Priority Habitat Management Area
PL	Public Law
Plan-EA	Watershed Plan Environmental Assessment
Plan-EIS	Watershed Plan Environmental Impact Statement
PLPCO	Utah Public Lands Policy Coordinating Office
PR&G	Principles, Requirements, and Guidelines
ROD	Record of Decision
ROW	Right-of-way
SGCN	Species of Greatest Conservation Need
SHPO	State Historic Preservation Officer
SLOs	Sponsoring Local Organizations
SWPPP	Stormwater Pollution Prevention Plan
TCP	Traditional Cultural Property
TES	Threatened and Endangered Species
THPO	Tribal Historic Preservation Officer
UDEM	Utah Division of Emergency Management
UDEQ	Utah Department of Environmental Quality
UDOT	Utah Department of Transportation
UDWR	Utah Division of Wildlife Resources
UDWRe	Utah Division of Water Resources
UGS	Utah Geological Survey
UNHP	Utah Natural Heritage Program
UPDES	Utah Pollutant Discharge Elimination System
USACE	U.S. Army Corps of Engineers
USC	U.S. Code
USDA	U.S. Department of Agriculture

USFS	U.S. Forest Service
USGS	U.S. Geological Survey
USFWS	U.S. Fish and Wildlife Service
US-89	U.S. Highway 89
UTLA	Utah Trust Lands Administration
WCWCD	Washington County Water Conservancy District
WOTUS	Waters of the U.S.
WSA	Wilderness Study Area
WSR	Wild and Scenic Rivers
WSRA	Wild and Scenic Rivers Act of 1968
WYBC	Western Yellow Billed Cuckoo
ZNP	Zion National Park
ZNP Agreement (1996)	Zion National Park Water Rights Settlement Agreement of 1996

Appendix A.

Comments and Responses

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AUGUST 2022

SCOPING REPORT

COVE-EAST FORK VIRGIN RIVER WATERSHED PLAN



Prepared for Natural Resources Conservation Service
125 State Street # 4010 Salt Lake City, Utah 84138

Prepared by Transcon Environmental, Inc.
444 South Main Street Cedar City, Utah 84720

SCOPING REPORT

Cove-East Fork Virgin River Watershed Plan-EIS

Prepared for:

Natural Resources Conservation Service

125 State Street # 4010

Salt Lake City, Utah 84138

Prepared by:

Transcon Environmental, Inc.

444 South Main Street

Cedar City, Utah 84720

Transcon environmental | Planners & Scientists

July 2022

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1.0 Introduction and Background

The U.S. Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), with assistance of the Kane County Water Conservancy District (KCWCD) as the project sponsor, in conjunction with the Washington County Water Conservancy District (WCWCD) as co-sponsor, is considering proposed improvements within the East Fork Virgin River Watershed. The proposed improvements include the construction of a new reservoir as well as other improvements within the existing Glendale and Orderville irrigation systems as needed or identified. Improvements under consideration will address agricultural water demands, water conservation, and increasing opportunities for public recreation.

The National Environmental Policy Act (NEPA) and the Council on Environmental Quality's regulations at 40 CFR Parts 1500–1508 require an evaluation of potential environmental impacts associated with federal projects and actions with input from the public. As the lead agency under NEPA, USDA-NRCS will collect and consider input from the public, agencies, and Tribes. This Scoping Report will describe comments received and issues identified during the outreach and scoping process.

1.1 Purpose of Scoping Process

Scoping is an integral part of the NEPA process; it provides an early opportunity to determine the scope and significance of issues to be addressed in the proposed action (40 CFR 1501.7). The objectives of scoping include:

- Identify significant issues related to the proposed project
- Identify social, environmental, and economic review and consultation requirements
- Define the environmental analysis process and technical studies necessary to address the impacts of the proposed project
- Identify and notify interested and affected parties
- Provide information to agencies, Tribes, and the public regarding the proposed project

1.2 Organizational Involvement

Roles and responsibilities for the scoping process included:

- USDA-NRCS: Lead Federal Agency
- KCWCD: Project Sponsor
- WCWCD: Project Co-sponsor
- Alpha Engineering: Third-party Engineering Consultant
- Transcon Environmental: Third-party Environmental Consultant

2.0 Public Scoping Overview

The public was notified of the project through multiple channels, including:

- Notice of Intent published on March 29, 2022, in the Federal Register
- Mailed letter
- Email notice
- Web page information
- Newspaper publication
- Press release

Each of these outreach methods are summarized below. Public scoping officially lasted 204 days, beginning Thursday, October 7, 2021, and ending Thursday, April 28, 2022. The public was initially notified at the beginning of scoping and re-notified (mail and email only) once the project Notice of Intent was published.

2.1 Public Outreach

A scoping letter (**Appendix A.1**) and project fact sheet (**Appendix A.2**) were sent directly to select landowners who own parcels that are directly adjacent to or within the project area Additional individuals who participated in the scoping and public comment process for the Draft Plan-Environmental Assessment (EA) were also included on an email and/or hard copy mailing list. The mailing list will be updated as the project progresses, and individuals request to be informed of project updates. As part of scoping, 127 members of the public were mailed hard copies of the fact sheet on October 7 or October 8, 2021, commencing the comment period. Furthermore, an additional 120 individuals received scoping notices by email (some addresses returned as undeliverable). This outreach was timed in conjunction with the publication of a scoping notification in a local newspaper.

A notification was published in the *Southern Utah News* on October 7 and October 14, 2021 (**Appendix A.3**) to notify the public about the project meeting, including the date, time, and location. The notification also included instructions for submitting comments. Project press releases were sent to the following individuals and outlets:

- Brian Maffly, Salt Lake Tribune
- Joan Meiners, The Spectrum
- Desert Sun News

Specific non-government organizations contacted for scoping included:

- Utah Rivers Council
- Trout Unlimited
- American Rivers
- Grand Canyon Trust

- Conserve Southwest Utah
- National Parks Conservation Association
- American Whitewater

The fact sheet was also posted on the USDA-NRCS project website: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/ut/programs/planning/wpfp/?cid=nrcseprd1403022

A virtual public meeting was held via Zoom Webinar on Wednesday, October 20, 2021, from 6:00 p.m. to 7:30 p.m. Approximately 41 members of the public attended, based on the number of unique names/emails contained in the Zoom attendee report. A list of attendees is included (**Appendix A.4.)** The meeting included a PowerPoint presentation that provided background, project details, NRCS PL-566 program overview, maps of the watershed, and details on how to comment. Participants were encouraged to provide written comments regarding the project. Following the presentation, the project team hosted a question-and-answer period where written questions were responded to verbally by project leadership.

Project leadership from USDA-NRCS, KCWCD, WCWCD, Alpha Engineering, and Transcon Environmental were present to discuss the project with the public.

Following the meeting, a recording of the public meeting and the presentation slides used during the meeting were both posted to the USDA-NRCS project website. The presentation slides are also included in **Appendix A.5**.

2.2 Public Comments Received

A total of 66 public comment documents were received via email, via hard copy letter, and via the Federal Register page which were categorized and organized into 249 specific comments. 118 identical or virtually equivalent versions of a single email were consolidated into a single comment. A comment summary table is included as **Appendix D** and all public comments received are included in the Administrative Record and available upon request. A summary of all issues identified during scoping can be found in Section 5.0.

3.0 Agency Scoping

Federal, state, and local agencies were sent scoping letters and invited to attend an agency scoping meeting, as summarized below. Agency scoping officially lasted 204 days, beginning Thursday, October 7, 2021, and ending Thursday, April 28, 2022. Agencies were re-notified of the scoping end date once the Notice of Intent was published for the project and the scoping end date was determined.

3.1 Agency Outreach

A total of 32 agency scoping fact sheets were sent to elected officials and individuals at federal, state, and local agencies on October 7, 2021. To ensure consistent messaging, the fact sheet was identical to the public scoping fact sheet, except for the meeting details.

Local governments and elected officials contacted for scoping included:

- Glendale Irrigation Company
- Kane County Commission
- Kane County Conservation District
- Mt. Carmel Irrigation Company
- Orderville Irrigation Company
- Town of Glendale
- Town of Orderville
- U.S. Congressional Representatives

Federal and state agencies contacted for scoping included:

- Bureau of Land Management (BLM), Kanab Field Office
- National Park Service (NPS), Zion National Park
- U.S. Army Corps of Engineers (USACE), St. George Field Office
- USACE, Nevada/Utah Regulatory Branch
- U.S. Bureau of Reclamation (BOR)
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- Utah Department of Agriculture
- Utah Department of Cultural and Community Engagement
- Utah Department of Environmental Quality
- Utah Department of Public Safety
- Utah Department of Water Rights
- Utah Division of Wildlife Resources
- Utah Public Lands Policy Coordination Office
- Utah School and Institutional Trust Lands Administration
- Utah State Clearinghouse

Agencies were also invited to attend a virtual agency scoping meeting held online via Zoom on Monday, October 18, 2021, from 2:30 p.m. to 3:30 p.m. Two individuals attended the agency scoping meeting, representing the Division of Wildlife Resources Southern Region Office and USACE St. George Regulatory Office.

3.2 Agency Comments Received

A total of 9 agency comment documents were received which were categorized and organized into 57 specific comments. A comment summary table is included as **Appendix D** and all agency comments received are included in the Administrative Record and available upon request. A summary of issues identified during both public and agency scoping is included below.

4.0 Tribal Scoping

Scoping letters were mailed to 17 representatives of the 11 tribes as part of the outreach process. A single comment letter was received from the Hopi Tribe requesting hard copies of the cultural resource reports once these are prepared. All tribal comments received are included in the Administrative Record and available upon request.

- Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony
- Ute Indian Tribe of the Uintah & Ouray Reservation
- Ute Mountain Ute Tribe
- Hopi Tribe of Arizona
- White Mesa, Ute Council
- Paiute Indian Tribe of Utah
- Navajo Nation Office of the President
- Pueblo of Zuni
- Moapa Band of Paiute Indians of the Moapa River Indian Reservation
- Kaibab Band of Paiute Indians of the Kaibab Indian Reservation
- San Juan Southern Paiute Tribe of Arizona

5.0 Summary of Issues

Based on the agency and public comments received, the primary project issues are listed below. All comments will be reviewed and responded to, as necessary, by the project team, and relevant comments will be considered and incorporated in the Draft Plan-Environmental Impact Statement (EIS). Multiple commenters requested that comments from the Draft Plan-EA process be included for consideration.

Summary of issues raised during scoping is included below.

General Comments

- Will the comments on the Draft Plan-EA be carried forward as issues to address in the Draft Plan-EIS?
- Comments contained requests to include other agencies and entities in the planning process: NPS, BLM, BOR, Colorado River Compact Signers.
- The Draft Plan-EIS should clearly disclose that the KCWCD already owns the land where the proposed Cove Reservoir would be located.
- The Draft Plan-EA discusses that the Jackson Flat Reservoir and the proposed project would both provide water to meet irrigation needs in the County. However, the two systems are separate, and water would not be shared between reservoirs. This should be clarified.

- The project needs to be shown to be consistent with the Washington County Resource Management Plan, specifically its irrigation policy, and the Kane County Resource Management Plan.

NEPA/Purpose and Need/Other Laws

- The Plan-EIS needs to be developed under current, applicable executive orders.
- The KCWCD and WCWCD should propose separate reservoir projects. The two water conservancy districts' needs and funding are different and the WCWCD does not need to be subsidized by the federal government.
- The purpose and need for the Draft Plan-EIS should clearly specify the water need and be broad enough to allow for a sufficient range of feasible and practicable alternatives.
- The Draft Plan-EIS should consider whether the water will ultimately be used for housing developments.

Water Resources

- The Plan-EIS needs to investigate the reduction in flow resulting from reservoir diversions on a seasonal basis, and any accompanying effects (e.g., increasing water temperature, loss of fish habitat, other ecological effects).
- The Draft Plan-EIS must analyze the project effects on groundwater resources and how any effects will be minimized or mitigated.
- The Draft Plan-EIS must address any potential impacts to wetlands, documenting these in a Waters of the U.S. Report, and detailing any necessary mitigation.

Invasive Species

- The Draft Plan-EIS needs to address non-native invasive species issues, including quagga mussels, Tamarisk, Russian olive, red shiner, and non-native game fish stocking in reservoir, among others.

Health and Safety

- The potential failure of the dam is extremely concerning for risk to downstream residents. The NRCS needs to assess all project risks to human health and safety and consider compensation for life and property loss in the event of a dam failure. A dam failure response plan should be included.
- The Draft Plan-EIS must address construction worker health and safety.

Economics

- All operating costs, water exchange agreements, and other economic incentives need to be clearly disclosed in the EIS to show the parties primarily benefitting from the reservoir.

- The NRCS must accurately assess the cost/benefit ratio of any and all project improvements constructed. Identified costs: reservoir operation, recreational facility operation, invasive species management need to be included. Identified benefits: agricultural increase, recreational reservoir use. Some comments claim the economic benefits are overstated and the project should be abandoned because of this.
- The Draft Plan-EIS must consider all the effects, costs, and benefits of any proposed hydropower facilities and should analyze a run-of-the-river hydropower alternative. Hydropower facilities must be shown to be economically viable.

Effects Analysis

- A full water budget and water quality analysis for the proposed reservoir needs to be included in the analysis, including inflow, outflow, evaporation, and seepage losses. Timing and location of diversions and releases need to be disclosed and effects analyzed.
- The Draft Plan-EIS must show conformance with the BLM Kanab Field Office Resource Management Plan.
- The Draft Plan-EIS should identify and explain mitigation measures to avoid or minimize negative effects of the project.
- The Draft Plan-EIS needs to analyze downstream recreational impacts, ecological impacts, and geomorphological impacts due to changes in the flow regime due to project diversions and releases.
- The Draft Plan-EIS should quantify the stationary, mobile, and non-road source emission activities associated with construction, and quantify any air quality impacts from operation and maintenance, including methane emissions from the reservoir.
- The Draft Plan-EIS needs to analyze traffic impacts during construction and design/detail appropriate Best Management Practices or mitigation measures.
- The Draft Plan-EIS must detail how all aspects of the Zion National Park Water Rights Settlement Agreement will be met.
- The Draft Plan-EIS needs to consider the effects of the East Zion Growth Initiatives on multiple resources, including recreation, economics, and water resources and rights.
- The Draft Plan-EIS must analyze project impacts on highly erodible soils, erosion and sediment deposition, and riparian resources.
- The Draft Plan-EIS must address changes to agricultural runoff, including chemical and pesticide loads, resulting from the project.

Alternatives

- The project should be expanded to include a comprehensive Watershed Plan for the entire East Fork Virgin River. This could have multiple sub-project components. Inclusion of a Beaver management plan is suggested.
- The Draft Plan-EIS should analyze additional reservoir sites beyond the Cove Reservoir location. A reservoir further upstream could more easily benefit water users.
- Additional recreational facilities within the watershed, not necessarily co-located with the reservoir, should be considered as part of project alternatives.
- The project purpose and need is too narrow and biased toward reservoir development. It needs to be broadened to include other alternatives.
- The project must consider non-structural/management alternatives to the proposed reservoir.
- The Draft Plan-EIS must consider agricultural water efficiency improvements as an alternative to the proposed reservoir.
- The NRCS should allocate funds to smaller, more economically viable projects instead of the proposed project.

Sensitive Species

- The Draft Plan-EIS must consider impacts to the Virgin Spinedace, managed under a conservation agreement, and petitioned to be listed as a threatened and endangered (T&E) species.
- The Draft Plan-EIS must clearly describe and disclose effects to aquatic species, whether positive or negative.
- The Draft Plan-EIS must address impacts to T&E species and habitat, including Mexican Spotted Owl, Southwestern Willow Flycatcher, Yellow-Billed Cuckoo, T&E fish species, and other state and federal sensitive species.

Recreation

- The project should consider a conservation pool for a water allocation for sport fisheries and development of sport fisheries as part of the recreation plan.

Watershed Protection

- The project should address erosion and bank stabilization in the Mt. Carmel area.

Wild and Scenic Rivers

- The Draft Plan-EIS must address the project impacts on the Wild and Scenic River designation of a section of the East Fork Virgin River downstream of the project. The NPS will require a Section 7 determination.

- The hydropower facilities must be Federal Energy Regulatory Commission (FERC) permitted and compliant with FERC regulations that limit licensing of dam and hydropower facilities above Wild and Scenic River designated segments.

Cumulative Effects

- The Draft Plan-EIS must consider cumulative effects of the following projects: the Lake Powell Pipeline project, the Ash Creek Reservoir and pipeline project, a new flood control project in the Virgin River watershed, and other past projects in the area.

Areas of Critical Environmental Concern

- The Draft Plan-EIS must address project impacts on downstream Areas of Critical Environmental Concern, wilderness areas, Wilderness Study Areas, and research natural areas.

Biological Resources

- The project should make a clear commitment to a minimum amount of water to be released during the summer months to benefit fish and wildlife habitat.

Climate Change

- The Draft Plan-EIS must address the impact of climate change on the project and water supply reliability.

Environmental Justice

- The Draft Plan-EIS must address Environmental Justice effects.

Legal

- A discussion of why the proposed project is so large compared to most NRCS watershed projects should be included in the Draft Plan-EIS.

Tribal and Cultural Resources

- The Draft Plan-EIS must comply with the National Historic Preservation Act.
- The Draft Plan-EIS needs to include input from sovereign tribes in the Lower Colorado River Basin and State of Utah who are not receiving their full water allocation.

Appendix A. Public Scoping

A.1. Public Scoping Letter

A.2. Project Fact Sheet

A.3. Newspaper Notification

A.4. Public Meeting Attendee List

A.5. Public Meeting Materials

A.1. Public Scoping Letter

United States Department of Agriculture

Natural Resources
Conservation Service

Utah State Office

www.ut.nrcs.usda.gov

September 21, 2021

<Adddress Block>

RE: Cove-East Fork Virgin River Watershed Plan EIS Project
Parcel No.:

<Salutation>:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with the Kane County Water Conservancy District (KCWCD) as the project sponsor and Washinton County Water Conservancy District (WCWCD) as the co-sponsor, is considering proposed improvements within the East Fork Virgin River Watershed. The proposed improvements include the construction of a new, up to 6,055-acre-foot capacity reservoir (Cove Reservoir), as well as other improvements within the existing Mt. Carmel, Glendale and Orderville Irrigation Systems. Improvements under consideration will address water conservation concerns, agricultural and municipal demands, public safety risks, and will increase opportunities for public recreation. See the enclosed Project Fact Sheet for information about project features.

This proposed action is prepared under the authority of the Watershed Prevention and Flood Protection Act (Public Law 83–566). This action is needed because agriculture users in the Upper Virgin Watershed routinely experience water shortages during late summer months when East Fork Virgin River flows are depleted. Existing irrigation facilities have limited capabilities to divert water from the river, and there is currently no capacity for storage during non-use and high-flow periods. As a result, adequate water is not available to local users; therefore, the purpose of the action is to provide enhanced conservation and beneficial use of water by increasing water availability through collection and storage during non-use periods to provide adequate flows during the irrigation season.

In compliance with the National Environmental Policy Act (NEPA), USDA-NRCS will develop an Environmental Impact Statement to analyze potential impacts to the natural and human environment from the proposed project. As the project sponsor, KCWCD, and WCWCD as the co-sponsor, in coordination with USDA-NRCS, has retained Transcon Environmental, a third-party environmental consultant, to assist with NEPA compliance activities and resource studies.

This letter is to notify you of the project, request comments, and invite you to a public scoping meeting, to be held virtually via Zoom on Wednesday, October 6 from 6:00pm—7:30pm. The Zoom details are below:

USDA is an equal opportunity provider, employer, and lender.

The purpose of the meeting is for the project team to better understand potential alternatives and issues to be considered during environmental analysis. The meeting will consist of a brief presentation about the proposed project followed by a question-and-answer session. Written comments about the project may be submitted during the scoping meeting, or sent to the address below. All comments must be post-marked by **October 21, 2021**. Please send or email comments to:

Transcon Environmental, Inc.
Attn: Brian Parker

We look forward to receiving your comments and discussing this project further.

Sincerely,

Emily Fife
Encl: Project Fact Sheet, including map

Commented [IS1]: NRCS, please update sender and title, if needed

A.2. Project Fact Sheet

USDA United States Department of Agriculture

Cove-East Fork Virgin River Watershed Project – Kane County, Utah

Agency Scoping Notice



Project Information

The U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), with assistance of the Kane County Water Conservancy District as the project sponsor and Washington County Water Conservancy District as the co-sponsor, is considering proposed improvements within the East Fork Virgin River Watershed. The proposed improvements include a new water storage facility (Cove Reservoir), or an alternate reservoir site, as well as other improvements associated with the Mt. Carmel, Glendale, and Orderville irrigation systems.

NRCS is holding a virtual agency meeting, via Zoom to provide information about the proposed project and to collect comments. Supplemental technical studies are scheduled to take place during fall 2021, with a Draft Watershed Plan – Environmental Impact Statement (Plan-EIS) circulated to the public and agencies for review in mid-2022. The Plan-EIS will further evaluate the proposed project along with any viable project alternatives in accordance with the rules and guidelines of the National Environmental Policy Act (NEPA) and Council on Environmental Quality (CEQ).

The Plan-EIS is being funded under the NRCS Watershed Flood Prevention and Protection Program (PL83-566), which provides both technical and financial assistance to help communities protect, improve, and develop water and land resource in watersheds up to 250,000 acres.

Project Background

Initially known as the "Cove Reservoir Watershed" project, alternatives and associated impacts were analyzed in a Watershed Plan-Environmental Assessment (Plan-EA); however, after careful project review and consideration of comments received on the Draft Plan-EA presented in winter 2020/2021, the NRCS has initiated the preparation of a Plan-EIS.

Improvements under consideration include water conservation, water storage, agricultural and municipal demands, public safety risks, and increased opportunities for public recreation in the East Fork Virgin River watershed.

Project Website

Additional information can be found at the NRCS project website:

https://www.nrcs.usda.gov/wps/portal/nrcs/detail/ut/programs/planning/wpfp/?cid=nrcseprd1403022

Agency Meeting

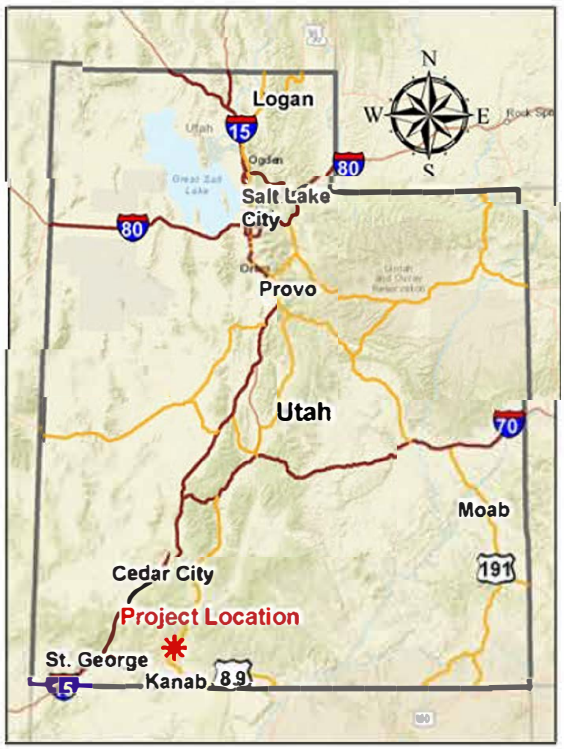
Agencies are invited to attend a project scoping presentation, discuss project details, and submit comments during the online meeting:

Virtual Meeting
Monday, October 18, 2021
2:30 P.M. – 3:30 P.M. (MST)

How to Join the Virtual Agency Meeting

Log-in via Zoom: zoom.us/join
Enter Meeting ID: 886 6521 8321
Passcode: 992578
Note: This meeting will be recorded. A copy can be made available upon request.

Project Location Map



At this time, the NRCS is requesting comments on the project to identify opportunities, issues, and resource concerns.

How to Provide Official Comment

All comments should be directed to Brian Parker:

Transcon Environmental
Attn: Brian Parker
1745 South Alma School Rd., Suite 220
Phoenix, AZ 85210
480-807-0095
bparker@transcon.com

Comments must be received or post-marked no later than 30 days after the NOI is published in the Federal Register.

How to Be Added to Mailing List

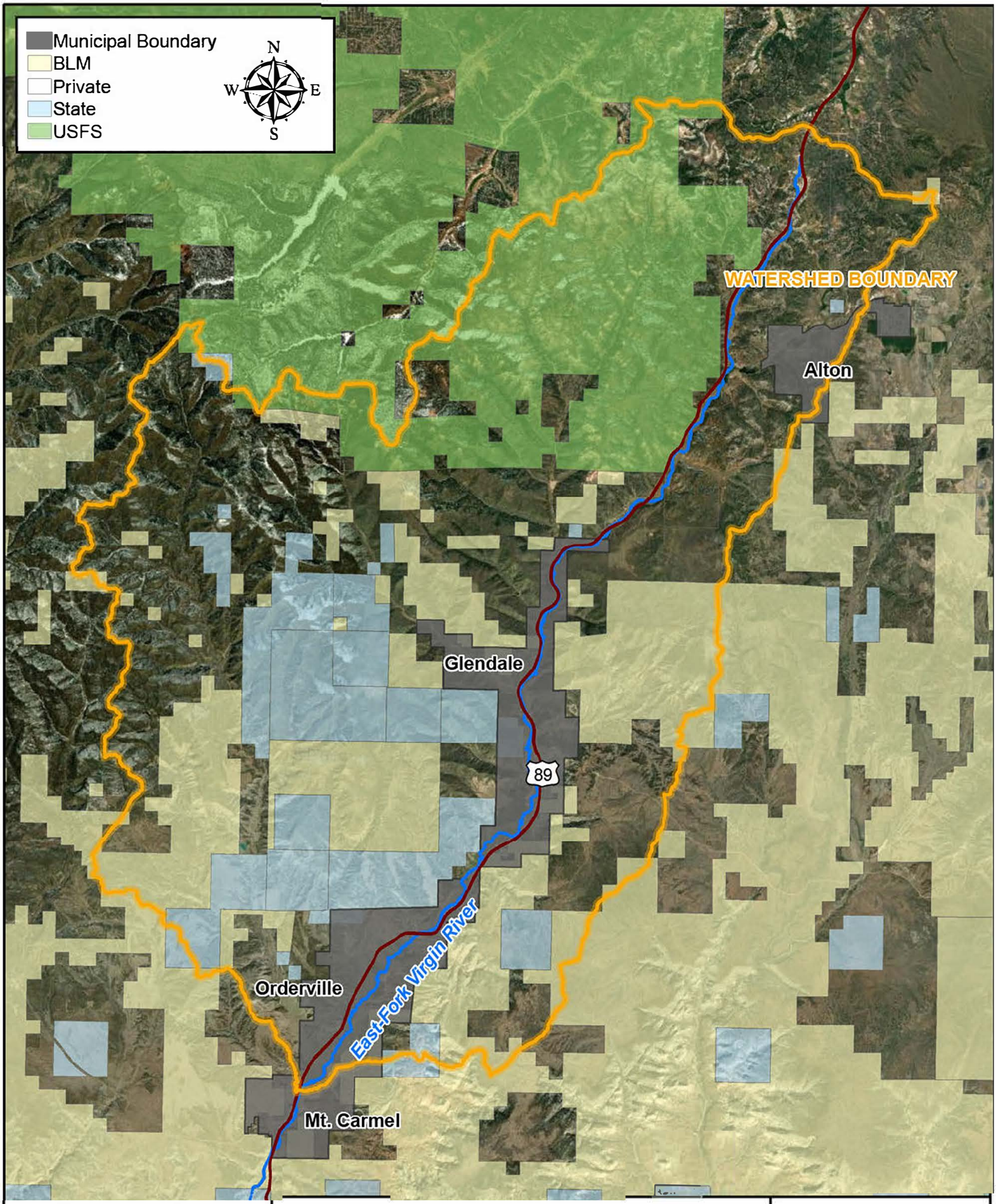
Provide your email address when logging into the Zoom meeting or send a letter or email request to Brian Parker using the contact information provided above.

Utah State Office

Natural Resources Conservation Service

nrcs.usda.gov/

USDA is an equal opportunity provider, employer, and lender. Utah State Office – October 2021



Transcon environmental | Planners & Scientists

USDA United States Department of Agriculture
Natural Resources Conservation Service

Cove - East Fork Virgin River Watershed Project

Watershed Boundary Exhibit (97,427 acres)

0 11,000
Feet

A.3. Newspaper Notification

ATTENTION
Kane County Voters
General Election
November 02, 2021
7:00 a.m. to 8:00 p.m.

Last day a voter can register to vote for the General Election by mailing a registration form, Online or in-person is October. 22, 2021
The Kane County Clerk's Office is open from 8:00 a.m. to 5:00 p.m.
Public Logic & Accuracy Testing will take place on October. 08, 2021 at 10:00 a.m.
Board of Canvassers will meet on Nov. 16, 2021 at 10:00 a.m.

****

Early Voting will begin on Oct. 19, and ends on Oct. 29, 2021, from 8:00 a.m. to 5:00 p.m. at the County Clerk's Office, 76 North Main Street.
All Voters will need a photo ID

****

All of Kane County is now a "Vote by Mail" County. This means you will receive a *"PAPER BALLOT"* in the mail. PLEASE DO NOT THROW IT AWAY!

If you choose not to vote your "Absentee/By Mail" Ballot you may vote in person at the "Kanab Election Center" located at the "Kane County Courthouse" 76 North Main on Election Day or at the "Valley Vote Center" located at the "Kane County North Event Center" located at 475 East State Street on Election Day. You will need to bring in your "By Mail Ballot" to the election center with you where your original ballot will be spoiled, you will be issued a *"NEW PAPER BALLOT."*

You can also choose to vote early in person at the Kane County Clerk/Auditor's Office by bringing in your "By Mail Ballot" where your original ballot will be spoiled, to cast your vote in person on a *"NEW PAPER BALLOT."*

Ballot Drop Box will be available beginning Oct. 12, 2021 at 8:00 A.M and Closing Nov. 02, 2021 at 8:00 P.M.

****

SAMPLE BALLOTS
Races that will be on the General Municipal Election

PRECINCTS: BW
Big Water Town Mayor (Vote for One)
VINCE OLSON
DAVID W SCHMUKER
Big Water Town Council (Vote for up to Two)
ANNE WELSH
LEVI BANFILL
JUDAH SCHMUKER

PRECINCTS: GL
Glendale Town Mayor (Vote for One)
DANNY SPENCER
KELLY LAMB
Glendale Town Council (Vote for up to Two)
CHRIS WILLIAMS
KRISTY L BRINKERHOFF
DAVID MAXWELL
JOANN S. LAMB

PRECINCTS: KA1:A, KA2:A, KA3:A, KA4
Kanab City Mayor (Vote for One)
TROY (COLTEN) JOHNSON
JEFF YATES
Kanab City Council (Vote for up to Two)
SCOTT COLSON
APRIL CROFTS
CHRIS HEATON

PRECINCTS: AL:B BU, BW, CM, CW:B, CW:C, GL, KA1:A, KA1:B, KA1:C, KA2:A, KA2:B, KA3:A, KA3:B, KA4, OR:A, OR:B
Kane County Hospital Board (Vote for up to Three)
BENJAMIN L BECKSTEAD
STUART K ALLAN
CAROL PENNEY SULLIVAN
JEFFERY B. MSODELL
JOE D. HOUSTON

PRECINCTS: OR:A
Orderville Town Council (Vote for Two)
JACOB LEE MILLARD
DAVID RORY HATCH
THOMAS GRIFFITHS
MARIANNE LEIGH

PRECINCTS: BU, CM, CW:B, CW:C, KA1:A, KA1:B, KA1:C, KA2:A, KA2:B, KA3:A, KA3:B, KA4, OR:B
Proposition #10
Shall a government body be established to : • Create the Zion Area Public Transit District ("the District") limited to the geographic boundaries of Kanab City and unincorporated area of Kane County, that: • Creates and operates a public shuttle bus system that serves Kane County residents and visitors to and from stops in Kanab, the East Zion area including the proposed new Zion Nation Park Visitor Center, stops within Zion National Park and surrounding areas, and additional parking areas and stops within the District; • Provides support to existing and future planned hiking and biking trails, residential and vacation lodging, restaurants, guides and outfitters, and other businesses; and • DOES NOT levy taxes upon taxable property or impose a sales and use tax; • Will work to obtain funding through private donations, local, state, and federal grants and may charge user fees; • Will be governed by a Board of Trustees who shall be selected in accordance with Utah Law; • Uses a funding method that is estimated to have a $0.00 financial impact to District residents.

Published in the *Southern Utah News* on October 7, 14, 21 and 28, 2021.

ARTICLES OF ORGANIZATION OF LIMITED LIABILITY COMPANY

ENTITY INFORMATION

ENTITY NAME: KLMM INVESTMENT, LLC
ENTITY ID: 23280455
ENTITY TYPE: Domestic LLC
EFFECTIVE DATE: 10/04/2021
CHARACTER OF BUSINESS: Any legal purpose
MANAGEMENT STRUCTURE: Member-Managed
PERIOD OF DURATION: Perpetual

STATUTORY AGENT INFORMATION

STATUTORY AGENT NAME: Trevor Kortsen
PHYSICAL ADDRESS: 123 N. San Francisco Street, Suite 300 FLAGSTAFF, AZ 86001
MAILING ADDRESS: 123 N. San Francisco Street, Suite 300 FLAGSTAFF, AZ 86001

PRINCIPAL ADDRESS
6393 N. Cosnino Rd.
FLAGSTAFF, AZ 86004

PRINCIPALS
Member: Elizabeth Meredith, as Trustee of the Meredith Family Revocable Living Trust, dated October 4, 2021
6393 N. Cosnino Rd.
FLAGSTAFF, AZ 86004

Member: Kyle Meredith, as Trustee of the Meredith Family Revocable Living Trust, dated October 4, 2021
6393 N. Cosnino Rd.
FLAGSTAFF, AZ 86004

ORGANIZERS
Trevor Kortsen

SIGNATURES
Organizer: Trevor Kortsen – 10/04/2021

Published in the *Southern Utah News* on October 7, 14 and 21, 2021.

2021 WATER RESOURCES PLAN PUBLIC COMMENT PERIOD
Wednesday, September 29, 2021 – Monday, November 15, 2021

The Utah Division of Water Resources (Division) is pleased to announce the draft 2021 Water Resources Plan (2021 Plan) is available for review. The 2021 Plan identifies action the Division will take over the next five years. It focuses on reliable data, supply security, and a healthy environment.

A public comment period is open from Wednesday, September 29, 2021, through Monday, November 15, 2021. The draft 2021 Plan is posted on the Water Plan page of the Division's website water.utah.gov/2021waterplan for review. Comments may be submitted using the comment form link found on the Water Plan page.

A virtual open house will be held on Wednesday, October 20, 2021, from 7:00 PM – 8:00 PM. During the open house, a short presentation about the 2021 Plan will be followed by a question and answer session. Written questions will be accepted throughout the virtual open house session using the Question and Answer feature of the meeting software. To join the open house, use the link found on the Water Plan page.

Published in the *Southern Utah News* on October 7 and 14, 2021.

ARTICLES OF ORGANIZATION OF LIMITED LIABILITY COMPANY

ENTITY INFORMATION

ENTITY NAME: BLUE CLOUD GROUP, LLC
ENTITY ID: 23261567
ENTITY TYPE: Domestic LLC
EFFECTIVE DATE: 08/19/2021
CHARACTER OF BUSINESS: Any legal purpose
MANAGEMENT STRUCTURE: Member-Managed
PERIOD OF DURATION: Perpetual

STATUTORY AGENT INFORMATION

STATUTORY AGENT NAME: United States Corporation Agents, Inc.
PHYSICAL ADDRESS: 17470 N. Pacesetter Way SCOTTSDALE, AZ 85255
MAILING ADDRESS: 17470 N. Pacesetter Way SCOTTSDALE, AZ 85255

PRINCIPAL ADDRESS
3300 South Gila Drive, Apt. 101
FLAGSTAFF, AZ 86005

PRINCIPALS
Member: Jake Levi Alec Zimmerman
3300 South Gila Drive, Apt. 101
FLAGSTAFF, AZ 86005

ORGANIZERS
Legalzoom.com, Inc.: 101 N. Brand Blvd., 11th Floor GLENDALE, CA 91203

SIGNATURES
Organizer: By: Cheyenne Moseley, Asst. Secretary of Legalzoom.com, Inc., A Delaware Corporation
08/19/2021

Published in the *Southern Utah News* on October 7, 14 and 21, 2021.

Proposed Cove-East Fork Virgin River Watershed Project – Kane Co, Utah Scoping Notice and Public Scoping Meeting Announcement Wednesday, October 20, 2021, 6:00-7:30 P.M.

Project Information:
The U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), with assistance of the Kane County Water Conservancy District as the project sponsor and Washington County Water Conservancy District as the cosponsor, is considering proposed improvements within the East Fork Virgin River Watershed. The proposed improvements include a new water storage facility (Cove Reservoir), or an alternate reservoir site, as well as other improvements associated with the Mt. Carmel, Glendale, and Orderville irrigation systems.
NRCS is holding a virtual public meeting, via Zoom to provide information about the proposed project and to collect comments. Supplemental technical studies are scheduled to take place during fall 2021, with a Draft Watershed Plan – Environmental Impact Statement (Plan-EIS) circulated to the public and agencies for review in mid-2022. The Plan-EIS will further evaluate the proposed project along with any viable project alternatives in accordance with the rules and guidelines of the National Environmental Policy Act (NEPA) and Council on Environmental Quality (CEQ).
The Plan-EIS is being funded under the NRCS Watershed Flood Prevention and Protection Program (PL83-566), which provides both technical and financial assistance to help communities protect, improve, and develop water and land resource in watersheds up to 250,000 acres.
Project Background:
Initially known as the "Cove Reservoir Watershed" project, alternatives and associated impacts were analyzed in a Watershed Plan-Environmental Assessment (Plan-EA); however, after careful project review and consideration of comments received on the Draft Plan-EA presented in winter 2020/2021, the NRCS has initiated the preparation of a Plan-EIS.
Improvements under consideration include water conservation, water storage, agricultural and municipal demands, public safety risks, and increased opportunities for public recreation in the East Fork Virgin River watershed.
At this time, NRCS is requesting comments on the project to identify issues and resource concerns. NRCS will hold a virtual public meeting to provide information about the proposed project and to collect comments.

Attend the virtual public scoping meeting via Zoom:
The public is invited to attend, discuss, and submit a comment during the public meeting:
Wednesday, October 20, 2021
6:00 P.M. – 7:30 P.M.
Meeting Link: www.zoom.join/us Enter Meeting ID: 891 2373 1558

Send us your comments:
All comments should be directed to:
Brian Parker
Transcon Environmental
1745 South Alma School Rd., Suite 220
Phoenix, AZ 85210
Phone: (480) 807-0095
bparker@transcon.com

Additional information can be found at the NRCS project website (shortened link): https://bit.ly/3AX7Pg4

Comments may be mailed or emailed to the above address or submitted during the public scoping meeting. Comments must be received or postmarked starting October 7, 2021 and ending 30 days after the Notice of Intent to prepare an EIS is posted in the Federal Register.

Published in the *Southern Utah News* on October 7 and 14, 2021.

ARTICLES OF INCORPORATION FOR-PROFIT CORPORATION

ENTITY INFORMATION

ENTITY NAME: MONICA PERTEA, PC
ENTITY ID: 23278120
ENTITY TYPE: Domestic Professional Corporation
EFFECTIVE DATE: 09/28/2021
CHARACTER OF BUSINESS: Any legal purpose
AUTHORIZED SHARES
Share Class: Common Share
Total: 10,000
PROFESSIONAL SERVICES: legal services

STATUTORY AGENT INFORMATION

STATUTORY AGENT NAME: Monica M. Pertea
PHYSICAL ADDRESS: 123 N. San Francisco St., Suite 300 FLAGSTAFF, AZ 86001

KNOWN PLACE OF BUSINESS
123 N. San Francisco St., Suite 300
FLAGSTAFF, AZ 86001

PRINCIPAL INFORMATION
Director: Monica Pertea 123 N. San Francisco St., Suite 300 FLAGSTAFF, AZ 86001

Incorporator: Monica Pertea 123 N. San Francisco St., Suite 300 FLAGSTAFF, AZ 86001

President: Incorporator: Monica Pertea 123 N. San Francisco St., Suite 300 FLAGSTAFF, AZ 86001

SIGNATURE
Incorporator: Monica Pertea
09/28/2021

Published in the *Southern Utah News* on October 7, 14 and 21, 2021.

Notice of Public Hearing

Proposed Rate adjustment for Garkane members

Scheduled for Monday, Oct. 25th, 2021 at Garkane's Hatch office at 1:00 p.m.

A public hearing is scheduled on Monday, Oct. 25, 2021, in Garkane's Hatch office at 1:00 P.M. The Hatch office is located at 468 N. Hwy 89, in Hatch, UT. Comments or questions may be submitted via email at **neal.brown@garkane.com** or you can mail your comments or questions to: Garkane Energy, Attn: Public Hearing, 1802 s. Hwy 89a, Kanab, UT 84741. All written, or emailed comments submitted by Friday, October 22, 2021 will be distributed to the Board of Directors for review.

The purpose of the public hearing will be to discuss the proposed rate adjustments brought upon by wholesale power cost increases imposed on Garkane Energy Cooperative by Deseret Power.

A copy of the full proposed draft will be available at **www.garkaneenergy.com** under "**Your Co-op**" in the rates section of the website.

Written comments can be directed to:
Garkane Energy
attn: Neal Brown
1802 S. Hwy 89a,
Kanab, UT 84741

or comments can be emailed to: neal.brown@garkane.com

All written, Facebook comments, or e-mailed comments and questions submitted by Friday, October 22 will be distributed to the Board of Directors for review.

Garkane energy
A Touchstone Energy® Cooperative
The power of human connections®

www.garkaneenergy.com

Garkane Hatch Office Address: 468 N. Hwy 89, Hatch, UT 84735

A.4. Public Meeting Attendee List

Name	Email Address
Brad Price	
Norm Evenstad	
Derek Hamilton	
Mike Noel	
Leslie Warta	
Brandon Horrocks	
Brent Gardner	
Dirk Clayson	
Miranda Castillo	
Brian Parker	
Scott Hoag	
Corey Cram	
Lance Smith	
Ron Bolander	
Jason Bauer	
Anson Clarkson	
Kelly Wilson	
Chelcie	
Tyler	
Jane Whalen	
Lisa Church	
Resident	
Don Robinson	
Fred Reimherr	
Steve Meismer	
Eric Esplin	
I'm	
John Horel	
Karl Spencer	
American Whitewater	
John Smith	
Fire Tablet	
Sandy	
Paul Fuhrmann	
Bryan Dixon	
NRCS	
Cass Bromley	
Kurt Brinkerhoff	
Robyn Henderek	

Callie Lucas	
Danny Johnson	
Nick Halberg	
Jane Jennings	
Randy Beckstrand	
LaceyR	
Pixel 3 XL	
John Carpenter	
Ellie Chambers	
Richard Spotts	
Sorensens	
Ed Myers	
Clay	
Helene	
Kristi Westwood	

A.5. Public Meeting Materials

THANK YOU FOR JOINING!

THIS MEETING WILL BEGIN AT APPROXIMATELY 6:05 P.M. TO ALLOW FOR ALL ATTENDEES TO SIGN IN.

WE APPRECIATE YOUR PATIENCE!







WELCOME

COVE – EAST FORK VIRGIN RIVER WATERSHED PROJECT

PUBLIC SCOPING MEETING

October 20, 2021







MEETING PURPOSE

- Introduce the Project Sponsor and Team
- Provide an overview of the NRCS PL-566 Program
- Review the background and history of the Cove – East Fork Virgin River Watershed Project
    - Formerly the Cove Reservoir Project
- Present the purpose and preliminary alternatives being considered
- Inform the public how to provide scoping comments on the project
- Answer questions and collect comments from the public

LEAD AGENCY / SPONSORS

LEAD FEDERAL AGENCY

- U.S. DEPARTMENT OF AGRICULTURE - NATURAL RESOURCES CONSERVATION SERVICE

SPONSORING LOCAL ORGANIZATIONS

- KANE COUNTY WATER CONSERVANCY DISTRICT (PRIMARY SPONSOR)
- WASHINGTON COUNTY WATER CONSERVANCY DISTRICT (CO-SPONSOR)

IN COOPERATION WITH

- ENVIRONMENTAL PROTECTION AGENCY
- BUREAU OF LAND MANAGEMENT
- NATIONAL PARK SERVICE

PROJECT TEAM

NRCS UTAH

Norm Evenstad, *Assistant State Conservationist*

Derek Hamilton, *Water Resources Coordinator*

Leslie Warta, *Environmental Compliance Specialist*

Lance Smith, *Project Engineer*

Marcel Corbeil, *Cultural Resources Specialist*

KCWCD - SPONSOR

Mike Noel, *Executive Director*

Dirk Clayson, *Private Consultant Lands and Real Estate*

WCWCD – CO-SPONSOR

Zach Renstrom, *General Manager*

Corey Cram, *Associate General Manager*

ENGINEERING AND DESIGN

Alpha Engineering - Brent Gardner, *Project Manager/Principal Engineer*

RB&G Engineering – Brad Price, *Geotechnical Analysis*

RB&G Engineering – Brandon Horrocks, *Geotechnical Analysis*

ENVIRONMENTAL

Transcon Environmental – Tim Green, *Environmental Program Manager*

Transcon Environmental – Brian Parker, *Environmental Project Manager*

Transcon Environmental – Ian Snyder, *Coordinator and NEPA Planner*

Transcon Environmental – Ron Bolander, *NEPA Specialist*

ECONOMIC ANALYSIS

Scott Hoag Jr., *Economic Analyst*

PROJECT AUTHORITY

- **Authority**: Public Law 83-566, the Watershed Protection and Flood Prevention Act of 1954, as amended
- **Policy**: National Watershed Program Manual and Handbook sets plan policy
- **Project Sponsors**: Local organizations that have legal authority and resources to install, operate, and maintain improvements.
- **Authorized Purposes**: Flood prevention; watershed protection (erosion/sediment control); public recreation; fish and wildlife habitat; agricultural water; M&I water; water quality; watershed structure rehab; hydropower sources
- **NEPA**: The Plan-EIS is being prepared in accordance with Section 102(2)(c) of the National Environmental Policy Act of 1969 (NEPA), PL 91-190, as amended.

PL-566 OVERVIEW

- The Watershed Protection and Flood Prevention Act (PL-566) authorizes the NRCS to help local organizations and governments plan and implement physically, environmentally, socially and economically sound watershed project plans for the benefit of the public.
- Provides technical and financial assistance to project sponsors for planning and installing watershed projects (e.g., dams, debris basins, pipelines, etc.)
- Locally led NRCS teams. Local leadership is key.
- Up to a 250,000-acre watershed per project

PL-566 ELIGIBLE PURPOSES

- Flood Prevention
- Watershed Protection
- Agricultural Water Management
- Municipal and Industrial Water Supply
- Fish and Wildlife Habitat and Public Recreation Development



PL-566 PROJECTS

STRUCTURAL MEASURES

- **Dams**
- **Channel restoration**
- **Diversions**
- **Floodwalls**
- **Dikes**

NON-STRUCTURAL MEASURES

- **Upland conservation and erosion protection**
- **Wetland restoration**



PROJECT NEPA BACKGROUND

- Initially known as the "*Cove Reservoir Watershed*" Project
- Development of alternatives, resource studies, and impacts analyses were conducted from spring 2018 to fall 2020.
- Documented in a Draft Watershed Plan Environmental Assessment (Plan-EA)
- Preferred Alternative identified in the Plan-EA was the Cove Reservoir
- Draft Plan-EA published for public review and comment in December 2020
- Following review and consideration of comments, the Draft Plan-EA was not approved, but informed the NRCS to move to an EIS to analyze any viable alternatives in further detail

PROJECT BACKGROUND

- Initial planning for the proposed project began over 25 years ago
- Numerous agencies and irrigation companies involved in the planning including the Bureau of Land Management, National Park Service, U.S. Fish and Wildlife Service, Utah Department of Natural Resources, KCWCD, WCWCD, Orderville Irrigation Co., etc.
- Guidelines and limitations for potential projects in the East Fork Virgin River Watershed, including several specific reservoir alternatives, were identified and agreed upon in the *Zion National Park Agreement* (1996)
- *East Fork Virgin River Instream Flow MOU* (2000) regulates water flows on the East Fork Virgin River within the watershed being analyzed for this project

PROJECT PURPOSE

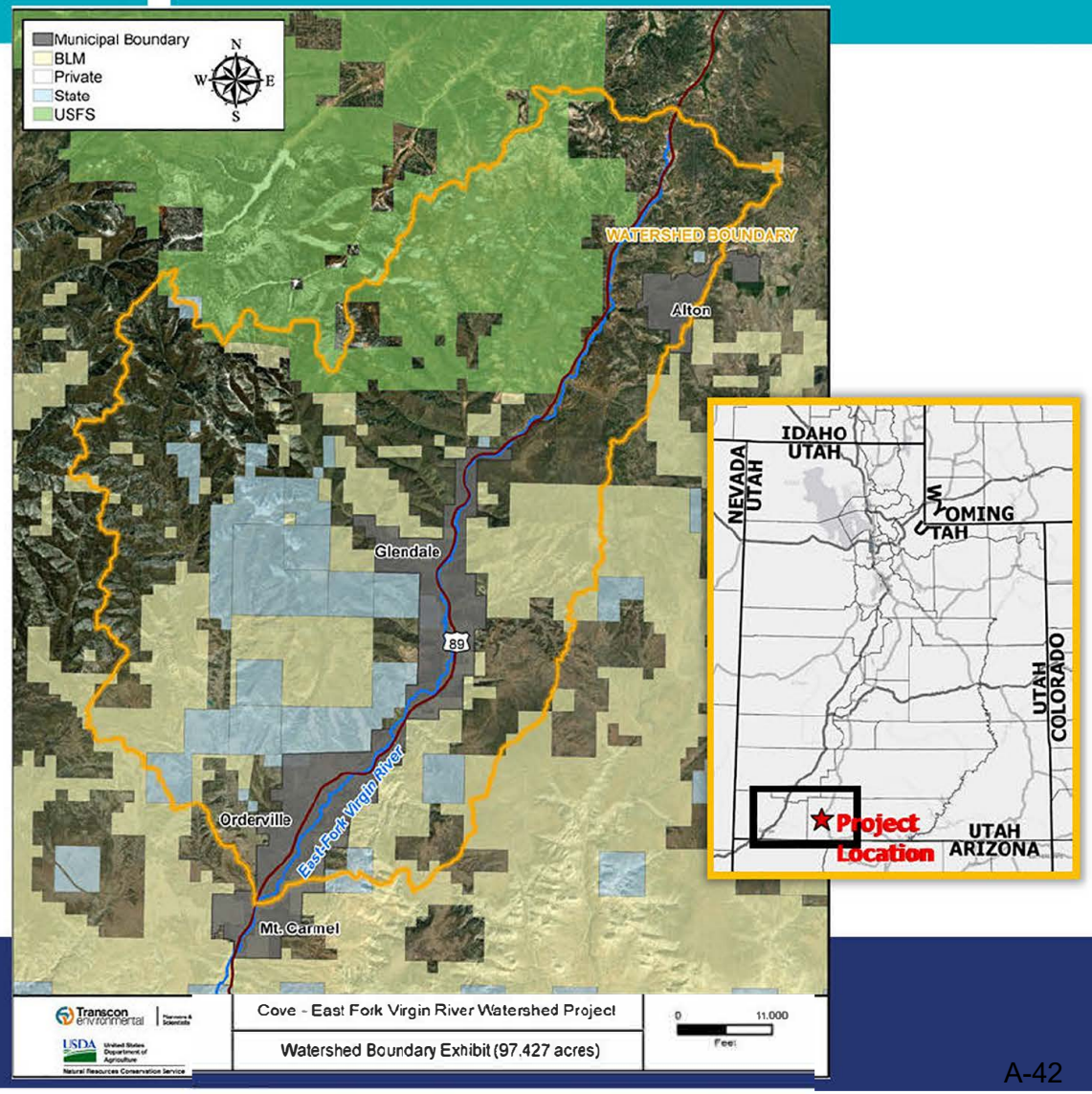
- Currently no critical water storage capacity or reliable irrigation water delivery to local agricultural users during the dry summer months
- Local water users in Kane County continue to experience water shortages
- Limited capability of existing irrigation system to utilize flows from the East Fork Virgin River
- Need for additional water reliability in Washington County
- Additional water-based recreation opportunities for locals and tourists

PROJECT PURPOSE

Project Response to the Needs:

- Identify a viable alternative which once implemented would:
  - Increase water availability and reliability for current and future users
  - Improve irrigation efficiency
  - Increase the availability of recreational opportunities (e.g., fishing, non-motorized boating, hiking, camping, etc.)
- Additional benefit: increase in hydroelectric energy supply to the community

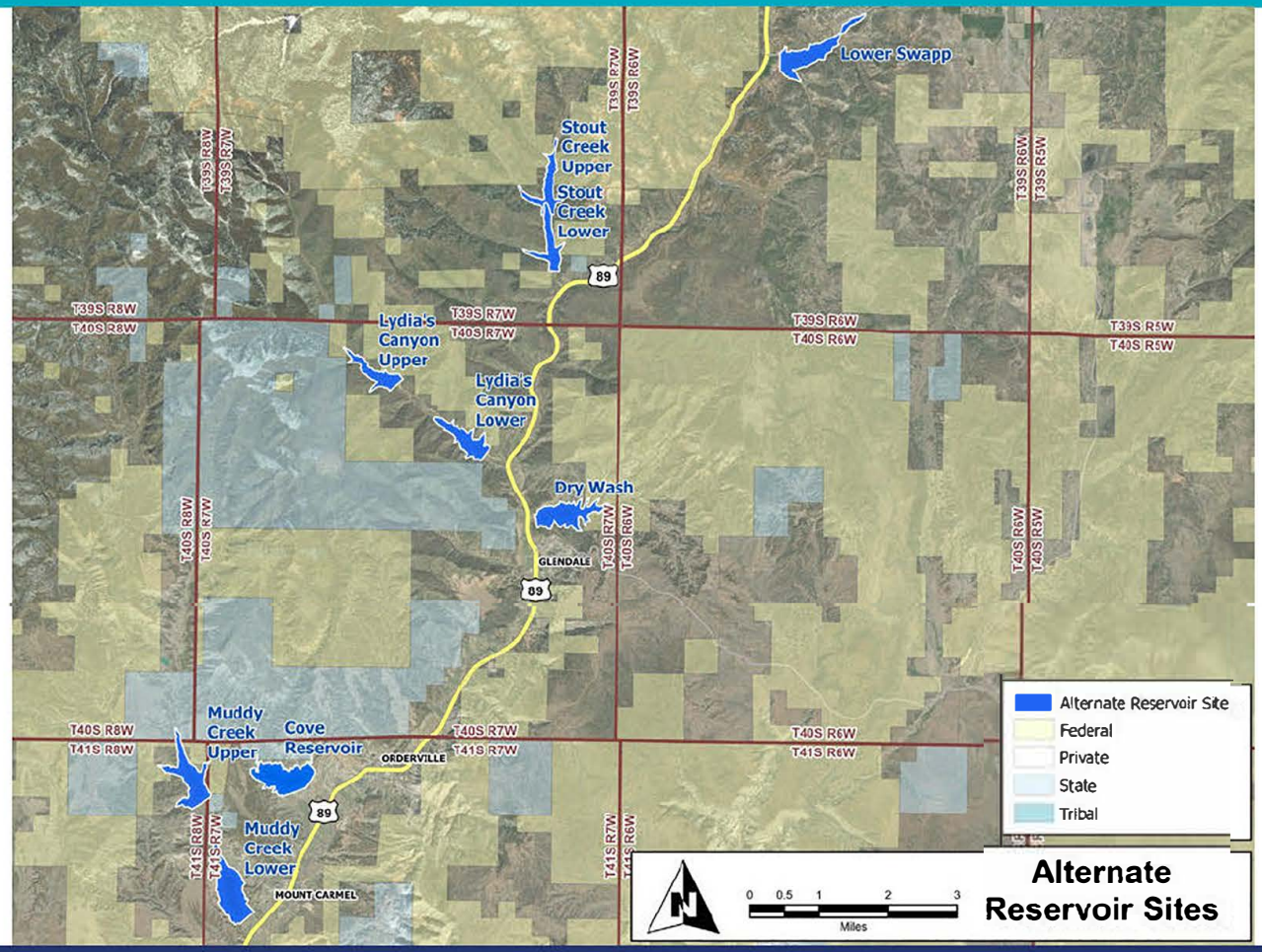
WATERSHED OVERVIEW



East Fork Virgin River Watershed

- Includes 3 HUC-6 Watersheds within the overall Upper Virgin Watershed
  - Lydia's Canyon-East Fork Virgin River (150100080203)
  - Muddy Creek (150100080202)
  - Headwaters East Fork Virgin River (150100080201)
- Overall watershed area - 97,427 acres
- Land Ownership
  - BLM
  - USFS
  - SITLA
  - Private

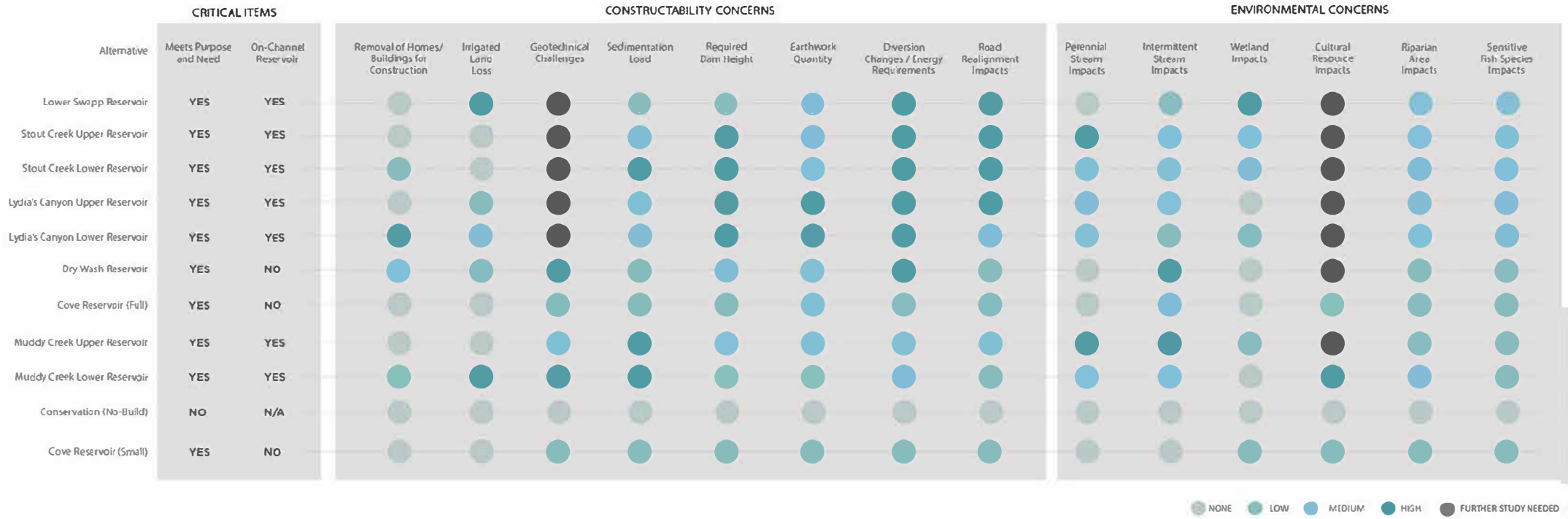
ALTERNATIVES BEING CONSIDERED



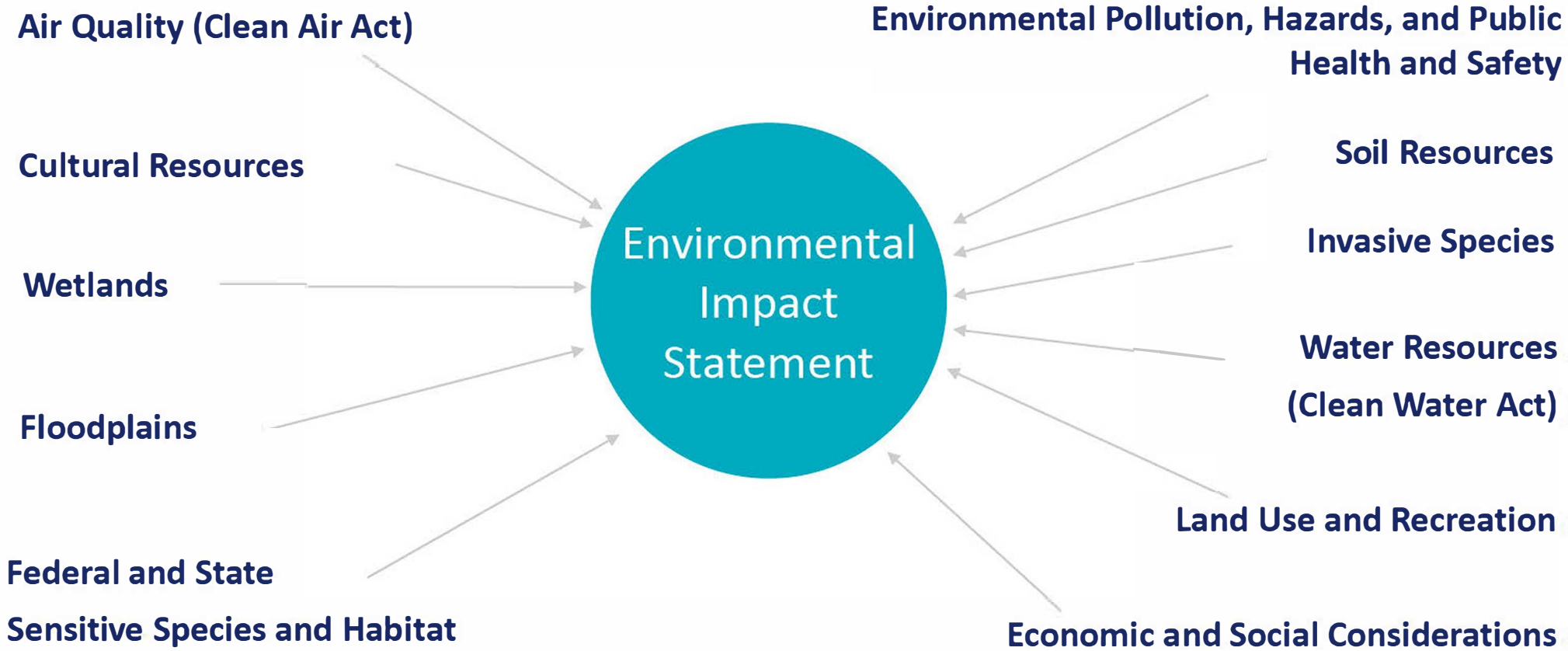
OTHER ITEMS BEING CONSIDERED

- Recreational facilities and access for the sites
- Water conservation
- Channel stabilization to reduce sediment loads.
- No Action Alternative

ALTERNATIVES MATRIX



RESOURCES TO BE CONSIDERED



NEPA PROCESS / TIMELINE

PROJECT TIMELINE

1. WE ARE HERE
   Resource Evaluation / Prepare Draft EIS
   FALL 2021– SUMMER 2022
2. Agency Review / Public Comment Period / Final EIS / Decision Document
   FALL 2022– SPRING 2023
3. Final Design*
   *(pending environmental approval and funding)
   2023 – 2024
4. Begin Project Construction*
   *(pending environmental approval and funding)
   2025

NEPA PROCESS

WE ARE HERE

Initiate Environmental Impact Statement
- Develop project purpose & need
- Conduct agency & public scoping
- Collect baseline data
- Develop project alternatives

Collect Data
- Analyze existing conditions
- Identify data gaps from existing Plan-EA
- Conduct additional needed resource surveys
- Agency consultation & coordination

Analyze Alternatives
- Analyze alternatives
- Evaluate potential impacts to environmental resources

Draft Environmental Impact Statement
- Release Draft EIS to public for review and comment
- Review all public and agency comments
- Prepare Final EIS

Decision Document
- NRCS will prepare a Record of Decision and post a Notice of Availability of the Final EIS in the Federal Register

HOW TO COMMENT

Official comments for the Cove – East Fork Virgin River Watershed Project can be submitted via comment card, letter, or email to the following:

Brian Parker
Transcon Environmental
1745 South Alma School Road, Suite 220
Phoenix, Arizona 85210
480-807-0095
bparker@transcon.com

Pre-addressed comment cards can be downloaded from the NRCS project planning website. Comment cards are also available for your convenience at the Kane County Water Conservancy District Office in Kanab, Utah.

Comments may also be provided during the virtual Q&A session following this presentation.

THANK YOU!



QUESTIONS

or

COMMENTS?



Appendix B. Project Mailing List

	A	B	C	D	E	F	G
1	**Type of Entity**	**Organization**	**POC Name**	**POC Title**	**Address**	**Email**	**What was sent**
2	Agency	Zion National Park	Robyn Henderek	Physical Scientist			Agency Scoping Notice
3	Agency	Zion National Park	Jeff Bradybaugh	Superintendent			Agency Scoping Notice
4	Agency	U.S. Army Corps of Engineers, St. George Field Office	Hollis Jencks	Project Manager			Agency Scoping Notice
5	Agency	U.S. Army Corps of Engineers, NV/UT Regulatory Branch	Jason Gipson	Chief			Agency Scoping Notice
6	Agency	U.S. Fish and Wildlife Service	Yvette Converse	Utah Field Office Supervisor			Agency Scoping Notice
7	Agency	Bureau of Land Management, Kanab Field Office	James Holland				Agency Scoping Notice
8	Agency	Bureau of Land Management, Kanab Field Office	Lisa Church				Agency Scoping Notice
9	Agency	US - EPA	Matt Hubner				Agency Scoping Notice
10	Agency	US Bureau of Reclamation		Regional Director		N/A	Agency Scoping Notice
11	Agency	US Congressional Representative	Chris Stewart			N/A	Agency Scoping Notice
12	Agency	US Senator	Mike Lee			N/A	Agency Scoping Notice
13	Agency	Utah State Clearinghouse	Taylor Kaufmann				Agency Scoping Notice
14	Agency	Utah School and Institutional Trust Lands Administration (SITLA)	Ron Torgerson				Agency Scoping Notice
15	Agency	Utah Division of Wildlife Resources	Main Office			N/A	Agency Scoping Notice
16	Agency	Utah Division of Wildlife Resources	Richard Hepworth	Aquatic Program Manager, Southern Regional Office			Agency Scoping Notice
17	Agency	Utah Department of Environmental Quality	N/A				Agency Scoping Notice
18	Agency	Utah Department of Environmental Quality	Erica Gaddis	Director			Agency Scoping Notice
19	Agency	Utah Department of Environmental Quality	Bill Damery				Agency Scoping Notice
20	Agency	Utah Department of Water Rights	TRUE				Agency Scoping Notice
21	Agency	Utah Department of Water Rights	Southwestern Regional Office				Agency Scoping Notice
22	Agency	Mt. Carmel Irrigation Company	Lucy Esplin				Agency Scoping Notice
23	Agency	Kane County Commission	Commissioners				Agency Scoping Notice
24	Agency	Utah Department of Cultural & Community Engagement	Chris Merritt				Agency Scoping Notice
25	Agency	Washington County Water Conservancy District	Corey Cram				Agency Scoping Notice
26	Agency	Washington County Water Conservancy District	Zach Renstrom				Agency Scoping Notice
27	Agency	Utah Department of Agriculture	Commissioner				Agency Scoping Notice
28	Agency	Utah Department of Public Safety	Judy Watanabe				Agency Scoping Notice
29	Agency	Utah Public Lands Policy Coordination Office	Sindy Smith				Agency Scoping Notice
30	Agency	Glendale Town	Mayor Kelly Lamb				Agency Scoping Notice
31	Agency	Town of Orderville	Mayor Robert Caruso				Agency Scoping Notice
32	Agency	Orderville Irrigation Company	N/A				Agency Scoping Notice
33	Agency	Glendale Irrigation Company	N/A				Agency Scoping Notice
34	Agency	Kane County Conservation District	Ben Clarkson	Chairman			Agency Scoping Notice
35	Agency	Utah State Senator	Derrin R. Owens				Agency Scoping Notice
36	Agency	Utah State Representative	Phil Lyman				Agency Scoping Notice
37	NGO	Utah Rivers Council	Nick Halburg				Public Scoping Notice
38	NGO	Utah Rivers Council	N/A				Public Scoping Notice
39	NGO	Trout Unlimited	Jordan Nielson				Public Scoping Notice
40	NGO	American Rivers	Michael Fiebig	Director, Southwest River Protection Program			Public Scoping Notice
41	NGO	Grand Canyon Trust	Mike Popejoy	Utah Public Lands Director			Public Scoping Notice
42	NGO	Conserve Southwest Utah	Thomas J. Butine	Board President			Public Scoping Notice
43	NGO	National Parks Conservation Association	Cory MacNulty	Associate Director, Southwest Region	N/A		Public Scoping Notice
44	NGO	American Whitewater	Kevin Colburn	National Stewardship Director			Public Scoping Notice
45	Public	G-1-5-ANNEX; G-2-77-ANNEX	Ms. Shirley M Brinkerhoff			N/A	Public Scoping Notice
46	Public	G-1-1-ANNEX	Mr. Kevin D. Maxwell			N/A	Public Scoping Notice
47	Public	G-1-1A-ANNEX	JD Maxwell & Chris Maxwell			N/A	Public Scoping Notice
48	Public	G-1-39-ANNEX	Mr. Daniel Sexton & Mr. David A. Wilson			N/A	Public Scoping Notice
49	Public	G-1-40-ANNEX	Mr. Eric L. Brinkerhoff & Mrs. Colen C. Brinkerhoff			N/A	Public Scoping Notice
50	Public	G-1-40A-ANNEX	Mr. Darwin Lamb & Mrs. Ellen Lamb			N/A	Public Scoping Notice
51	Public	G-2-78-ANNEX	Mr. Dan Epple			N/A	Public Scoping Notice
52	Public	G-2-80-ANNEX	Mr. Dellas H. Sornesen & Mrs. Colleen T. Sorensen			N/A	Public Scoping Notice notice
53	Public	G-2-81-ANNEX	Mr. Jason Spencer			N/A	Public Scoping Notice
54	Public	G-2-88-ANNEX; G-2-91A-ANNEX	Ms. Tresa Lown			N/A	Public Scoping Notice
55	Public	G-2-93-ANNEX	Mr. Kent Charles Anderson			N/A	Public Scoping Notice
56	Public	O-4-37-ANNEX; O-4-37C-ANNEX	Mr. Kevin Towt & Oklevueha Native American Church of Toquerville c/o Kevin Towt			N/A	Public Scoping Notice
57	Public	O-4-37A-ANNEX; O-4-37B ANNEX; O-4-11 ANNEX; O-4-15-ANNEX; O-4	Don Robinson & Zion Series, LLC			N/A	Public Scoping Notice
58	Public	O-4-7-ANNEX	Mr. Merlin Esplin & Mrs. Christine Esplin & Esplin Merlin & Christine C 1/3 INT			N/A	Public Scoping Notice
59	Public	O-4-8-ANNEX; O-4-9-ANNEX	Mr. Brian Lamb & Mrs. Carol Lamb			N/A	Public Scoping Notice
60	Public	O-4-4C-ANNEX; O-4-12-ANNEX; O-4-4B-ANNEX	Mr. Orval Heaton & Heaton Orval C 1/8 INT			N/A	Public Scoping Notice
61	Public	1-7-6-1	The Regney Family Limited Partnership			N/A	Public Scoping Notice
62	Public	1-7-6-27	Ms. Rosemary Cundiff & Cundiff Rosemary H-SUC-TR			N/A	Public Scoping Notice
63	Public	1-7-6-13; 1-7-6-14; 1-7-6-15; 1-7-6-3; 1-7-6-29 ; 1-7-6-16; O-4-4-ANNEX	Heaton Four, LLC			N/A	Public Scoping Notice
64	Public	O-4-2-1-ANNEX; O-4-5-ANNEX	Mr. Doran R. Lamb & Mrs. Lois T. Lamb & D & L Family Enterprises			N/A	Public Scoping Notice
65	Public	O-4-6-ANNEX	Mr. John Jeffery Esplin & Mrs. Tina B. Esplin			N/A	Public Scoping Notice
66	Public	O-4-152-ANNEX	Ms. Jolene Clark & D & L legacy Ranch, LLC c/o			N/A	Public Scoping Notice
67	Public	O-4-151-ANNEX	Mr. James Bernard Lamb			N/A	Public Scoping Notice
68	Public	O-4-148-ANNEX	Ms. Delynn T Lamb			N/A	Public Scoping Notice
69	Public	O-4-145-ANNEX	Mr. James Bernard Lamb			N/A	Public Scoping Notice
70	Public	O-4-144-ANNEX	Mr. Eric Esplin & Roland Esplin & Sons Inc c/o			N/A	Public Scoping Notice
71	Public	O-4-139-ANNEX	Mr. Dell Mond Tait & Mrs. Meriann Tait			N/A	Public Scoping Notice
72	Public	O-4-137-ANNEX	Mr. John D. Reese & Mrs. Lisa L Reese			N/A	Public Scoping Notice
73	Public	O-4-136-ANNEX	Mr. Gene Demille & Mrs. Toni B Demille			N/A	Public Scoping Notice
74	Public	O-4-135-ANNEX	Mr. John D Reese & Mrs. Lisa L Reese			N/A	Public Scoping Notice

	A	B	C	D	E	F	G
75	Public	O-4-133-ANNEX	Ms. Cary A Reese & Ms. Deanna D Reese			N/A	Public Scoping Notice
76	Public	O-4-117-ANNEX	Ms. Lucile G Larson & Mineral Springs Property, LLC c/o			N/A	Public Scoping Notice
77	Public	O-4-116-ANNEX	Mr. Eric C Esplin & Mrs. Lucy L Esplin -TR-			N/A	Public Scoping Notice
78	Public	O-4-115-ANNEX	Ms. Christine F Souza			N/A	Public Scoping Notice
79	Public	O-4-114-ANNEX	Esplin Livestock, LLC			N/A	Public Scoping Notice
80	Public	O-4-122-ANNEX	Ms. Delynn T Lamb			N/A	Public Scoping Notice
81	Public	O-4-111-ANNEX	Mr. John R. Hoffer & Mrs. Melba S Hoffer -TR-			N/A	Public Scoping Notice
82	Public	O-4-112-ANNEX	Mr. Stewart Stevens & Mrs. Leann Stevens			N/A	Public Scoping Notice
83	Public	O-4-109-ANNEX	Heritage Orachard, LLC			N/A	Public Scoping Notice
84	Public	O-4-110-ANNEX	Mr. Steven L Stevens & Mrs. Marsha C Stevens			N/A	Public Scoping Notice
85	Public	O-4-107-ANNEX	Mr. Darwin Lamb & Mrs. Ellen Lamb			N/A	Public Scoping Notice
86	Public	O-4-107A-ANNEX	Mr. Darwin Lamb & Mrs. Ellen Lamb			N/A	Public Scoping Notice
87	Public	O-4-103B-ANNEX	Mr. Travis D Franklin & Mrs. Camille Franklin			N/A	Public Scoping Notice
88	Public	O-4-103-ANNEX	Mr. Brian B. Harris & Mrs. Shawna L Harris			N/A	Public Scoping Notice
89	Public	O-4-103A-ANNEX	Mr. Davis W Jones II			N/A	Public Scoping Notice
90	Public	O-4-105-ANNEX	Mrs. Josie L Tait & Mr. Gary A Tait -TR-			N/A	Public Scoping Notice
91	Public	O-4-102-ANNEX	Mr. David M Rogers & Mrs. Carol Marie Rogers			N/A	Public Scoping Notice
92	Public	O-4-100-ANNEX	Ms. Nancy Rebecca Tait -TR-			N/A	Public Scoping Notice
93	Public	O-4-99-ANNEX	Mr. Sean Frost & Mr. Dusti Frost			N/A	Public Scoping Notice
94	Public	O-4-82A-ANNEX	Mr. Jay Tharon Salter -TR-			N/A	Public Scoping Notice
95	Public	O-4-82-ANNEX	Ms. Patricia Salter -TR-			N/A	Public Scoping Notice
96	Public	O-4-81-ANNEX	Ms. Tamra L Birth & Stevens Family Home, LLC c/o			N/A	Public Scoping Notice
97	Public	O-4-84-ANNEX	Mr. Brigham J. Johnson & E Slash Properties, LLC c/o			N/A	Public Scoping Notice
98	Public	O-4-79A-ANNEX	Mr. James W. Jennings & Mrs. Jane E Jennings -TR-			N/A	Public Scoping Notice
99	Public	O-4-79-ANNEX	Mr. James W. Jennings & Mrs. Jane E Jennings -TR-			N/A	Public Scoping Notice
100	Public	O-4-79B-ANNEX	Mr. James W. Jennings & Mrs. Jane E Jennings -TR-			N/A	Public Scoping Notice
101	Public	O-4-36A-ANNEX	Mr. Travis Franklin			N/A	Public Scoping Notice
102	Public	O-4-78-ANNEX	Mr. Arthur L Tait & Mrs. Roma C Tait -TR-			N/A	Public Scoping Notice
103	Public	O-4-36-ANNEX	Mr. Arthur L Tait & Mrs. Roma C Tait -TR-			N/A	Public Scoping Notice
104	Public	O-4-34-ANNEX	Zion Series, LLC			N/A	Public Scoping Notice
105	Public	O-4-32-ANNEX	Mr. Bowdy Gardner			N/A	Public Scoping Notice
106	Public	O-4-31-ANNEX	Mr. Joseph Sorensen & Mrs. Shalisse Sorensen			N/A	Public Scoping Notice
107	Public	O-4-29-ANNEX	Mr. Charles Dean Hepworth & Paria Valley Livestock Co, LLC c/o			N/A	Public Scoping Notice
108	Public	O-4-27-1-ANNEX	Mr. Rex Andrew Crofts			N/A	Public Scoping Notice
109	Public	O-4-27-ANNEX	Mr. Corbin Partridge & Mrs. Lori Partridge			N/A	Public Scoping Notice
110	Public	O-4-23-ANNEX	Ms. Rosalie L Esplin -TR-			N/A	Public Scoping Notice
111	Public	O-4-141-ANNEX	Mr. Eric C Esplin & Mrs. Lucy L Esplin -TR-			N/A	Public Scoping Notice
112	Public	O-4-140-ANNEX	Mr. Spencer Hugh & Mrs. Allie R Hugh -TR-			N/A	Public Scoping Notice
113	Public	O-4-131-ANNEX	Mr. Eric Esplin & Roland Esplin & Sons Inc c/o			N/A	Public Scoping Notice
114	Public	O-4-138-ANNEX	Mr. Kline R Esplin & Mrs. Cami L Esplin			N/A	Public Scoping Notice
115	Public	O-4-130A-ANNEX	Ms. Lorene Esplin -TR-			N/A	Public Scoping Notice
116	Public	O-4-128-ANNEX	Mr. Brian Lamb & Mrs. Carol Lamb			N/A	Public Scoping Notice
117	Public	O-4-127-ANNEX	Mr. Kendall A Tait & Mrs. Verlee H Tait			N/A	Public Scoping Notice
118	Public	O-4-121-ANNEX	Ms. Rosalie L Esplin -TR-			N/A	Public Scoping Notice
119	Public	O-4-120-ANNEX	Ms. Dale V Sorensen & Mrs. Margaret C Sorensen			N/A	Public Scoping Notice
120	Public	O-4-118-ANNEX	Ms. Delynn Crofts & Ms. Glenda Crofts			N/A	Public Scoping Notice
121	Public	O-4-98-ANNEX	Ms. Delynn Crofts & Ms. Glenda Crofts			N/A	Public Scoping Notice
122	Public	O-4-89-ANNEX	Ms. Erin K Bettridge			N/A	Public Scoping Notice
123	Public	O-4-85-ANNEX	Ms. Jessica J Tait			N/A	Public Scoping Notice
124	Public	O-4-95A-ANNEX	Ms. Kathleen Elaine Dering			N/A	Public Scoping Notice
125	Public	O-4-87-ANNEX	Mr. Randall F Tait -SUC TR-			N/A	Public Scoping Notice
126	Public	O-4-86-ANNEX	Ms. Lorene Z Esplin -TR-			N/A	Public Scoping Notice
127	Public		George and Frances Alderson				Public Scoping Notice
128	Public		Noel Poe				Public Scoping Notice
129	Public		Jo Anne Rando-Moon				Public Scoping Notice
130	Public		Kevin Golic				Public Scoping Notice
131	Public		Laura and Walter Fertig				Public Scoping Notice
132	Public		John Hiscock				Public Scoping Notice
133	Public		Sandra Katz				Public Scoping Notice
134	Public		Robert and Frankie Jackson				Public Scoping Notice
135	Public		Matt Vukin				Public Scoping Notice
136	Public		Helene Jorgenson, SUNews				Public Scoping Notice
137	Public		Aurelia Lunceford				Public Scoping Notice
138	Public		Randy Aton				Public Scoping Notice
139	Public		Joy Stein				Public Scoping Notice
140	Public		Pamela Gilbert				Public Scoping Notice
141	Public		Chris Gorzalski				Public Scoping Notice
142	Public		Bryan Dixon				Public Scoping Notice
143	Public		Chris and Marte Sampson				Public Scoping Notice
144	Public		Tom Dillon				Public Scoping Notice
145	Public		Richard Spotts				Public Scoping Notice
146	Public		Christine Souzy				Public Scoping Notice
147	Public		Marcia Alley Scoville				Public Scoping Notice

	A	B	C	D	E	F	G
148	Public		Jane Whalen	Conserve Southwest Utah; Board of Directors			Public Scoping Notice
149	Public		Jerry Hermansen and Bridget Mackey				Public Scoping Notice
150	Public		Steve Finucane				Public Scoping Notice
151	Public		June Lepley				Public Scoping Notice
152	Public		Julie and Jim Hancock				Public Scoping Notice
153	Public		Allen Gilburg				Public Scoping Notice
154	Public		Nancy Goodell				Public Scoping Notice
155	Public		Susan Hand				Public Scoping Notice
156	Public		Mike McTeer				Public Scoping Notice
157	Public		Andrew Kramer				Public Scoping Notice
158	Public		Angie Frabasilio				Public Scoping Notice
159	Public		Walter Wegst				Public Scoping Notice
160	Public		Pamela Palmer				Public Scoping Notice
161	Public		Marha Ham				Public Scoping Notice
162	Public		M. Honer-Orton				Public Scoping Notice
163	Public		Barry Sochat				Public Scoping Notice
164	Public		Ingrid Akerblom		Cedar City , UT		Public Scoping Notice
165	Public		April Johnson		Kanab, UT 84741		Public Scoping Notice
166	Public		Dean Baker		Kanab, UT		Public Scoping Notice
167	Public		Kathryn Merrick		Kanab, UT		Public Scoping Notice
168	Public		Tracy Hiscock		Kanab, UT		Public Scoping Notice
169	Public		Laura Wilson		N/A		
170							Public Scoping Notice
171	Public		Gary Bezzant	UDWR Habitat Program Manager	N/A		Public Scoping Notice
172	Public		Meghan Burke		N/A		Public Scoping Notice
173	Public		Barbara Wise		N/A		Public Scoping Notice
174	Public		Robert L. Johnson		N/A		Public Scoping Notice
175	Public		Terry L. Thatcher		N/A		Public Scoping Notice
176	Public		Deborah Berret and Dr. Brian Berret		N/A		Public Scoping Notice
177	Public		Larry Clark		N/A		Public Scoping Notice
178	Public		Dr. C Clark		N/A		Public Scoping Notice
179	Public		Elisa Rios		N/A		Public Scoping Notice
180	Public		Margaret Bourke		N/A		Public Scoping Notice
181	Public		Carolyn Shelton		N/A		Public Scoping Notice
182	Public		Bridgette Meinhold		N/A		Public Scoping Notice
183	Public		Matt Meinhold		N/A		Public Scoping Notice
184	Public		Ed Bolander		N/A		Public Scoping Notice
185	Public		Latimer Smith		N/A		Public Scoping Notice
186	Public		Peter Mills		N/A		Public Scoping Notice
187	Public		Merlin Esplin		N/A		Public Scoping Notice
188	Public		M'Leah Woodard		Ogden, UT		Public Scoping Notice
189	Public		Robert Lacey		Orderville, UT		Public Scoping Notice
190	Public		Craig Wallentine		Park City , UT 84060		Public Scoping Notice
191	Public		Jean M. Lown		St. George, UT		Public Scoping Notice
192	Public		Jim Varney		N/A		Public Scoping Notice
193	Public		Tom Butine		N/A		Public Scoping Notice
194	Public		Ed Jacobsen		N/A		Public Scoping Notice
195	Public		Paul Zuckerman		N/A		
196							Public Scoping Notice
197	Public		Kestrel Kunz		N/A		Public Scoping Notice
198	Public		David Kizer		N/A		Public Scoping Notice
199	Public		Jeff Grey		N/A		Public Scoping Notice
200	Public		Jane Jennings		N/A		Public Scoping Notice
201	Public		Andrea Randall		N/A		Public Scoping Notice
202	Public		Susan Bingham		N/A		Public Scoping Notice
203	Public		Travis Crofts		N/A		Public Scoping Notice
204	Public		Mike Walters		N/A		Public Scoping Notice
205	Public		Kelly Wilson		N/A		Public Scoping Notice
206	Public		Joan Meiners		N/A		Public Scoping Notice
207	Public		Amanda Brinkerhoff		N/A		Public Scoping Notice
208	Public		Shauna Ertolacci		N/A		Public Scoping Notice
209	Public		Tina Esplin		N/A		Public Scoping Notice
210	Public		Christopher Keleher		N/A		Public Scoping Notice
211	Public		Francine Medrano		N/A		Public Scoping Notice
212	Public		Doran Lamb		N/A		Public Scoping Notice
213	Public		Sawyer		N/A		Public Scoping Notice
214	Public		Moto		N/A		Public Scoping Notice
215	Public		John Horel		N/A		Public Scoping Notice
216	Public		Susan Zarekarizi		N/A		Public Scoping Notice
217	Public		David Darger		N/A		Public Scoping Notice
218	Public		Karl Spencer		N/A		Public Scoping Notice
219	Public		Mesia Lamb		N/A		Public Scoping Notice
220	Public		Brian Lamb		N/A		Public Scoping Notice
221	Public		Isaac Cheek		N/A		Public Scoping Notice
222	Public		Lisa Rutherford		N/A		Public Scoping Notice
223	Public		Paul Thompson		N/A		Public Scoping Notice
224	Public		Mathew Stephens		N/A		Public Scoping Notice
225	Public		Stephen Neeleman		N/A		Public Scoping Notice
226	Public		Richard Van Dam		N/A		Public Scoping Notice
227	Public		Michael Grange		N/A		Public Scoping Notice
228	Public		Scott McDonell		N/A		Public Scoping Notice
229	Public		Joseph Sorensen		N/A		Public Scoping Notice
230	Public		Carroll Heaton		N/A		Public Scoping Notice

	A	B	C	D	E	F	G
231	Public		Lexi Peery		N/A		Public Scoping Notice
232	Public		Morgan		N/A		Public Scoping Notice
233	Public		Paul Deen		N/A		Public Scoping Notice
234	Public		Russell Duff		N/A		Public Scoping Notice
235	Public		Chloe Lewis		N/A		Public Scoping Notice
236	Public		Tom Diegel		N/A		Public Scoping Notice
237	Public		Laura Klina		N/A		Public Scoping Notice
238	Public		Tim Esplin		N/A		Public Scoping Notice
239	Public		Rebecca Otton		N/A		Public Scoping Notice
240	Public		Joe		N/A		Public Scoping Notice
241	Public		Doran Lamb		N/A		Public Scoping Notice
242	Public		Bartholomew Battista		N/A		
243							Public Scoping Notice
244	Public		Marsha Tupper		N/A		Public Scoping Notice
245	Public		Cary		N/A		Public Scoping Notice
246	Public		Karen Heet		N/A		Public Scoping Notice
247	Public		John Reese		N/A		Public Scoping Notice
248	Public		Craig Tupper		N/A		Public Scoping Notice
249	Public		Rosemary Cundiff		N/A		Public Scoping Notice
250	Public		[NO NAME REGISTERED]		N/A		Public Scoping Notice
251	Public		Julia Dalesandro		N/A		Public Scoping Notice
252	Public		James Heaton		N/A		Public Scoping Notice
253	Public		Ed Myers		N/A		Public Scoping Notice
254	Public		Julia Badian		N/A		Public Scoping Notice
255	Public		Carrie		N/A		Public Scoping Notice
256	Public		Sean Hemmersmeier		St. George, UT		Public Scoping Notice
257	Tribal	Ute Indian Tribe of the Uintah and Ouray Reservation, Utah	Mr. Luke Duncan	Chairman		N/A	Consultation letter, Public Scoping Notice
258	Tribal	Ute Indian Tribe of the Uintah and Ouray Reservation, Utah, Cultural	Ms. Betsy Chapoose	Director		N/A	Consultation letter, Public Scoping Notice
259	Tribal	Paiute Indian Tribe of Utah	Ms. Tamra Borchardt-Slayton	Chairperson		N/A	Consultation letter, Public Scoping Notice
260	Tribal	Paiute Indian Tribe of Utah	Ms. Dorena Martineau	Cultural Resource Director		N/A	Consultation letter, Public Scoping Notice
261	Tribal	Kaibab Band of Paiute Indians of the Kaibab Indian Reservation , Tribal Affairs Building	Ms. Ona Segundo	Chairwoman		N/A	Consultation letter, Public Scoping Notice
262	Tribal	Kaibab Band of Paiute Indians of the Kaibab Indian Reservation , Cultural Preservation Office	Mr. Daniel Bullets			N/A	Consultation letter, Public Scoping Notice
263	Tribal	Moapa Band of Paiute Indians of the Moapa River Indian Reservation	Laura Parry	Chairwoman		N/A	Consultation letter, Public Scoping Notice
264	Tribal	Moapa Band of Paiute Indians of the Moapa River Indian Reservation	Shanandoah Anderson	Cultural Manager		N/A	Consultation letter, Public Scoping Notice
265	Tribal	Las Vegas Tribe of Paiute Indians of the Las Vegas Colony	Mr. Benny Tso			N/A	Consultation letter, Public Scoping Notice
266	Tribal	Las Vegas Tribe of Paiute Indians of the Las Vegas Colony	Ms. Ramona Salazar			N/A	Consultation letter, Public Scoping Notice
267	Tribal	Navajo Nation, Navajo Nation Office of the President	Mr. Jonathan Nez	President		N/A	Consultation letter, Public Scoping Notice
268	Tribal	Navajo Nation, Navajo Nation Historic Preservation Department	Mr. Richard M. Begay	THPO and Department Manager		N/A	Consultation letter, Public Scoping Notice
269	Tribal	Ute Mountain Ute Tribe	Mr. Manuel Heart	Chairman		N/A	Consultation letter, Public Scoping Notice
270	Tribal	Ute Mountain Ute Tribe	Mr. Terry Knight	Tribal Historic Preservation Officer		N/A	Consultation letter, Public Scoping Notice
271	Tribal	Ute Mountain Ute Tribe	Ms. Nichol Shurack	Tribal Archaeologist		N/A	Consultation letter, Public Scoping Notice
272	Tribal	White Mesa Ute Council	Mr. Malcolm Lehi	Councilman		N/A	Consultation letter, Public Scoping Notice
273	Tribal	San Juan Southern Paiute Tribe of Arizona	Ms. Carlene Yellowhair	President			Consultation letter, Public Scoping Notice
274	Tribal	Pueblo of Zuni	Mr. Val Panteah, Sr.	Governor		N/A	Consultation letter, Public Scoping Notice
275	Tribal	Pueblo of Zuni	Mr. Kurt Dongoske	Director and Tribal Historic Preservation Officer		N/A	Consultation letter, Public Scoping Notice
276	Tribal	Hopi Tribe, Hopi Tribe Chairman's Office	Mr. Timothy L. Nuvangyaoma	Chairman		N/A	Consultation letter, Public Scoping Notice
277	Tribal	Hopi Tribe, Hopi Culture Preservation Office	Mr. Leigh Kuwanwisiwma			N/A	Consultation letter, Public Scoping Notice
278	Tribal	Hopi Tribe, Hopi Culture Preservation Office	Mr. Stewart B. Koyiyumptewa	Tribal Historic Preservation Officer		N/A	Consultation letter, Public Scoping Notice
279	Tribal	Hualapai Tribe	Dr. Damon R. Clarke	Chairman		N/A	Consultation letter, Public Scoping Notice
280	Tribal	Hualapai Tribe	Mr. Peter Bungart	Tribal Historic Preservation Officer		N/A	Consultation letter, Public Scoping Notice

Appendix C. Agency and Tribal Scoping

C.1. Agency Scoping Letter

C.2. Cooperating Agency Invitation Letter

C.3. Tribal Scoping Letter

C.4. Agency Scoping Meeting Materials

C.1. Agency Scoping Letter

USDA United States Department of Agriculture

Cove-East Fork Virgin River Watershed Project – Kane County, Utah

Agency Scoping Notice



Project Information

The U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), with assistance of the Kane County Water Conservancy District as the project sponsor and Washington County Water Conservancy District as the co-sponsor, is considering proposed improvements within the East Fork Virgin River Watershed. The proposed improvements include a new water storage facility (Cove Reservoir), or an alternate reservoir site, as well as other improvements associated with the Mt. Carmel, Glendale, and Orderville irrigation systems.

NRCS is holding a virtual agency meeting, via Zoom to provide information about the proposed project and to collect comments. Supplemental technical studies are scheduled to take place during fall 2021, with a Draft Watershed Plan – Environmental Impact Statement (Plan-EIS) circulated to the public and agencies for review in mid-2022. The Plan-EIS will further evaluate the proposed project along with any viable project alternatives in accordance with the rules and guidelines of the National Environmental Policy Act (NEPA) and Council on Environmental Quality (CEQ).

The Plan-EIS is being funded under the NRCS Watershed Flood Prevention and Protection Program (PL83-566), which provides both technical and financial assistance to help communities protect, improve, and develop water and land resource in watersheds up to 250,000 acres.

Project Background

Initially known as the "Cove Reservoir Watershed" project, alternatives and associated impacts were analyzed in a Watershed Plan-Environmental Assessment (Plan-EA); however, after careful project review and consideration of comments received on the Draft Plan-EA presented in winter 2020/2021, the NRCS has initiated the preparation of a Plan-EIS.

Improvements under consideration include water conservation, water storage, agricultural and municipal demands, public safety risks, and increased opportunities for public recreation in the East Fork Virgin River watershed.

Project Website

Additional information can be found at the NRCS project website:

https://www.nrcs.usda.gov/wps/portal/nrcs/detail/ut/programs/planning/wpfp/?cid=nrcseprd1403022

Agency Meeting

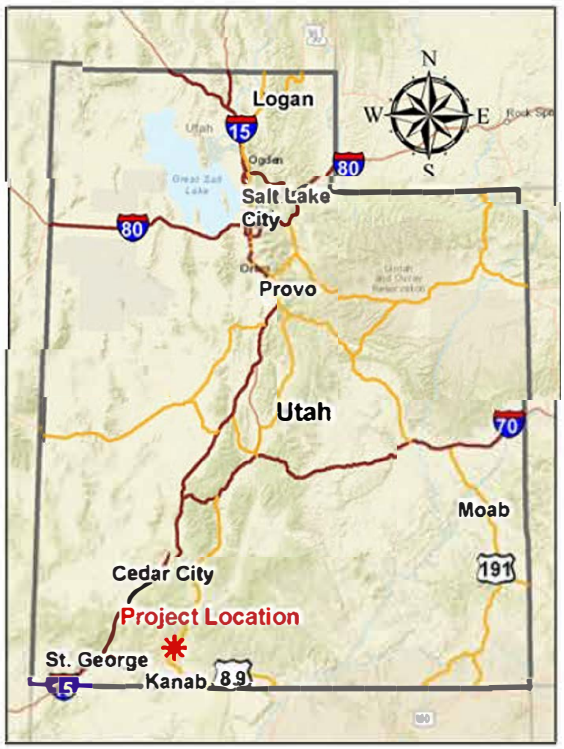
Agencies are invited to attend a project scoping presentation, discuss project details, and submit comments during the online meeting:

Virtual Meeting
Monday, October 18, 2021
2:30 P.M. – 3:30 P.M. (MST)

How to Join the Virtual Agency Meeting

Log-in via Zoom: zoom.us/join
Enter Meeting ID: 886 6521 8321
Passcode: 992578
Note: This meeting will be recorded. A copy can be made available upon request.

Project Location Map



At this time, the NRCS is requesting comments on the project to identify opportunities, issues, and resource concerns.

How to Provide Official Comment

All comments should be directed to Brian Parker:

Transcon Environmental
Attn: Brian Parker
1745 South Alma School Rd., Suite 220
Phoenix, AZ 85210
480-807-0095
bparker@transcon.com

Comments must be received or post-marked no later than 30 days after the NOI is published in the Federal Register.

How to Be Added to Mailing List

Provide your email address when logging into the Zoom meeting or send a letter or email request to Brian Parker using the contact information provided above.

Utah State Office

Natural Resources Conservation Service

nrcs.usda.gov/

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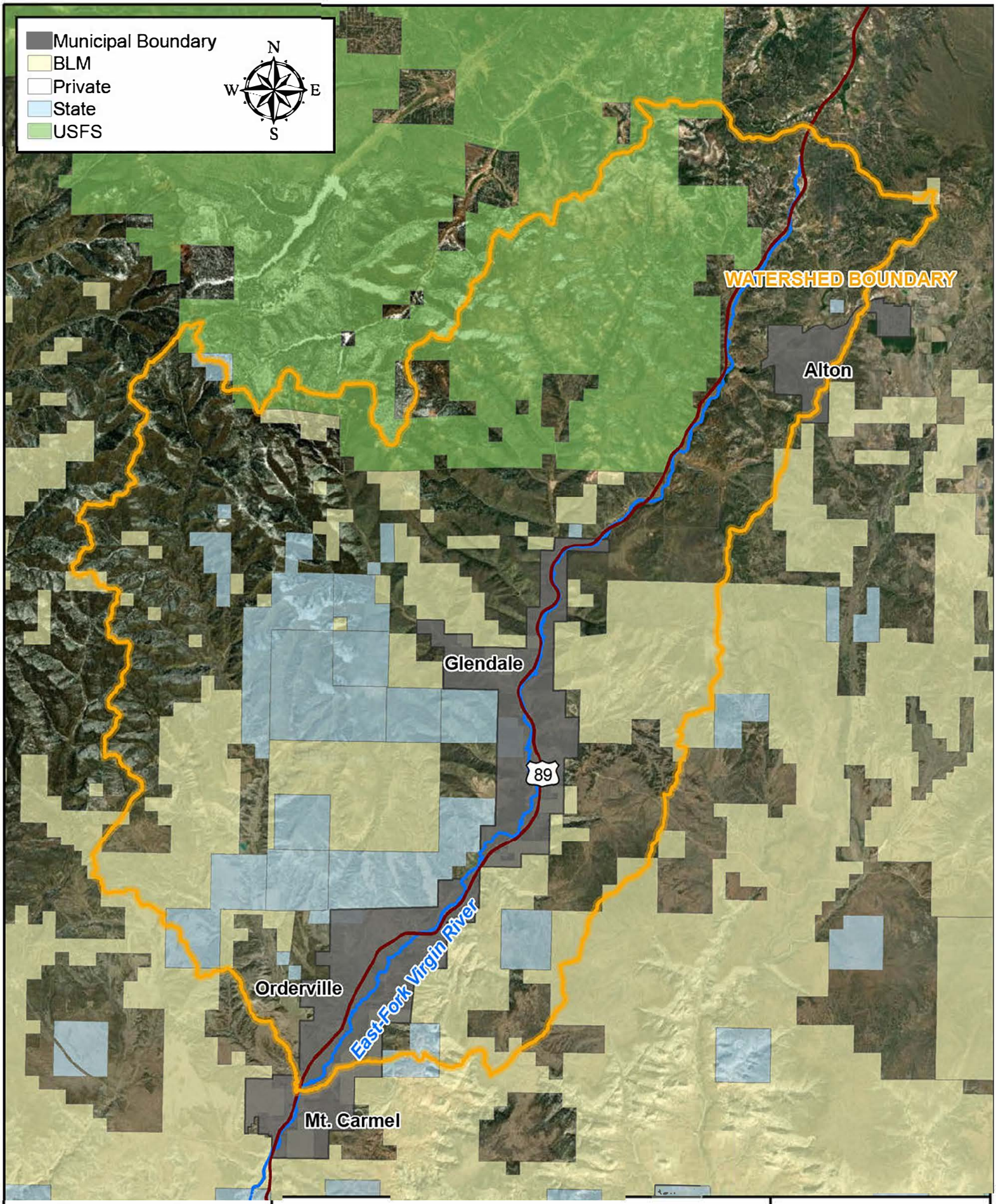

Transcon environmental | Planners & Scientists

USDA United States Department of Agriculture
Natural Resources Conservation Service

Cove - East Fork Virgin River Watershed Project

Watershed Boundary Exhibit (97,427 acres)

0 11,000
Feet

C.2. Cooperating Agency Invitation Letter

USDA

United States Department of Agriculture

Natural Resources
Conservation Service

Utah State Office

www.ut.nrcs.usda.gov

October 15, 2021

Mr. Whit Bunting
Field Manager, Kanab Field Office
Bureau of Land Management

RE: Formal request to be a Cooperating Agency in the development of the Cove-East Fork Virgin River Watershed Plan-Environmental Impact Statement (Plan-EIS) for proposed improvements in Kane County, Utah.

Dear Mr. Bunting:

In accordance with the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) at 40 CFR Part 1501.8, the Natural Resources Conservation Service (NRCS) is formally requesting that the Bureau of Land Management become a cooperating agency in the planning and development of the Cove-East Fork Virgin River Watershed Plan-EIS. Please visit the project website at https://bit.ly/cove-eastforkvirginriver-EIS for information on the Plan-EIS.

This request is made since your agency is identified as having special expertise or jurisdiction by law related to this project. The Plan-EIS is being prepared to fulfill our NEPA compliance responsibilities pertaining to our federal financial assistance through the Watershed Protection and Flood Prevention Program as authorized through Public Law 83-566. Upon acceptance of this invitation, roles can be defined in an informal agreement or a memorandum of understanding. If your agency is unable to participate as a cooperating agency, please return a written explanation indicating that your agency cannot participate.

Please send notification confirming your decision to: Emily Fife, State Conservationist, NRCS, Wallace F Bennett Federal Building,

Thank you for your timely response and assistance with these efforts. If you have any questions, please contact Derek Hamilton, Water Resources Coordinator, at

Sincerely,

Norm Evenstad

NORM EVENSTAD
Asst. State Conservationist - Water Resources

cc:
Alan Atkins, Area Conservationist, NRCS, Richfield, UT
Kristi Westwood, District Conservationist, NRCS, Panguitch, UT
Derek Hamilton, Water Resources Coordinator, NRCS, Salt Lake City, UT

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United States Department of Agriculture

Natural Resources
Conservation Service

Utah State Office

www.ut.nrcs.usda.gov

October 15, 2021

Environmental Protection Agency
ATTN: NEPA Program Director

RE: Formal request to be a Cooperating Agency in the development of the Cove-East Fork Virgin River Watershed Plan-Environmental Impact Statement (Plan-EIS) for proposed improvements in Kane County, Utah.

Dear NEPA Program Director:

In accordance with the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) at 40 CFR Part 1501.8, the Natural Resources Conservation Service (NRCS) is formally requesting that the Environmental Protection Agency become a cooperating agency in the planning and development of the Cove-East Fork Virgin River Watershed Plan-EIS. Please visit the project website at https://bit.ly/cove-eastforkvirginriver-EIS for information on the Plan-EIS.

This request is made since your agency is identified as having special expertise or jurisdiction by law related to this project. The Plan-EIS is being prepared to fulfill our NEPA compliance responsibilities pertaining to our federal financial assistance through the Watershed Protection and Flood Prevention Program as authorized through Public Law 83-566. Upon acceptance of this invitation, roles can be defined in an informal agreement or a memorandum of understanding. If your agency is unable to participate as a cooperating agency, please return a written explanation indicating that your agency cannot participate.

Please send notification confirming your decision to: Emily Fife, State Conservationist, NRCS, Wallace F Bennett Federal Building,

Thank you for your timely response and assistance with these efforts. If you have any questions, please contact Derek Hamilton, Water Resources Coordinator, at

Sincerely,

Norm Evenstad

NORM EVENSTAD
Asst. State Conservationist - Water Resources

cc:
Alan Atkins, Area Conservationist, NRCS, Richfield, UT
Kristi Westwood, District Conservationist, NRCS, Panguitch, UT
Derek Hamilton, Water Resources Coordinator, NRCS, Salt Lake City, UT

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United States Department of Agriculture

Natural Resources
Conservation Service

Utah State Office

125 South State Street
Room 4010
Salt Lake City, UT 84138

Ph: 801-524-4550
Fax: 844-715-4928
www.ut.nrcs.usda.gov

October 15, 2021

Mr. Jeff Bradybaugh
Superintendent, Zion National Park
National Park Service

RE: Formal request to be a Cooperating Agency in the development of the Cove-East Fork Virgin River Watershed Plan-Environmental Impact Statement (Plan-EIS) for proposed improvements in Kane County, Utah.

Dear Mr. Bradybaugh:

In accordance with the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) at 40 CFR Part 1501.8, the Natural Resources Conservation Service (NRCS) is formally requesting that the National Park Service become a cooperating agency in the planning and development of the Cove-East Fork Virgin River Watershed Plan-EIS. Please visit the project website at https://bit.ly/cove-eastforkvirginriver-EIS for information on the Plan-EIS.

This request is made since your agency is identified as having special expertise or jurisdiction by law related to this project. The Plan-EIS is being prepared to fulfill our NEPA compliance responsibilities pertaining to our federal financial assistance through the Watershed Protection and Flood Prevention Program as authorized through Public Law 83-566. Upon acceptance of this invitation, roles can be defined in an informal agreement or a memorandum of understanding. If your agency is unable to participate as a cooperating agency, please return a written explanation indicating that your agency cannot participate.

Please send notification confirming your decision to: Emily Fife, State Conservationist, NRCS, Wallace F Bennett Federal Building, 125

Thank you for your timely response and assistance with these efforts. If you have any questions, please contact Derek Hamilton, Water Resources Coordinator, at

Sincerely,

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Derek Hamilton, Water Resources Coordinator, NRCS, Salt Lake City, UT

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United States Department of Agriculture

Natural Resources
Conservation Service

Utah State Office

www.ut.nrcs.usda.gov

October 15, 2021

Mr. Dave Ure
Director
Utah School and Institutional Trust Lands Administration

RE: Formal request to be a Cooperating Agency in the development of the Cove-East Fork Virgin River Watershed Plan-Environmental Impact Statement (Plan-EIS) for proposed improvements in Kane County, Utah.

Dear Mr. Ure:

In accordance with the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) at 40 CFR Part 1501.8, the Natural Resources Conservation Service (NRCS) is formally requesting that the Utah School and Institutional Trust Lands Administration become a cooperating agency in the planning and development of the Cove-East Fork Virgin River Watershed Plan-EIS. Please visit the project website at https://bit.ly/cove-eastforkvirginriver-EIS for information on the Plan-EIS.

This request is made since your agency is identified as having special expertise or jurisdiction by law related to this project. The Plan-EIS is being prepared to fulfill our NEPA compliance responsibilities pertaining to our federal financial assistance through the Watershed Protection and Flood Prevention Program as authorized through Public Law 83-566. Upon acceptance of this invitation, roles can be defined in an informal agreement or a memorandum of understanding. If your agency is unable to participate as a cooperating agency, please return a written explanation indicating that your agency cannot participate.

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Thank you for your timely response and assistance with these efforts. If you have any questions, please contact Derek Hamilton, Water Resources Coordinator, at

Sincerely,

Norm Evenstad

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Asst. State Conservationist - Water Resources

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Alan Atkins, Area Conservationist, NRCS, Richfield, UT
Kristi Westwood, District Conservationist, NRCS, Panguitch, UT
Derek Hamilton, Water Resources Coordinator, NRCS, Salt Lake City, UT

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Natural Resources
Conservation Service

Utah State Office

www.ut.nrcs.usda.gov

October 15, 2021

Mr. Jason Gipson
Chief, Nevada-Utah Regulatory Branch
U.S. Army Corps of Engineers

RE: Formal request to be a Cooperating Agency in the development of the Cove-East Fork Virgin River Watershed Plan-Environmental Impact Statement (Plan-EIS) for proposed improvements in Kane County, Utah.

Dear Mr. Gipson:

In accordance with the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) at 40 CFR Part 1501.8, the Natural Resources Conservation Service (NRCS) is formally requesting that the U.S. Army Corps of Engineers become a cooperating agency in the planning and development of the Cove-East Fork Virgin River Watershed Plan-EIS. Please visit the project website at https://bit.ly/cove-eastforkvirginriver-EIS for information on the Plan-EIS.

This request is made since your agency is identified as having special expertise or jurisdiction by law related to this project. The Plan-EIS is being prepared to fulfill our NEPA compliance responsibilities pertaining to our federal financial assistance through the Watershed Protection and Flood Prevention Program as authorized through Public Law 83-566. Upon acceptance of this invitation, roles can be defined in an informal agreement or a memorandum of understanding. If your agency is unable to participate as a cooperating agency, please return a written explanation indicating that your agency cannot participate.

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Thank you for your timely response and assistance with these efforts. If you have any questions, please contact Derek Hamilton, Water Resources Coordinator, at

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Derek Hamilton, Water Resources Coordinator, NRCS, Salt Lake City, UT

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United States Department of Agriculture

Natural Resources
Conservation Service

Utah State Office

www.ut.nrcs.usda.gov

October 15, 2021

Ms. Veronica Magnuson
District Ranger, Cedar City Ranger District
U.S. Forest Service

RE: Formal request to be a Cooperating Agency in the development of the Cove-East Fork Virgin River Watershed Plan-Environmental Impact Statement (Plan-EIS) for proposed improvements in Kane County, Utah.

Dear Ms. Magnuson:

In accordance with the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) at 40 CFR Part 1501.8, the Natural Resources Conservation Service (NRCS) is formally requesting that the U.S. Forest Service become a cooperating agency in the planning and development of the Cove-East Fork Virgin River Watershed Plan-EIS. Please visit the project website at https://bit.ly/cove-eastforkvirginriver-EIS for information on the Plan-EIS.

This request is made since your agency is identified as having special expertise or jurisdiction by law related to this project. The Plan-EIS is being prepared to fulfill our NEPA compliance responsibilities pertaining to our federal financial assistance through the Watershed Protection and Flood Prevention Program as authorized through Public Law 83-566. Upon acceptance of this invitation, roles can be defined in an informal agreement or a memorandum of understanding. If your agency is unable to participate as a cooperating agency, please return a written explanation indicating that your agency cannot participate.

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Thank you for your timely response and assistance with these efforts. If you have any questions, please contact Derek Hamilton, Water Resources Coordinator, at

Sincerely,

Norm Evenstad

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Asst. State Conservationist - Water Resources

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Alan Atkins, Area Conservationist, NRCS, Richfield, UT
Kristi Westwood, District Conservationist, NRCS, Panguitch, UT
Derek Hamilton, Water Resources Coordinator, NRCS, Salt Lake City, UT

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United States Department of Agriculture

Natural Resources
Conservation Service

Utah State Office

October 15, 2021

Ms. Yvette Converse
Supervisor, Utah Field Office
U.S. Fish and Wildlife Service
2369 West Orton Circle, Suite 50
West Valley City, UT 84119

RE: Formal request to be a Cooperating Agency in the development of the Cove-East Fork Virgin River Watershed Plan-Environmental Impact Statement (Plan-EIS) for proposed improvements in Kane County, Utah.

Dear Ms. Converse:

In accordance with the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) at 40 CFR Part 1501.8, the Natural Resources Conservation Service (NRCS) is formally requesting that the U.S. Fish and Wildlife Service become a cooperating agency in the planning and development of the Cove-East Fork Virgin River Watershed Plan-EIS. Please visit the project website at https://bit.ly/cove-eastforkvirginriver-EIS for information on the Plan-EIS.

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Derek Hamilton, Water Resources Coordinator, NRCS, Salt Lake City, UT

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C.3. Tribal Scoping Letter

November 20, 2020

Mr. Greg Anderson
Chairman
Moapa Band of Paiute Indians of the Moapa Indian Reservation, Nevada

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Anderson:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

As designed, the project will involve the construction of a new, approximately 6,055-acre-foot reservoir east of Orderville, Utah. Project components associated with the reservoir include an earthen dam, principal and auxiliary spillways, reservoir outlet works and emergency drain, an access road around the reservoir, camping and recreation area, and a boat ramp to allow for non-motorized boating. The project would also involve the replacement of approximately 1.7-miles of pipeline in Glendale, Utah and the relocation and upgrade of the existing Glendale Hydroelectric Plant.

An electronic copy of the Draft Plan-EA can be downloaded from the NRCS Cove Reservoir Watershed planning webpage, accessed from the web address below. A hard copy of the Draft Plan-EA can also be made available to you upon request.

https://www.nrcs.usda.gov/wps/portal/nrcs/detail/ut/programs/planning/wpfp

NRCS invites you to submit comments anytime during the open comment period starting November 25, 2020 and ending on December 31, 2020. Please refer to the enclosed flyer for instructions on submitting comments. **Comments must be received by December 31, 2020 to become part of the public record.**

We look forward to hearing from and working with you on this important project. We welcome your call if you have questions on the proposed project or if you wish to arrange a meeting. If you have any questions, comments or concerns, please contact State Cultural Resources Specialist Tara S. Hoffmann at at your earliest convenience.

Sincerely,



EMILY FIFE
NRCS State Conservationist

Encl: NOA Flyer

cc:

Tara S. Hoffmann, State Cultural Resources Specialist, Salt Lake City, UT
Norm Evenstad, NRCS, Assistant State Conservationist- Water Resources, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Mr. Richard M. Begay
THPO and Department Manager

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Begay:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

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Sincerely,



EMILY FIFE
NRCS State Conservationist

Encl: NOA Flyer

cc:

Tara S. Hoffmann, State Cultural Resources Specialist, Salt Lake City, UT
Norm Evenstad, NRCS, Assistant State Conservationist- Water Resources, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

USDA

November 20, 2020

Ms. Elaine Cantsee
Councilwoman
White Mesa, Ute Council

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Ms. Cantsee:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

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Sincerely,



EMILY FIFE
NRCS State Conservationist

Encl: NOA Flyer

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Tara S. Hoffmann, State Cultural Resources Specialist, Salt Lake City, UT
Norm Evenstad, NRCS, Assistant State Conservationist- Water Resources, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Ms. Betsy Chapoose
Director
Cultural Rights Protection Department
Ute Indian Tribe of the Uintah & Ouray Reservation, Utah

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Ms. Chapoose:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

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Sincerely,



EMILY FIFE
NRCS State Conservationist

Encl: NOA Flyer

cc:

Tara S. Hoffmann, State Cultural Resources Specialist, Salt Lake City, UT
Norm Evenstad, NRCS, Assistant State Conservationist- Water Resources, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Dr. Damon R. Clarke
Chairman
Hualapai Tribe
941 Hualapai Way
Peach Springs, Arizona 86434

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Dr. Clarke:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

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NRCS State Conservationist

Encl: NOA Flyer

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Norm Evenstad, NRCS, Assistant State Conservationist- Water Resources, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

USDA

November 20, 2020

Mr. Harold Cuthair
Chairman
Ute Mountain Ute Tribe

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Cuthair:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

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EMILY FIFE
NRCS State Conservationist

Encl: NOA Flyer

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Norm Evenstad, NRCS, Assistant State Conservationist- Water Resources, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

USDA

November 20, 2020

Mr. Darren Deboda
Moapa Band of Paiute Indians of the Moapa Indian Reservation, Nevada

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Deboda:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

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Norm Evenstad, NRCS, Assistant State Conservationist- Water Resources, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Dr. Kurt Dongoske
Director and Tribal Historic Preservation Officer
Pueblo of Zuni

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Dr. Dongoske:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

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NRCS State Conservationist

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Norm Evenstad, NRCS, Assistant State Conservationist- Water Resources, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Mr. Luke Duncan
Chairman
Ute Indian Tribe of the Uintah & Ouray Reservation, Utah

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Duncan:

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Sincerely,



EMILY FIFE
NRCS State Conservationist

Encl: NOA Flyer

cc:

Tara S. Hoffmann, State Cultural Resources Specialist, Salt Lake City, UT
Norm Evenstad, NRCS, Assistant State Conservationist- Water Resources, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Ms. Dawn Hubbs
Tribal Historic Preservation Officer
Hualapai Tribe

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Ms. Hubbs:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

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Natural Resources Conservation Service 125 South State Street, Room 4010, Salt Lake City, UT 84138
www.ut.nrcs.usda.gov 801-524-4550 Fax 844-715-4928
USDA is an equal opportunity provider, employer, and lender.

Sincerely,



EMILY FIFE
NRCS State Conservationist

Encl: NOA Flyer

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Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Mr. Terry Knight
Tribal Historic Preservation Officer
Ute Mountain Ute Tribe

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Knight:

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Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Mr. Stewart B. Koyiyumptewa
Tribal Historic Preservation Officer
Hopi Tribe of Arizona
Hopi Cultural Preservation Office

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Koyiyumptewa:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

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November 20, 2020

Mr. Leigh Kuwanwisiwma
Director
Hopi Culture Preservation Office
The Hopi Tribe

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Kuwanwisiwma:

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Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Ms. Dorena Martineau
Paiute Indian Tribe of Utah

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Ms. Martineau:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

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November 20, 2020

Mr. Jonathan Nez
Navajo Nation Office of the President

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Nez:

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USDA

November 20, 2020

Mr. Timothy L. Nuvangyaoma
Chairman
Hopi Tribe Chairman's Office

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Nuvangyaoma:

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November 20, 2020

Mr. Val Panteah Sr.
Governor
Pueblo of Zuni

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Panteah:

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November 20, 2020

Ms. Ona Segundo
Chairwoman
Kaibab Band of Paiute Indians of the Kaibab Indian Reservation
Tribal Affairs Building

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Ms. Segundo:

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November 20, 2020

Ms. Nichol Shurack
Tribal Archaeologist

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Ms. Shurack:

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November 20, 2020

Mr. Benny Tso
Chairman
Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Tso:

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November 20, 2020

Mr. Clint Wagon
Chairman
Eastern Shoshone Tribe of the Wind River Reservation, Wyoming

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Wagon:

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November 20, 2020

Ms. Carlene Yellowhair
President
San Juan Southern Paiute Tribe of Arizona
50 South Main Street

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Ms. Yellowhair:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

As designed, the project will involve the construction of a new, approximately 6,055-acre-foot reservoir east of Orderville, Utah. Project components associated with the reservoir include an earthen dam, principal and auxiliary spillways, reservoir outlet works and emergency drain, an access road around the reservoir, camping and recreation area, and a boat ramp to allow for non-motorized boating. The project would also involve the replacement of approximately 1.7-miles of pipeline in Glendale, Utah and the relocation and upgrade of the existing Glendale Hydroelectric Plant.

An electronic copy of the Draft Plan-EA can be downloaded from the NRCS Cove Reservoir Watershed planning webpage, accessed from the web address below. A hard copy of the Draft Plan-EA can also be made available to you upon request.

https://www.nrcs.usda.gov/wps/portal/nrcs/detail/ut/programs/planning/wpfp

NRCS invites you to submit comments anytime during the open comment period starting November 25, 2020 and ending on December 31, 2020. Please refer to the enclosed flyer for instructions on submitting comments. **Comments must be received by December 31, 2020 to become part of the public record.**

We look forward to hearing from and working with you on this important project. We welcome your call if you have questions on the proposed project or if you wish to arrange a meeting. If you have any questions, comments or concerns, please contact State Cultural Resources Specialist Tara S. Hoffmann at , at your earliest convenience.

Sincerely,



EMILY FIFE
NRCS State Conservationist

Encl: NOA Flyer

cc:

Tara S. Hoffmann, State Cultural Resources Specialist, Salt Lake City, UT
Norm Evenstad, NRCS, Assistant State Conservationist- Water Resources, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

C.4. Agency Scoping Meeting Materials

THANK YOU FOR JOINING!

THIS MEETING WILL BEGIN AT APPROXIMATELY 6:05 P.M. TO ALLOW FOR ALL ATTENDEES TO SIGN IN.

WE APPRECIATE YOUR PATIENCE!







WELCOME

COVE – EAST FORK VIRGIN RIVER WATERSHED PROJECT

PUBLIC SCOPING MEETING

October 20, 2021







MEETING PURPOSE

- Introduce the Project Sponsor and Team
- Provide an overview of the NRCS PL-566 Program
- Review the background and history of the Cove – East Fork Virgin River Watershed Project
    - Formerly the Cove Reservoir Project
- Present the purpose and preliminary alternatives being considered
- Inform the public how to provide scoping comments on the project
- Answer questions and collect comments from the public

LEAD AGENCY / SPONSORS

LEAD FEDERAL AGENCY

- U.S. DEPARTMENT OF AGRICULTURE - NATURAL RESOURCES CONSERVATION SERVICE

SPONSORING LOCAL ORGANIZATIONS

- KANE COUNTY WATER CONSERVANCY DISTRICT (PRIMARY SPONSOR)
- WASHINGTON COUNTY WATER CONSERVANCY DISTRICT (CO-SPONSOR)

IN COOPERATION WITH

- ENVIRONMENTAL PROTECTION AGENCY
- BUREAU OF LAND MANAGEMENT
- NATIONAL PARK SERVICE

PROJECT TEAM

NRCS UTAH

Norm Evenstad, *Assistant State Conservationist*

Derek Hamilton, *Water Resources Coordinator*

Leslie Warta, *Environmental Compliance Specialist*

Lance Smith, *Project Engineer*

Marcel Corbeil, *Cultural Resources Specialist*

KCWCD - SPONSOR

Mike Noel, *Executive Director*

Dirk Clayson, *Private Consultant Lands and Real Estate*

WCWCD – CO-SPONSOR

Zach Renstrom, *General Manager*

Corey Cram, *Associate General Manager*

ENGINEERING AND DESIGN

Alpha Engineering - Brent Gardner, *Project Manager/Principal Engineer*

RB&G Engineering – Brad Price, *Geotechnical Analysis*

RB&G Engineering – Brandon Horrocks, *Geotechnical Analysis*

ENVIRONMENTAL

Transcon Environmental – Tim Green, *Environmental Program Manager*

Transcon Environmental – Brian Parker, *Environmental Project Manager*

Transcon Environmental – Ian Snyder, *Coordinator and NEPA Planner*

Transcon Environmental – Ron Bolander, *NEPA Specialist*

ECONOMIC ANALYSIS

Scott Hoag Jr., *Economic Analyst*

PROJECT AUTHORITY

- **Authority**: Public Law 83-566, the Watershed Protection and Flood Prevention Act of 1954, as amended
- **Policy**: National Watershed Program Manual and Handbook sets plan policy
- **Project Sponsors**: Local organizations that have legal authority and resources to install, operate, and maintain improvements.
- **Authorized Purposes**: Flood prevention; watershed protection (erosion/sediment control); public recreation; fish and wildlife habitat; agricultural water; M&I water; water quality; watershed structure rehab; hydropower sources
- **NEPA**: The Plan-EIS is being prepared in accordance with Section 102(2)(c) of the National Environmental Policy Act of 1969 (NEPA), PL 91-190, as amended.

PL-566 OVERVIEW

- The Watershed Protection and Flood Prevention Act (PL-566) authorizes the NRCS to help local organizations and governments plan and implement physically, environmentally, socially and economically sound watershed project plans for the benefit of the public.
- Provides technical and financial assistance to project sponsors for planning and installing watershed projects (e.g., dams, debris basins, pipelines, etc.)
- Locally led NRCS teams. Local leadership is key.
- Up to a 250,000-acre watershed per project

PL-566 ELIGIBLE PURPOSES

- Flood Prevention
- Watershed Protection
- Agricultural Water Management
- Municipal and Industrial Water Supply
- Fish and Wildlife Habitat and Public Recreation Development



PL-566 PROJECTS

STRUCTURAL MEASURES

- **Dams**
- **Channel restoration**
- **Diversions**
- **Floodwalls**
- **Dikes**

NON-STRUCTURAL MEASURES

- **Upland conservation and erosion protection**
- **Wetland restoration**



PROJECT NEPA BACKGROUND

- Initially known as the "*Cove Reservoir Watershed*" Project
- Development of alternatives, resource studies, and impacts analyses were conducted from spring 2018 to fall 2020.
- Documented in a Draft Watershed Plan Environmental Assessment (Plan-EA)
- Preferred Alternative identified in the Plan-EA was the Cove Reservoir
- Draft Plan-EA published for public review and comment in December 2020
- Following review and consideration of comments, the Draft Plan-EA was not approved, but informed the NRCS to move to an EIS to analyze any viable alternatives in further detail

PROJECT BACKGROUND

- Initial planning for the proposed project began over 25 years ago
- Numerous agencies and irrigation companies involved in the planning including the Bureau of Land Management, National Park Service, U.S. Fish and Wildlife Service, Utah Department of Natural Resources, KCWCD, WCWCD, Orderville Irrigation Co., etc.
- Guidelines and limitations for potential projects in the East Fork Virgin River Watershed, including several specific reservoir alternatives, were identified and agreed upon in the *Zion National Park Agreement* (1996)
- *East Fork Virgin River Instream Flow MOU* (2000) regulates water flows on the East Fork Virgin River within the watershed being analyzed for this project

PROJECT PURPOSE

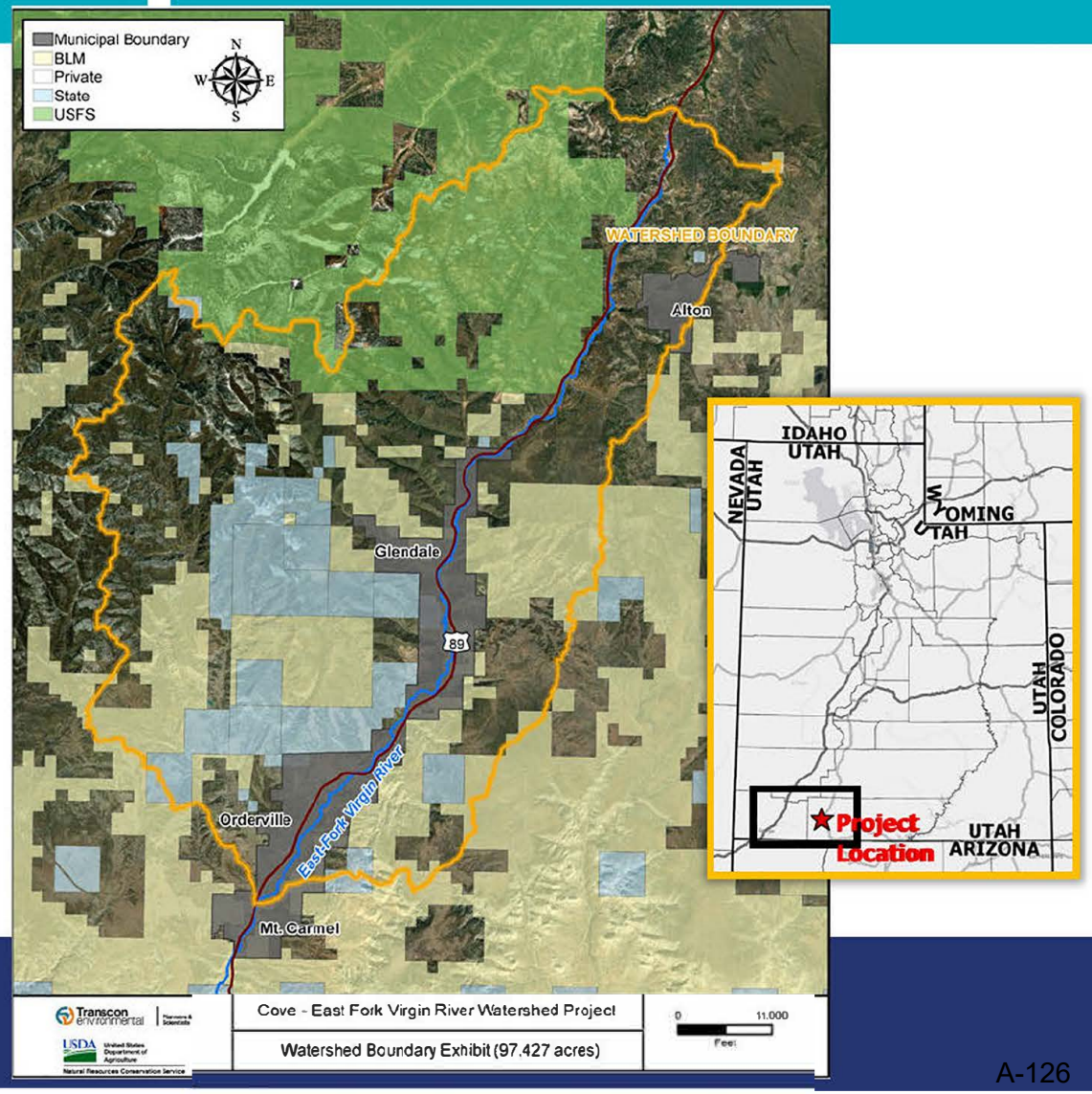
- Currently no critical water storage capacity or reliable irrigation water delivery to local agricultural users during the dry summer months
- Local water users in Kane County continue to experience water shortages
- Limited capability of existing irrigation system to utilize flows from the East Fork Virgin River
- Need for additional water reliability in Washington County
- Additional water-based recreation opportunities for locals and tourists

PROJECT PURPOSE

Project Response to the Needs:

- Identify a viable alternative which once implemented would:
  - Increase water availability and reliability for current and future users
  - Improve irrigation efficiency
  - Increase the availability of recreational opportunities (e.g., fishing, non-motorized boating, hiking, camping, etc.)
- Additional benefit: increase in hydroelectric energy supply to the community

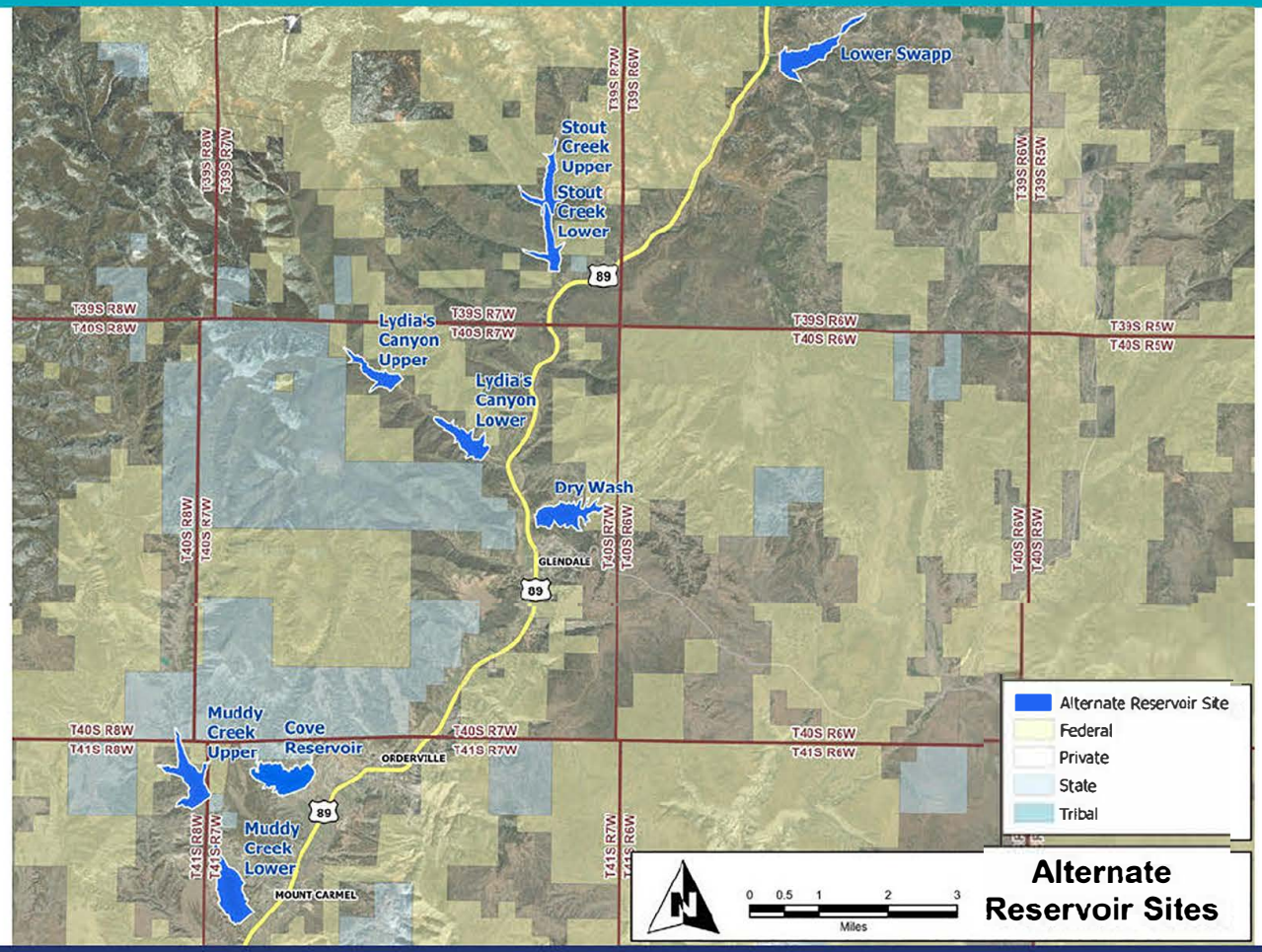
WATERSHED OVERVIEW



East Fork Virgin River Watershed

- Includes 3 HUC-6 Watersheds within the overall Upper Virgin Watershed
  - Lydia's Canyon-East Fork Virgin River (150100080203)
  - Muddy Creek (150100080202)
  - Headwaters East Fork Virgin River (150100080201)
- Overall watershed area - 97,427 acres
- Land Ownership
  - BLM
  - USFS
  - SITLA
  - Private

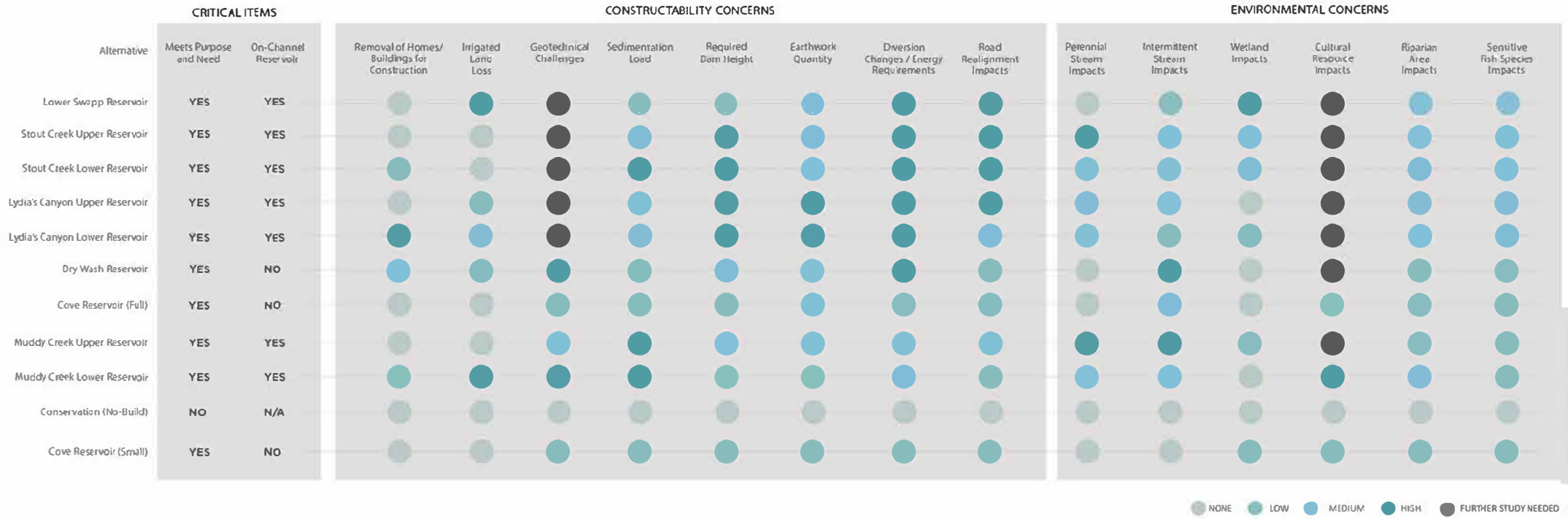
ALTERNATIVES BEING CONSIDERED



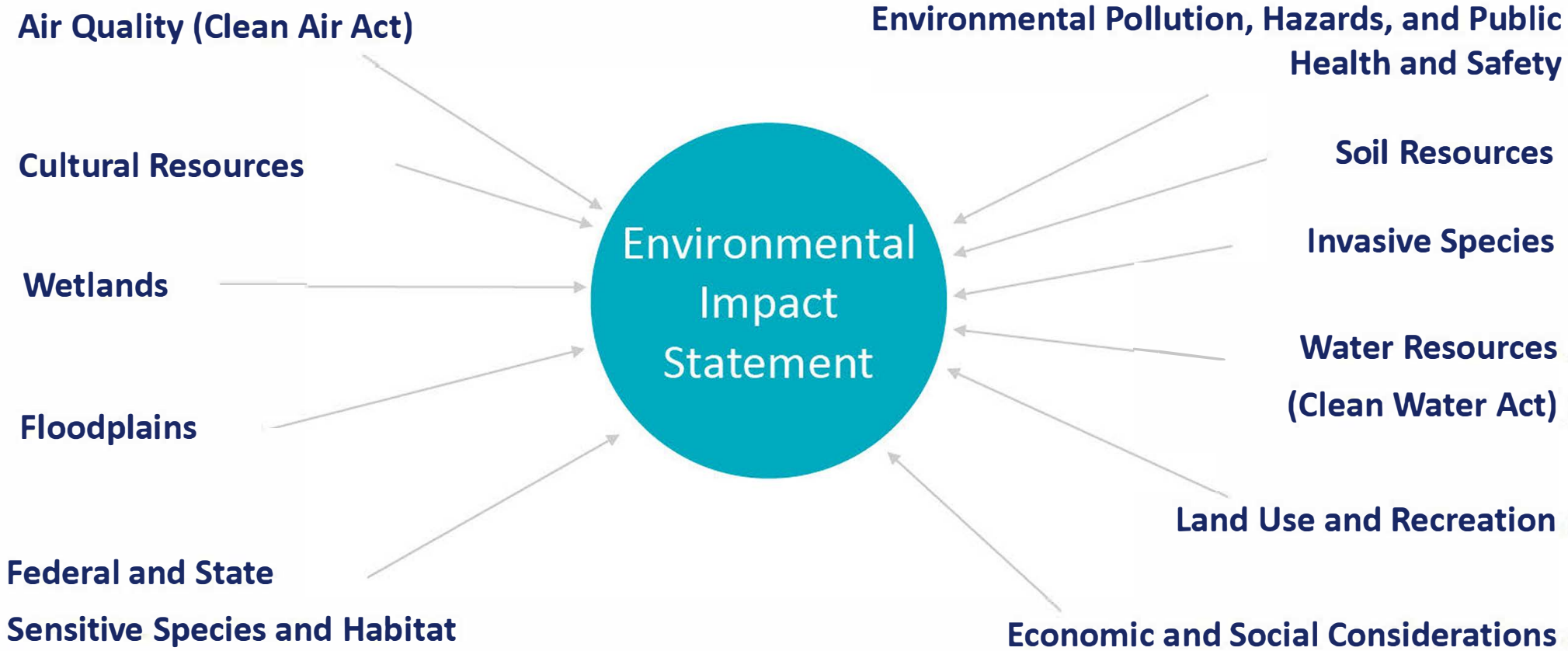
OTHER ITEMS BEING CONSIDERED

- Recreational facilities and access for the sites
- Water conservation
- Channel stabilization to reduce sediment loads.
- No Action Alternative

ALTERNATIVES MATRIX



RESOURCES TO BE CONSIDERED



NEPA PROCESS / TIMELINE

PROJECT TIMELINE

1. WE ARE HERE
   Resource Evaluation / Prepare Draft EIS
   FALL 2021– SUMMER 2022
2. Agency Review / Public Comment Period / Final EIS / Decision Document
   FALL 2022– SPRING 2023
3. Final Design*
   *(pending environmental approval and funding)
   2023 – 2024
4. Begin Project Construction*
   *(pending environmental approval and funding)
   2025

NEPA PROCESS

WE ARE HERE

Initiate Environmental Impact Statement
- Develop project purpose & need
- Conduct agency & public scoping
- Collect baseline data
- Develop project alternatives

Collect Data
- Analyze existing conditions
- Identify data gaps from existing Plan-EA
- Conduct additional needed resource surveys
- Agency consultation & coordination

Analyze Alternatives
- Analyze alternatives
- Evaluate potential impacts to environmental resources

Draft Environmental Impact Statement
- Release Draft EIS to public for review and comment
- Review all public and agency comments
- Prepare Final EIS

Decision Document
- NRCS will prepare a Record of Decision and post a Notice of Availability of the Final EIS in the Federal Register

HOW TO COMMENT

Official comments for the Cove – East Fork Virgin River Watershed Project can be submitted via comment card, letter, or email to the following:

Brian Parker
Transcon Environmental

Pre-addressed comment cards can be downloaded from the NRCS project planning website. Comment cards are also available for your convenience at the Kane County Water Conservancy District Office in Kanab, Utah.

Comments may also be provided during the virtual Q&A session following this presentation.

THANK YOU!



QUESTIONS

or

COMMENTS?



Appendix D. Comment Summary Table

CID	Doc ID	Received	Type	Group	Entity	Commenter	Commenter ID	Category	Comment
1	1	10/10/2021	Email	Public		Richard Spotts	1	NEPA Process	When do you expect or estimate that the required Notice of Intent (NOI) may be published in the Federal Register which normally officially starts the scoping comment period and process under NEPA?
2	1	10/10/2021	Email	Public		Richard Spotts	1	NEPA Process	Why did you open an early scoping period on the NRCS project web page on October 7 rather than wait for the NOI to be published?
3	1	10/10/2021	Email	Public		Richard Spotts	1	NEPA Process	Did you release a news release or media notice on October 7 and/or will you do so when the NOI is published?
4	1	10/10/2021	Email	Public		Richard Spotts	1	NEPA Process	Will the previous extensive comments that I and others submitted on the Cove Reservoir EA be carried forward as part of this EIS level analysis and administrative record, or will those comments be excluded going forward such that this is a *de novo* NEPA process and that previous comments would need to be re-submitted now to be considered in preparing the DEIS and to be included in the EIS level administrative record?
5	1	10/10/2021	Email	Public		Richard Spotts	1	NEPA Process	Can I and other members of the public participate in the "agency" virtual meeting on October 18th or only at the October 20th virtual meeting?
6	1	10/10/2021	Email	Public		Richard Spotts	1	NEPA Process	As with the previous EA, will the National Park Service and/or Bureau of Land Managementbe official "cooperating agencies" on this EIS level analysis process, and should the Bureau of Reclamation be included given their "special expertise" relating to water development projects?
7	1	10/10/2021	Email	Public		Richard Spotts	1	NEPA Process	Since this proposed project and previous EA were developed during the Trump administration, were these NRCS decisions investigated under President Biden's Executive Order 13990, and, if so, what were the findings?
8	1	10/10/2021	Email	Public		Richard Spotts	1	Water Resources	Was your "agency scoping notice" or another notification of this new scoping process sent to the official state representatives under the Colorado River Compact (especially those for Arizona, Nevada, and California as they may be directly affected by future diversions or reductions in Virgin River flows)?
9	1	10/10/2021	Email	Public		Richard Spotts	1	NEPA Process	What is the specific source and amount of public funding that NRCS is using for this new EIS level analysis and public involvement process, and is any of this funding contingent upon future Congressional appropriations or USDA/NRCS administrative allocations?
10	2	10/11/2021	Email	Public	Southern Utah News	Helene Jorgensen	2	General	Hi Brian; I am a reporter with the Southern Utah News and talked to your last year about the CoveReservoir project. Would you have time to talk to me this morning (if you don't haveColumbus Day off? I have some questions about what the EIS will entail and what the proposed purposes of the project are?
11	3	10/11/2021	Email	Public		Jane Whalen	3	General	Please put me on the mailing list. Is the project the same as the EA? Will all comments from the EA be answered?
12	4	10/12/2021	Email	Agency	Resource Development Coordinating Committee	Sindy Smith	4	NEPA Process	Has the NOI been published in the Federal Register yet? If not, when do you anticipate that will happen?
13	5	10/12/2021	Email	Public		Bryan Dixon	5	NEPA Process	I would also like to observe the agency meeting to see what kinds of questions NRCS poses and what positions might be expressed, even in preliminary form. It should be a public open meeting. Please send me the necessary login information.
14	6	10/12/2021	Email	Agency		Robert Lacey	6	NEPA Process	Which local agencies will be invited to the meeting on the 18th? I represent the Town of Orderville as a council member.
15	7	10/13/2021	Email	Public		Jane Whalen	3	NEPA Process	Will the new description of the Project be available for upcoming meetings? Thus far, there is little information on the new project plan so that will make it hard to write and constructive scoping comments. Thanks so much for taking the time to respond.
16	8	10/18/2021	Email	Public		Barry Sochat	7	Water Resources	Dear Mr Parker, I am a long time resident of Rockville and shareholder and officeholder of the Hall & Grafton Ditch Company. Please include these comments into your formal record. I have serious concerns about any upstream water project that could reduce the stream flow of the North Fork Virgin River through Rockville. Given the threats from Cyanobacteria outbreaks in the Virgin River due to the ongoing drought's low flow and increased water temperature, I think a further reduction in stream flow could prove detrimental to our town.
17	9	10/20/2021	Mail	Public		John Carpenter	8	Health and Safety	I have studied disasters around around our country as preparation for a previous occuparion. Johnstown comes to mind. Our most destructive dam failure in the past. The circumstances here are quite different until you get down to our home. Even a sturdy concrete dam would not seem safe in our land configuration. Many American dam failures have resulted in hundreds of fatalities. Nothing in our area at this time calls for such water storage. We presently pump from a deep spring. Is there a possibility that projects above us could do the same? The lake formed in this project is too small to be effectively or widely used for recreation. Turning "East Zion" into mecca of homes, electric busses, and great wealth for the developers is a hopeless idea. Entrance to Zion Park from here is via a twisting narrow road and a small mile long tunnel presently crowded and slow all summer. For very practical reasons, such a dam here is irresponsable, is a harbinger of a failed resort idea, and benefits only the developer.
18	10	10/20/2021	Mail	Public		Kelly Wilson	9	Health and Safety	We who live below the proposed dam have serious concerns about the long term safety of the dam when we hear that it is going to be a "high risk earthern dam". I have read extensively on earthern dams and in certain applications they are perfectly fine. We have a problem when it is proposed to hold 6,000 acre feet of water and be 90 feet high and I have property, as do many others, right in the path of a potential failure. 1.) Can you detail the precautions and safety measures that are in place? 2.) Who is going to compensate for property loss when there is a disaster and the dam fails?

CID	Doc ID	Received	Type	Group	Entity	Commenter	Commenter ID	Category	Comment
19	11	10/20/2021	Email	Public		Laura Wilson	10	Health and Safety	Downsteamers bear a life threatening risk and the notion that more water is needed for our fields is not an honest assessment according to the Utah River Council and my own observation after living below the fields for 40 years.. Let Washington County build their own risky dam. According to the internet Earthen dams break all over the US. Sooner or later this dam will break. I have seen it in a dream and two others I know of have had the same experience. This Dam Will break! Unusually heavy rains, rodents, tree root seepage, earthquakes and even terrorism are all dangers that can't be controlled. The Utah Geological Survey says Utah has a 50% chance of damaging earthquakes. We've known that. I am assuming the Virgin River will be at a high level from time to time all year round, taking up the gap from the dam. This will put our children at risk who play in the river. It will cause cottonwood trees to become waterlogged and fall over causing dangerous log jams. The Cottonwood Lane bridge will choke with logs causing further flooding and damage up stream.. In the early stages of this Cove Reservoir plan, residents were not notified. Only 17 letters were sent out in 2018 and those letters only went to field owners who naturally want more water. Yes, a nice lake and recreational area and housing development will be an asset but our Water Conservancy District and the Town of Orderville should be protecting its citizens from a dam that could take lives, erode fields, rip out water and electrical and sewer lines, highway and cause citizen deaths. This is my "COMMENT FORM" filled out and send email to bparker prior to the Public Scoping which has not done a good job of letting the public know of this meeting and presented in the papers too close to the actual meeting to get comments in time. I request time to present my feelings at the Public Meeting.on Oct 20, 2021.
20	12	10/31/2021	Email	Public	N/A	Craig Wallentine	11	Purpose and Need	Include an accurate accounting of the actual Long Valley farm beneficiaries is needed to define achievable Cove project goals and meet NRCS requirements. The original Cove Environmental Assessment (EA) claimed to be for the benefit of the upstream Long Valley farmers. However, the EA failed to explain exactly how many upstream farmers would benefit and by how much. The EA was also based on inaccurate demand information since half of the proposed agricultural service acreage had already been developed for municipal and industrial uses. The failure to accurately define the purposes of the Cove Reservoir project has not been remedied as shown during the public comment scoping session on October 20th, 2021. During that public meeting, the two Cove Project sponsors; the Kane County Water Conservation District (KCWCD) and the Washington County Water Conservation District (WCWCD) directly contradicted each other about who is actually going to benefit from this taxpayer subsidized project. At the October session, Mr. Mike Noel of the KCWCD stated that 90% percent of the water in the Cove reservoir would be for Long Valley farmers.Mr. Noel was then contradicted by the WCWCD representative who stated that 50% of the water in the Cove reservoir would be for Washington County farmers. This fundamental confusion would not be tolerated in a corporate capital project discussion.
21	12	10/31/2021	Email	Public	N/A	Craig Wallentine	11	Economics	The DEIS must accurately detail the number of the upstream farmers and the amount of acreage in the Long Valley that will benefit with special attention paid to identified senior water rights and to which water rights are currently being contested so that NRCS Federal taxpayer dollars are not wasted.
22	12	10/31/2021	Email	Public	N/A	Craig Wallentine	11	Alternatives	The DEIS should include the alternative of splitting the proposed project into two separate projects with the Washington County Water Conservancy District managing their own downstream water storage project with or without NRCS funding. The Gardner Policy Institute and other local development agencies have produced well documented projections for the increased municipal and commercial water demand (at higher prices than typical agricultural water prices) in Washington County, Utah for at least the next 50 years. Rather than misrepresenting that the proposed Cove project is for long term agricultural use in Washington County, the WCWCD should submit an alternative project that splits out its municipal and commercial water storage project from the upstream EFVR project. Based on the actual facts of long term Washington County water use, the WCWCD storage project may or may qualify for some form of NRCS support. The two water districts could establish a Memorandum of Understanding between the two entities to allow water conservation programs and to reduce capital costs while saving federal taxpayers a significant amount of money. At a minimum, having a separate WCWCD project alternative will lead to a more open, honest discussion of the benefit of NRCS projects in Southern Utah.

CID	Doc ID	Received	Type	Group	Entity	Commenter	Commenter ID	Category	Comment
23	12	10/31/2021	Email	Public	N/A	Craig Wallentine	11	Economics	As discussed extensively in the comments to the original Cove Environmental Assessment, WCWCD owns the majority of the water rights involved and desires to best serve its changing customer base in the future. The DEIS should honestly and openly address this long-term shift in Washington County water demand to more municipal and commercial water use away from agricultural use. The WCWCD has the right to act in its economic best interest to facilitate the transition of agricultural water rights to municipal and commercial use in their service area, thus allowing all parties to maximize their economic value – whether as farmers selling their water rights or developers buying them. However, it should not be using federal taxpayer subsidies for private gain. The 2020 WCWCD Annual report shows that the District is very well funded with a net reserve of over a quarter of a billion dollars. In the past year alone, the WCWCD increased net reserves by multiples of the Federal taxpayer subsidy they are seeking in the Cove project (increase of $50MM in 2020 over 2019). So clearly there is no reason for WCWCD to seek an unjustified federal taxpayer subsidy.
24	12	10/31/2021	Email	Public	N/A	Craig Wallentine	11	Alternatives	The DEIS should address the specifics alternative of a separate WCWCD municipal and commercial water storage project. The DEIS should include an analysis of the financial benefits of a separate and alternative WCWCD managed reservoir project. The alternative project would be sized to fit within the scope of the existing WCWCD diversion and storage facilities along the Virgin River which would save money upfront. The DEIS should include a written statement from the Board of the WCWCD as to their alternative plans if the current Cove Reservoir proposal fails to meet NRCS guidelines. Their next-best plan should be the basis of the alternative project design so it will directly address the needs of Washington County in a cost effective manner without taxpayer subsidies. It is highly likely that a privately financed WCWCD water storage project would succeed because of the many associated benefits that will accrue to Washington County private interests (e.g. increase land value, increased commercial and residential development, increased water right value, etc). The DEIS alternative would encourage the well-capitalized WCWCD to use its own private resources to develop its commercial goals in Washington County in the 21st century without federal taxpayer subsidies. As a privately funded project, the ongoing conversion of agricultural water rights to municipal and commercial use by WCWCD stakeholders will not violate any NRCS Federal taxpayer funding rules.
25	12	10/31/2021	Email	Public	N/A	Craig Wallentine	11	Economics	The DEIS Should Include a detailed explanation of downstream reservoir operating costs and water exchange agreements. In order to qualify for NRCS funding, the Long Valley agricultural water use needs to be detailed and documented. The original Cove Environmental Assessment (EA) failed to explain how Long Valley farmers upstream would benefit from the Cove reservoir downstream of their properties. If Long Valley farmer water is to be stored downstream then either the water will need to be pumped back upstream (but pumping costs were not disclosed in the EA) and the costs included in project economics or a number of complex water exchange agreements to reallocate stream flows water must be created and registered in the public domain. The DEIS should include copies of all Water Exchange Agreements associated with the proposed Cove reservoir project and their associated economics to be sure that Federal taxpayers are not being taken advantage of by non-agricultural water users.
26	12	10/31/2021	Email	Public	N/A	Craig Wallentine	11	Water Resources	The DEIS should include a clear and accurate calculation on probable evaporation rates and net losses for the proposed Cove reservoir during an era of aridification. The original Cove project financials depended upon an opaque and non-publicly accessible study by the Utah Division of Water Resources referenced in appendices as the "project analyses". The EA documents stated that the evaporation rates would be at least 2.22 feet per year (per acre). During the 12/9/2020 public hearing, the WCWCD project manager stated that the expected evaporation rate at the Orderville elevation would be 30 inches or 2.5 feet per year per acre. Unfortunately, the Cove EA documentation went on to claim, in contradiction to its own numbers, that Cove Reservoir evaporation losses would be less than half of the actual expected losses, conveniently inflating the value of the project. This type of internal inconsistency would not be tolerated in a corporate capital project review. The DEIS must include current and accurate evaporation and net loss calculations for the Cove project. The calculations should specifically address the increase in local temperature since the historical evaporation rates were originally determined. The DEIS should also account for the projected increase in evaporation rates caused by further temperature rise and decreased local humidity over the 100 year life of the project. Building a project in an arid environment using out of date evaporation factors would be bad engineering practice.

CID	Doc ID	Received	Type	Group	Entity	Commenter	Commenter ID	Category	Comment
27	12	10/31/2021	Email	Public	N/A	Craig Wallentine	11	Invasive Species	The DEIS should address the actual cost of quagga mussel contamination of the proposed Cove reservoir project in detail. The original Cove EA contained minimal facts about the operation of the Cove reservoir project and managing quagga mussels. The project sponsor KCWCD has been actively promoting boating on the proposed reservoir while not addressing the cost of quagga mussel control. When asked about this issue at the project public hearing on 10/20/2021 Mr. Noel of KCWCD stated that “bald eagles spread quagga mussels”. Per the National Oceanic and Atmospheric Administration, bald eagles are actually likely to be poisoned by avian botulism propagated by the quagga mussels. The DEIS should include the scientific data supporting Mr. Noel’s claim about the danger from bald eagles to Cove Reservoir users and his plan for managing bald eagle risks at the Cove Reservoir. The DEIS project economics should also include a realistic estimate of the costs of doing effective boat inspections at the private county reservoir that KCWCD will be operating in a region of contaminated local reservoirs.
28	12	10/31/2021	Email	Public		Craig Wallentine	11	Health and Safety	DEIS should include a detailed Occupational Health & Safety Plan for each project alternative. The best way to ensure worker health and safety is through good project design. A strategic project worker safety risk assessment should be included in the DEIS. A separate upstream low risk, high return NRCS project would carry greatly reduced worker exposures to protect the EFVR watershed, help Long Valley farmers and accelerate the growth of the East side Zion National Park outdoor recreation economy. A downstream WCWCD reservoir project alternative with massive earth moving and construction components should be assessed carefully on its own because of the major worker safety issues involved. Regardless of the final project alternative selected, the DEIS should also include a list of potential construction contractors and their demonstrated OSHA safety track record. Using only the safest contractors is an excellent start to protecting workers. Requiring this reporting will encourage contractors to make safe operations a condition of employment with poor performing contractors being weeded out before they facilitate increased worker deaths, injuries and illnesses.
29	13	10/31/2021	Email	Public		Craig Wallentine	11	Water Resources	The DEIS Should Include a full Watershed Management Plan for the East Fork of the Virgin River. The Cove EIS Scoping plan should include a comprehensive water management plan for the East Fork Virgin River (EFVR) watershed beginning at the headwaters of the EFVR watershed as shown on the Cove project map. The watershed management plan should include a clear analysis of how aridification will impact the EFVR watershed over the 100-year project life. The water management plan should include best available and best practicable conservation management processes, tailored for each elevation level across the 100,000 acre EFVR watershed. The primary NRCS project goal is that total and seasonal water flow be managed more effectively upstream of the Cove Reservoir project thus greatly reducing the cost of this project. Upstream watershed management would benefit more Long Valley farmers, native fish, local wildlife and flora at a much lower cost than a single high cost downstream project without any watershed management component. Focusing on the EFVR as a priority is consistent with PL-566 requirements “that local sponsors help ensure adequate conservation treatment measures on at least 50% of the watershed area above retention reservoirs”. A comprehensive EFVR watershed management plan will be cheaper to implement as it will be tailored to current and future water flows while taking advantage of smart water management practices upstream where they will be of the most value to Long Valley users. This critical watershed information should be included in the NEPA DEIS documents for public comment.

CID	Doc ID	Received	Type	Group	Entity	Commenter	Commenter ID	Category	Comment
30	13	10/31/2021	Email	Public		Craig Wallentine	11	Alternatives	The DEIS should include the alternative of two separate projects with a priority on the upstream watershed and agricultural project. The upstream NRCS project would be focused on a cost effective project that would benefit (a) the EFVR watershed and natural environment during a period of long term aridification; (b) benefit Long Valley farmers with federal cost sharing up to 75%; (c)provide increased outdoor recreational activities and local tourism; while (d) greatly reducing the cost of capital construction. The upstream NRCS project would take advantage of best practical watershed management technology and efficient agricultural practices so that a large reservoir would not be needed downstream for Long Valley farmers. Eliminating the proposed reservoir from the upstream proposal would make more money available for smart, local water conservation programs and also meet the fundamental requirements of PL-566 by eliminating a flood risk that does not need to be created by a large expenditure of federal taxpayer dollars. The second, downstream project alternative should be developed by WCWCD on behalf of its private water rights stakeholders. The WCWCD project would help private interests obtain the maximum value for their water rights in Washington County by supplying the high demand growth in municipal and commercial water use in St. George and surrounding communities without inappropriate federal taxpayer subsidies.
31	13	10/31/2021	Email	Public		Craig Wallentine	11	Alternatives	Natural restoration programs should be given priority in the EFVR Watershed DEIS. The Utah Division of Wildlife Resources (UDWR) has written a beaver management plan that has been shown to effectively protect upland Utah watersheds and counter the long-term impacts of aridification. The original Cove Environmental Assessment (EA) made no mention of this low cost alternative to restore natural water management practices to the East Fork Virgin River watershed. Nearby Beaver, Utah was named for the great number of beaver dams present in early pioneer days and reintroduced beavers are doing a good job of stream restoration in the adjacent Escalante River watershed. The successful restoration of beaver habitats in the Intermountain West is well documented in "Eager: The Surprising, Secret Life of Beavers and Why They Matter" by Ben Goldfarb and "Saving the Dammed - Why We Need Beaver-Modified Ecosystems" by Ellen Wohl. The UDWR Beaver Management Plan shows that there are “substantial opportunities” for watershed restoration and improvement in the 100,000 acre watershed that feeds directly into Long Valley. As stated in the Cove project design basis, slowing the flow of water through natural means will reduce excess storm runoff and erosion and smooth out irrigation water flows. The Cove DEIS should include a detailed discussion of how reintroduction of beavers in the EVFR watershed could be a low cost and natural restoration project.
32	13	10/31/2021	Email	Public		Craig Wallentine	11	Water Resources	The DEIS documentation should include detailed hydrological information on the Long Valley farm beneficiaries of this project. The original Cove Environmental Assessment (EA) contained almost no information on the actual farm users for the project especially in Long Valley. The DEIS should include a tabulation of the number of farmers, the amount of irrigated land at each elevation in Long Valley, the historical water usage time series (e.g. how much water is needed each month) for alfalfa production by these farmers in Long Valley and the increased water demand based on the project projections. The original Cove EA appeared to be based on a few emails between KCWCD board members that were then extrapolated into the justification for the largest NRCS project in the United States. An investment of this magnitude deserves better and more quantitative water use analysis in the DEIS.
33	13	10/31/2021	Email	Public		Craig Wallentine	11	Alternatives	The DEIS should give priority to natural and low cost EVFR stream management and restoration projects versus high cost downstream capital investments. The DEIS should include a detailed EFVR river management plan upstream of the proposed Cove reservoir site with common sense water management projects that would benefit the upstream farmers such as: (1) inclusion of water efficient programs from the USDA and Utah Farm Bureau to reduce water usage in current farm operations and increase water retention on local properties; (2) removal of invasive species like tamarisk and Russian olive trees and replacement with native flora that use less water (3) use of natural flora along the EFVR to trap and release more water for local users along with natural stream management (4) natural stream restoration programs as discussed on the NRCS website and in the literature on renewing river corridors in dry-land regions; (5) consideration of a long term agricultural strategy for Long Valley with a view to what crops are going to be economically viable at that elevation as aridification continues and water prices increase (6) consideration of the relative benefit for federal taxpayers of purchasing a certain amount of water conservation easements rather than funding expensive capital projects. The original Cove Environmental Assessment (EA) discussed none of these critical alternatives and this critical watershed information should be included in the DEIS documents for public comment.

CID	Doc ID	Received	Type	Group	Entity	Commenter	Commenter ID	Category	Comment
34	13	10/31/2021	Email	Public		Craig Wallentine	11	Alternatives	The DEIS should include discussion of other potential water storage sites and structures that would benefit Long Valley farmers upstream of the proposed Cove reservoir site. The project sponsors claim that the proposed reservoir site is optimal. However, common sense suggests that placing an agricultural water reservoir downstream of the farmers it is intended to benefit is not logical. In addition, it does not appear that the proposed Cove reservoir will function as designed. During the October 21, 2021 public comment session, Mr. Mike Noel of the KCWCD stated that (1) the inlet to the proposed reservoir would not handle either high spring runoff flows nor (2) monsoon storm-water flows. He then went on to say (3) that essentially only “clear” water would be allowed into the reservoir so that dam silting would not be an issue and that fish stocked in the proposed reservoir would have clearer water. The DEIS should contain tabulations showing exactly how the proposed reservoir will function; e.g. use historical and projected water flows as constrained by Mr. Noel with the resulting time series on how the reservoir water level and water quality will fluctuate. It may be that the reservoir will not be functional given existing water usage and the constraints that Mr. Noel has described. If the EFVR water supply is fully allocated and the reservoir cannot function as claimed per the limitations outlined by Mr. Noel, then there is no logical reason to build an oversized reservoir downstream of the Long Valley farmers since there will be no “excess” water flow to capture. Please discuss alternative water retention sites across the EFVR watershed that could actually capture “excess” water flows while managing the sedimentation issue at much lower capital cost. It would seem that smaller upstream dams and diversion areas could (1) capture “excess” flows when and as needed; (2) slow down water flow to allow sedimentation to occur in manageable locations so that clearer water can flow out and on downstream and (3) identifying locations above and in Long Valley for placing water management structures upstream of the actual farmers who can then use the water. In essence, this would be a continuation of the upstream EFVR watershed management program in the agricultural area above the proposed dam site per NRCS best practices.
35	13	10/31/2021	Email	Public		Craig Wallentine	11	Recreation	The DEIS should include an accurate assessment of the impact of East Zion Growth Initiatives on agricultural land use in Long Valley. The proposed new East Entrance Visitor Center at Applecross Station along with the major new trail network and the proposed subsidized shuttle systems with Kanab and Springdale will dramatically increase the number of visitor days on the east side of Zion National Park to the benefit of visitors, locals and the environment. The original Cove environmental assessment failed to fully discuss this anticipated tourism associated growth in Long Valley. At the public hearing on 10/20/21, the KCWCD representative stated that there are already many vacation rental units in the Mount Carmel to Glendale area. Utah congressional representatives are also on record as saying that they will not support any caps on total visitors to Zion National Park which means a long term increase in East Zion visitor days. Taken all together, this indicates that pressure for tourist accommodations on the east side of Zion Park will result in gradual conversion of agricultural lands in Long Valley to higher profit commercial and municipal uses such as outdoor activity companies, automobile service stations, food stores, coffee shops, retail stores, restaurants, hotels/motels and private lodging. The EIS should take account of impending development activities that will inevitably reduce the amount of agricultural land in use in Long Valley thus reducing the scope of and claimed benefits of the proposed Cove reservoir project.
36	13	10/31/2021	Email	Public		Craig Wallentine	11	Recreation	The DEIS should include a more accurate assessment of the actual potential recreational benefits of the proposed Cove reservoir . The DEIS should not use Federal or Utah state parks with high interest features as the benchmarks for the Cove Reservoir project which lacks such distinguishing features. Accurate benchmarking will prevent overstatement of the actual number of increased visitor days generated by the project. The DEIS should also not be comparing the private, seasonal Cove reservoir with much larger, year round reservoirs like Quail Creek State Park which is deeper, twice the size and much closer to local population centers or Sand Hollow Utah State park which is six times the size with steady sources of inflows. The DEIS should use smaller, privately owned/county owned recreational facility benchmarks for this project. As the KCWCD representative stated at the public hearing on 10/20/2021, local usage of the reservoir will be encouraged thru subsidized use for local residents who will not bring new dollars to the area and higher fees will be assessed for out of county/out of state users which will suppress demand. These two management decisions will result in both reduced visitor days and lower per person economic benefit per user day than outlined in the original environmental assessment. Further, the EIS should include realistic costs for maintaining visitor support facilities and dealing with invasive species if it is to be anything more than a glorified rest stop with minimal incremental recreational benefits. The EIS needs accurate recreational benchmarks, discussion of management practices/income and honest cost accounting in order to produce a trustworthy estimate of recreational benefits.

CID	Doc ID	Received	Type	Group	Entity	Commenter	Commenter ID	Category	Comment
37	13	10/31/2021	Email	Public		Craig Wallentine	11	Alternatives	The DEIS should address an alternative of a larger Valley camping and recreational site on the East side of Zion National Park with easy access to the Applecross Station Entry Station and Kanab. The original Cove environmental assessment correctly identified the critical fact that outdoor recreational facilities generate significantly higher return on investment than one additional cutting of hay. While the recreational benefits of the original Environmental Assessment were overstated for the ridiculously undersized campground with its minimal amenities, a properly sized outdoor recreational alternative should be considered for the East side of Zion National Park as part of an upstream NRCS project focused on improving the upper EFVR watershed and the economy of Long Valley. A full-scale campground of 200 campsites (10X the EA proposal) with room for both motorized and tent campers would generate significant financial benefit from extended stay visitors and accelerate the growth in the tourist economy of Long Valley and nearby Kanab. Inclusion of this new site in the Utah State Park system would generate far more financial benefit than currently contemplated in the Cove project design. The impact of such an alternative should be included when considering the future land use in Long Valley both not only because it will generate higher project returns but also because the expanded East side recreational opportunity this type of growth will likely free up water resources and reduce irrigation needs and prevent the creation of a dam that creates significant flood risk where none exists.
38	13	10/31/2021	Email	Public		Craig Wallentine	11	Water Resources	The DEIS should include an assessment of the cumulative impact of East Zion Growth Initiatives on water rights usage as agricultural land use is converted to commercial and municipal use in Long Valley. The EIS should discuss the change in water rights ownership as commercial development is promoted on the East side of Zion National Park in the coming decades. While this change will not be the same order of magnitude as in Washington County and would not threaten NRCS support, the actual number of irrigated acres in Long Valley will steadily decline over the project time horizon and should be accounted for in the upstream project design basis especially the acreage of irrigated fields adjacent to logical commercial and residential development sites.
39	14	11/9/2021	Email	Agency	Office of the Govorner	Redge Johnson (Executive Director)	12	Biological Resources	The state of Utah (State) appreciates the opportunity to provide scoping comments on the Cove-East Fork Virgin River Watershed Project Environmental Impact Statement (EIS). The State provided comments on the project's Environmental Assessment on December 31, 2020, and in collaboration with the Division of Wildlife Resources (DWR), the State restates these comments for the EIS project your consideration. Additionally, the State would like to take this opportunity to highlight that the Kane County Resource Management Plan1 states that one of the purposes for the county land use plan is to "provide for sustainable productive watersheds for a continued supply of waters for Kane County's irrigated agriculture, sector which is dependent on both stream flows and water storage" (page 264).
40	14	11/9/2021	Email	Agency	Office of the Govorner	Redge Johnson (Executive Director)	12	Biological Resources	The Draft EA claims potential benefits for three Threatened and Endangered (T&E) species: the Southwest willow flycatcher, woundfin, and Virgin River chub. Another species of particular concern for this project area is the Virgin spinedace, which is managed under a Conservation Agreement and Strategy and has been petitioned for listing as a T&E species. The U.S. Fish and Wildlife Service is currently determining whether listing is warranted for the Virgin spinedace, and yet impacts to that species are not included in the EA. The State recommends that impacts for this species, in addition to the others listed above, be considered, and included in the draft EIS. Prior to claiming a benefit to the species listed above, DWR recommends the following points be carefully considered: • The term "summer months" should be defined, and the low end of the stream flow delivery range should be included, in relation to the high end of 882 acre-feet • The claimed benefits these flows could have for T&E species are undemonstrated. There is reference to a water budget for the project which includes evaporative losses (193 acre-feet), but it is unclear how much water will still be in the stream channel 50 miles downstream from the project, at different levels of release. • When water is diverted to Cove Reservoir, spring runoff flows would decrease. T&E fish and Virgin spinedace require higher spring flushing flows to cue spawning and clean necessary spawning habitat. A reduction in spring flows could limit available spawning habitat, thus impacting existing spawning, ultimately reducing population levels. The EA should express what percentage of the total flow in the East Fork Virgin River would be diverted. The extent and effect of decreased spring runoff flows should be analyzed and reported as a potential impact in Table S-4. • The Draft EA does not analyze how much of an increase in flow would be required to reduce temperatures and salinity below Pah Tempe Hot Springs. It is not possible to determine from the document whether the proposed releases from Cove Reservoir would be sufficient to deliver native fish benefits in that reach.

CID	Doc ID	Received	Type	Group	Entity	Commenter	Commenter ID	Category	Comment
41	14	11/9/2021	Email	Agency	Office of the Govorner	Redge Johnson (Executive Director)	12	Biological Resources	Cove Reservoir has the potential to become an important recreation offering in a part of the state with limited opportunities for cold water sport fisheries. The State recommends the following points be carefully considered regarding potential recreational benefits associated with the creation of a cold-water sport fishery: • The proposed location of Cove Reservoir is at an elevation where frequent and largedrawdowns would occur, which would negatively impact a sport fishery. A conservation pool will be an extremely important component if the fishery andrecreation plan is to be successful. Additional analysis is needed to determine the appropriate size for a conservation pool and what the extent and timing of drawdowns should be to produce the desired cold-water fishery. • It is currently unclear if DWR would be interested in contributing financially to a conservation pool at the reservoir. That determination would be made in the future based on the analysis of the necessary conservation pool size and cost and weighed in terms of benefits gained. Additionally, if DWR elected to contribute, DWR would not be able to pay more than the appraised value of the water. It is not clear presently whether the benefits of such a conservation pool would justify the costs. • More detail is needed on the plans for recreational facilities including a boat ramp, such as when would these actions take place, how far into the reservoir the ramp would go, and how many days of the year the boat ramp would be accessible. These details are important for the cost/benefit analysis. • There will also be stocking limitations in this system due to existing agreements. Kane County Water Conservancy District should coordinate with DWR in developing any stocking plans for the reservoir.
42	14	11/9/2021	Email	Agency	Office of the Govorner	Redge Johnson (Executive Director)	12	Biological Resources	In summary, the State finds additional analysis is needed to determine impacts to the Virgin spinedace, as well as the claimed benefits to the three T&E species that inhabit the project area. Additional analysis on the requirements needed to establish a conservation pool that would create a sustainable cold water sport fishery would also strengthen the draft EA. For questions regarding these recommendations or any others related to the project, please contact Gary Bezzant, Habitat Program Manager, DWR, via The State appreciates the opportunity to provide scoping comments on the proposed Cove-East Fork Virgin River Watershed Project EIS.
43	15	12/21/2021	Email	Agency	Utah State University	Justin Stout	13	Water Resources	I was born and raised in Southern Utah. My family settled Shunesburg, Grafton, Cane Beds Arizona and Hurricane. I do see that CSU is committed to "attempting" to conserve southern Utah. I agree with most of the comments made in your comment document Re: the Cove Reservoir. However, your comments lack actual scientific rigour.- which is EXACTLY - the issue. How can a group from Phoenix give you guidance on where your'e to go when they have Zero knowledge in the area. From my reading, the majority of their/your evidence appears to be a misinterpreted set of data for the Colorado River Basin. The papers you cite do not explicitly apply to So. Utah. Your comms people should check you on this before you try this... Again I strongly feel that CSU are focusing on the wrong part of conservation. While I agree with forcing the Cove Reservoir into an EIA, You all have sat silent on the development of property (EXAMPLE: HOUSING AND CAMPING DEVELOPMENTS.) next to the national park boundaries.These developments have worse implications for the Virgin River and the surrounding economy than a 6 thousand acre foot Reservoir on the East Creek. A very specific example is what has happened in Star Vally Wyoming. Is that what you want? Private Development on the edge of protected land should be your priority. Again. YOU ALL ARE MISSING THE POINT! I hope that the CSU can actually become a TRUE members of conservation of Southern Utah. Not just another problem. Please contact me so you can do better to serve the true conservationists in So Ut. We are many!
44	16	2/12/2022	Email	Public		Laura Wilson	10	Health and Safety	I have had several dreams showing me in detail how a complete failure of this dam will affect my property below the Cove Reservoir. I would like to add that others have had similar dreams. The devastation, not only to me, but all citizens along the Southern Virgin River, would be deadly and catastrophic. How it will break, I did not see, only that it broke completely and all at once. Perhaps a very large earthquake, or terrorism. If what we recently read in “Come Follow Me” about the continents coming together and the Isles of the Sea coming together indicates a serious shaking of the earth, maybe all dams will break and all men will fall to the ground. Most of us have felt resigned to this project with the feeling that there is nothing we can do to stop it. However, it might be something of a compromise if you built a smaller dam, letting other cities share the risk by getting their own systems. Just thought I would comment one last time before the public comment period is over.

CID	Doc ID	Received	Type	Group	Entity	Commenter	Commenter ID	Category	Comment
45	17	2/7/2022	Email	Tribe	Hopi Tribe	Stewart B. Koyiyumptewa	14	Tribal and Cultural Resources	Thank you for your correspondences dated January 14, 2022, regarding the National Resources Conservation Service (NRCS) proposing the Cove Reservoir-EA. The Hopi Cultural Preservation Office appreaciates the NRCS's continuing solicitation of our input and your efforts to address our concerns. The Hopi Tribe claims cultural affiliation to prehistoric cultural groups in Utah. The Hopi Cultural Preservation Office supports the identification and avoidence of prehistoric archaeological sites and we consider the prehistoric archaeological sites of our ancestors to be "footprints" and Traditional Cultural Properties. We request consultation of any proposal in Utah that has the potential to effect prehistoric cultural resources. We undersatand environmental analyses will be prepared, and thereore we look forward to being provided with hard copies of the cultural resources reports and draft environmental assessment for review and comment. If prehistoric cultural resources are identified that will be adversely affected by the proposed project, we request continuing consultation including being provided with a copy of any proposed treatment plans for review and comment. Thank you for your consideration.
46	18	4/15/2022	Email	Public		Dave and Jolene Clark	15	Watershed Protection	The Clarks called Norm Evenstad regarding an issue of debris depositing on the East Fork Virgin River and its impact on their property adjacent to the river. They sent him a photo by email. The property is located in the Mt. Carmel area. The photo shows a lot of debris, but lateral bank erosion that could benefit from bank stabilization is not observed. The NRCS can respond to erosion issues that threaten life and property under the Emergency Watershed Protection Program (EWP). Norm mentioned this to the Clarks, and also that it is past the event date to qualify for a EWP. Photo included in printed comment.
47	19	4/18/2022	Email	Public		Hayden Forbes	16	Water Resources	Thank you for the opportunity to provide comments on the Cove Reservoir - East Fork Virgin Environmental Impact Statement. As a river enthusiast who cherishes wild and free-flowing rivers, I implore the National Resources Conservation Service and other project partners to abandon the proposed project as described in both the previous Environmental Assessment and the EIS scoping notice by choosing the No Action Alternative. If the project proceeds, the NRCS needs to fully assess all downstream impacts of the project, including impacts to recreational, ecological, and other values. This should include a complete review of different annual hydrograph scenarios. Naturally varying river flows support a myriad of important ecological attributes, including sediment transport and vegetation management., On the East Fork of the Virgin River’s spring peak flows provide the only possible time of year to go boating. Downstream reaches on the mainstem of the Virgin are very well-known amongst recreators and flows are dependent upon high spring streamflows in the East Fork Virgin River. The project as proposed would have severe environmental and recreational impacts, is not economically feasible and is a misuse of taxpayer money. Thank you for considering my comments on this project.
48	20	4/19/2022	Email	Public		Michael Greenburg	17	Water Resources	I can't believe that in the 21st century we still have to fight against dams in a desert that should never have been cultivated in the first place, but here we are. Cove Reservoir doesn't make sense outside the narrow interests of alfalfa farmers, who shouldn't be farming such a water-intensive crop in the Colorado river basin anyway--the fact that you are even considering using our money to subsidize them is insulting. We need only to look to the diminished ecosystem of the Grand Canyon to see why this is a bad idea; our desert rivers need heavy spring runoff and occasional flash floods to remain healthy, and as somebody who lives in and loves Utah I don't want to see yet another one diminished for foolish ends.
49	21	4/19/2022	Email	Public		Samuel Cramer	18	Water Resources	Thank you for the opportunity to provide comments on the Cove Reservoir - East Fork Virgin Environmental Impact Statement. As a river enthusiast who cherishes wild and free-flowing rivers, I implore the National Resources Conservation Service and other project partners to abandon the proposed project as described in both the previous Environmental Assessment and the EIS scoping notice by choosing the No Action Alternative. If the project proceeds, the NRCS needs to fully assess all downstream impacts of the project, including impacts to recreational, ecological, and other values. This should include a complete review of different annual hydrograph scenarios. Naturally varying river flows support a myriad of important ecological attributes, including sediment transport and vegetation management., On the East Fork of the Virgin River’s spring peak flows provide the only possible time of year to go boating. Downstream reaches on the mainstem of the Virgin are very well-known amongst recreators and flows are dependent upon high spring streamflows in the East Fork Virgin River. The project as proposed would have severe environmental and recreational impacts, is not economically feasible and is a misuse of taxpayer money. Thank you for considering my comments on this project.

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50	22	4/19/2022	Email	Public		Keegan Waller	19	Water Resources	Thank you for the opportunity to provide comments on the Cove Reservoir - East Fork Virgin Environmental Impact Statement. As a river enthusiast who cherishes wild and free-flowing rivers, I implore the National Resources Conservation Service and other project partners to abandon the proposed project as described in both the previous Environmental Assessment and the EIS scoping notice by choosing the No Action Alternative. If the project proceeds, the NRCS needs to fully assess all downstream impacts of the project, including impacts to recreational, ecological, and other values. This should include a complete review of different annual hydrograph scenarios. Naturally varying river flows support a myriad of important ecological attributes, including sediment transport and vegetation management., On the East Fork of the Virgin River's spring peak flows provide the only possible time of year to go boating. Downstream reaches on the mainstem of the Virgin are very well-known amongst recreators and flows are dependent upon high spring streamflows in the East Fork Virgin River. The project as proposed would have severe environmental and recreational impacts, is not economically feasible and is a misuse of taxpayer money. Thank you for considering my comments on this project.
51	23	4/19/2022	Email	Public		Andy Scherer	20	Water Resources	Thank you for the opportunity to provide comments on the Cove Reservoir - East Fork Virgin Environmental Impact Statement. As a river enthusiast who cherishes wild and free-flowing rivers, I implore the National Resources Conservation Service and other project partners to abandon the proposed project as described in both the previous Environmental Assessment and the EIS scoping notice by choosing the No Action Alternative. If the project proceeds, the NRCS needs to fully assess all downstream impacts of the project, including impacts to recreational, ecological, and other values. This should include a complete review of different annual hydrograph scenarios. Naturally varying river flows support a myriad of important ecological attributes, including sediment transport and vegetation management., On the East Fork of the Virgin River's spring peak flows provide the only possible time of year to go boating. Downstream reaches on the mainstem of the Virgin are very well-known amongst recreators and flows are dependent upon high spring streamflows in the East Fork Virgin River. The project as proposed would have severe environmental and recreational impacts, is not economically feasible and is a misuse of taxpayer money. Thank you for considering my comments on this project.
52	24	3/29/2022	Email	Public		Richard Spotts	1	Purpose and Need	Dear USDA and DOI Secretaries Vilsack and Haaland: Please review the Natural Resources Conservation Service's (NRCS) published Federal Register Notice of Intent (NOI) today at the web link below and attached, and challenge this proposed wasteful diversion of Virgin River water in the Lower Colorado River Basin before it could reach Lake Mead. Former Utah Republican legislative leader Mike Noel's controversial proposed Cove Reservoir project, actively promoted during the Trump era, unfortunately remains alive under a misrepresented Trojan horse "watershed plan" title under the Biden administration. In reviewing this NOI, it is appallingly clear that the NRCS office in Utah ignored virtually all of the previous public comments on their earlier defective and biased Environmental Assessment (EA). For example, the two action alternatives described in today's NOI are substantially similar to what was originally proposed in the EA. Both would divert Virgin River water that would otherwise flow downriver to Lake Mead. Both would facilitate more water-wasting alfalfa farming during the hot summers, and likely provide for potential future water sales and transfer to expand sprawl developments in Washington County. In a nutshell, if approved and implemented, this project would use federal funds to facilitate further unsustainable private water use and development instead of advancing feasible and bona fide methods to actually improve watershed health during this mega drought. In addition, the NRCS continues to refuse to answer basic questions such as how or whether this proposed Virgin River diversion would comply with the Colorado River Compact (Law of the River). Lake Mead is already dangerously low, but the NRCS and other Utah promoters of this Cove Reservoir seek this harmful Virgin River diversion without regard for the added negative impacts on other Lower Colorado River Basin water users.

CID	Doc ID	Received	Type	Group	Entity	Commenter	Commenter ID	Category	Comment
53	24	3/29/2022	Email	Public		Richard Spotts	1	Purpose and Need	Cont… This NOI is supposed to start a broad scoping process under the National Environmental Policy Act (NEPA) where the public may provide comments on the proper purpose and need for action, feasible alternatives to the proposed action, and resources/issues of concern. Sadly, based on the arbitrary narrowness of this NOI, NRCS appears to remain highly biased toward what Mike Noel and other development interests want. The Cove Reservoir could apparently not be built unless the Bureau of Land Management (BLM) approves needed borrow pits. So NRCS and BLM are each responsible for this NEPA compliance prior to any final decisions. Given the high level of public controversy and conflicts with the Biden administration's executive orders and professed environmental policies, the ultimate fate of this proposal may be with high-level Agriculture (NRCS) and Interior (BLM) Department Biden administration officials. However, there is no indication that these officials are even aware of nor perhaps care about what is going on in Utah. Just like with their ridiculous proposed Lake Powell Pipeline, Utah's regressive officials continue to arrogantly ignore the two-decade-long mega drought and foolishly believe that they can create water by building more storage structures. Strong accountability is needed to stop federal subsidizing of this unsustainable insanity. Please help change this status quo by challenging the NRCS' improper bias toward the Cove Reservoir and by ensuring that any subsequent DEIS provides a positive purpose and need statement that enables a broader and objective analysis of genuine watershed health alternatives without any proposed Virgin River diversions. For more relevant background information, please see the additional attachments and second web link below. Thank you very much for your consideration. ATTACHMENT - Copy of Publication in Federal Register
54	24	3/29/2022	Email	Public		Richard Spotts	1	General	Please accept, carefully consider, respond to, and include in the relevant project file my following comments on the above-referenced Draft Watershed Plan (DWP) and Environmental Assessment (EA) for the proposed Cove Reservoir Project. I reviewed this DWP and EA and I attended the Zoom EA public meeting on December 9, 2020. I asked many questions during that virtual meeting; some of which were at least partially answered, while others were deflected or ignored. By way of brief background, I have been a Washington County Utah resident for over eighteen years, and I have a strong and longstanding interest in environmental, public lands, wildlife, and water issues. I also have extensive professional and volunteer experience with implementation of the National Environmental Policy Act (NEPA) and the associated Council on Environmental Quality (CEQ) regulations. I deeply care about the proper conservation and management of water and other natural resources.
55	24	3/29/2022	Email	Public		Richard Spotts	1	Purpose and Need	At the outset, I do not believe that this EA is adequate under NEPA because of a biased and narrow purpose and need, deficient evaluation of possible lessdamaging alternatives, and a superficial cumulative effects analysis. Instead, I believe that this DWP and EA are a type of “Trojan horse” propaganda piece whereby private and county water rights holders want the federal government to largely pay for a local project that would primarily benefit those holders’ potential future profits from speculative water sales. The purported recreational and listed fish species benefits are merely window dressing to make this boondoggle appear more reasonable. Indeed, I believe that this proposed project is another cynical example of Utah public officials who consistently slap Uncle Sam in the face with one hand while grabbing his wallet with the other hand. These types of highly questionable projects have flourished during the Trump administration because greed for the few with political connections currently supersedes fidelity to law, science, and the overall public interest.
56	24	3/29/2022	Email	Public		Richard Spotts	1	Water Resources	It seems clear that the overwhelming driver of this DWP and EA is to primarily use federal funds for a local project to divert water to a reservoir to increase surface water supplies to private and county water rights holders. In the near term, these additional supplies would be used to increase alfalfa production and associated profits on private lands. Alfalfa production is obviously one of most wasteful uses of water, especially given the prolonged drought caused by climate change. There are already severe water shortages in much of the West, including in the Colorado River Basin. Lakes Mead and Powell are at historically low levels, and some states have already had supply reductions under the Colorado River Compact and Drought Contingency Plan. The demand for water continues to increase while the supply continues to decrease. Some municipal water districts are literally paying people to convert lawns into natural xeriscape to reduce water use. And tiered water pricing rates are being instituted to properly promote water conservation.
57	24	3/29/2022	Email	Public		Richard Spotts	1	General	The DWP and EA say that this Virgin River water would be “lost” if this diversion is not allowed. That alone demonstrates fundamental bias and myopia. If not diverted, this spring runoff water simply travels down the Virgin River and ends up in Lake Mead. The Virgin River system is part of the Lower Basin under the Colorado River Compact.
58	24	3/29/2022	Email	Public		Richard Spotts	1	General	On the controversial proposed Lake Powell Pipeline (LPP), all Compact states (save Utah) asked that the environmental review process be halted until all Compact states could come to a consensus on future Colorado River water management and possible additional diversions. Although the EA is silent on this key point, I believe that this proposed Cove Reservoir diversion of Lower Basin water should fall under the same Compact states’ request. The amount of water here may be much less than the LPP, but a new diversion of any amount would have a cumulative effect and establish a potentially dangerous precedent.

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59	24	3/29/2022	Email	Public		Richard Spotts	1	Economics	During the December 9 Zoom EA meeting, the leading project proponent, Mr. Mike Noel, acknowledged in response to a question that the Cove Reservoir water could be used for municipal and industrial purposes. I believe that this was a pivotal admission about the likely true dominant motivation of project proponents. The short-term wasteful agricultural water use for alfalfa would be converted to much more lucrative water sales for these higher M&I value uses. Out of necessity and growing scarcity, water marketing is rapidly gaining ground in the West. Like the old adage that "water flows uphill toward money in the West." I generally support water marketing because it reflects the true value of this increasingly precious commodity and encourages more efficient use of water. However, as a taxpayer, I do not believe that the federal government should interfere with this free market by rewarding or subsidizing some water rights holders at the competitive disadvantage of other such holders. The proposed Cove Reservoir would constitute such an unfair subsidy to a few private and county water rights holders. These federal funds would be much better spent on providing projects and incentives that facilitate greater water conservation and reclamation by the general public. It is unfair to have the American people pay for most of a capital improvement while a few private and county water rights holders gain the appreciated profits. The EA basically ignores these realistic cost-benefit and social equity issues. For example, the EA analysis does not provide for reimbursement of federal funds if the original justification (alfalfa water augmentation) is changed to municipal and industrial water sales. The EA also fails to address to what extent the private and county water rights holders could market their rights for profit without the need for an off-river diversion and reservoir. The Southern Nevada Water District might be willing to pay top dollar for these Virgin River water rights without the need for a federally-subsidized reservoir project. Indeed, such market-driven water transfers might have the greatest public benefits at little or no cost to the taxpayers.
60	24	3/29/2022	Email	Public		Richard Spotts	1	Purpose and Need	The EA's stated purpose and need boils down to four components: agricultural (and future M&I) water; reservoir recreation; hydroelectric power; and Virgin River Endangered Species Act (ESA) species. On the water purpose, the EA admits that no non-structural alternatives were carried forward and analyzed. Much of this watershed suffered from excessive historic overgrazing and other land uses that resulted in serious soil erosion and the unnatural downcutting of gullies and ravines. There are many existing and feasible watershed restoration methods to reverse this current erosive trajectory and begin to heal the watershed. For example, small check dams can be constructed in deep gullies and ravines to slow storm flows, capture sediment, and gradually elevate the gradient. Where they are absent and sufficient riparian vegetation does or could exist (with livestock exclusion fencing), beavers can be reintroduced to serve as nature's premier watershed restoration experts. By implementing these positive and much less expensive and energy-intensive methods, heavy runoff during severe storm events would be cumulatively slowed across the watershed, with less soil erosion and sediment transport and greater soil infiltration and groundwater recharge. These watershed restoration outcomes would have much greater environmental, economic, and social benefits and would serve the American people instead of a few water rights holders. These outcomes would also help to restore the Virgin River's natural ecological and hydrologic processes. It is appalling that the NRCS did not analyze any of these types of alternatives, and instead this EA only compares the proposed reservoir and no reservoir. NRCS has an affirmative legal duty to not only consider the applicant's purpose and need but also the federal agency's broader purpose and need in terms of fulfilling its statutory mission and serving the public interest. NRCS failed to fulfill this duty by limiting the EA purpose and need to essentially what Mr. Noel and other proponents wanted. NRCS is supposed to advance watershed restoration and soil conservation, not promote narrow reservoir projects. And the Bureau of Reclamation and Army Corps of Engineers are supposed to be the federal agencies with dam building jurisdiction and expertise.
61	24	3/29/2022	Email	Public		Richard Spotts	1	Economics	On the reservoir recreation purpose, this is another example of biased tunnel-vision. There is indeed growing public demand for recreational opportunities in this region and excessive tourism is already causing problems in some popular locations. However, much of this tourism is drawn by relatively unique scenic beauty combined with opportunities for experiencing pristine natural areas. Reservoirs are common throughout most of the United States, and there are many existing reservoirs (Jackson Flat, Sand Hollow, Quail Creek, Kolob, Gunlock, etc.) in this region. Most visitors do not come here to camp by a small reservoir. Instead, most visitors come here to camp in spectacularly beautiful areas and to have a chance to hike, mountain bike, or otherwise explore wildlands. As such, the Cove Reservoir is unlikely to be a tourist draw and its EA projected recreational value may be greatly overestimated. The federal funds would be much better spent on providing more mountain biking, equestrian, and hiking trails and primitive camp sites along loops of those trails. That approach would fit with what most tourists to this area desire. As such, I believe that reservoir recreation is largely a potential illusory or nominal benefit that proponents seek to exploit to advance their water project.
62	24	3/29/2022	Email	Public		Richard Spotts	1	Purpose and Need	On the hydroelectric power purpose, the EA is predictably myopic on the subject of energy. First, the EA basically ignores climate change, and does not analyze the significant need to use and burn fossil fuels to build this reservoir and excavate and transport the substantial borrow materials from distant pits. There is no comparison of how much of the hydroelectric energy would be offset or superseded by this significant burning of fossil fuels (that cumulatively contribute to climate change and associated drought). Second, without this diversion, this water could run into Lake Mead, where it may be converted to hydroelectricity when released at Hoover Dam. Third, modern "run-of-the river" hydro was not analyzed as an alternative. Fourth, there was no consideration of using these federal funds to augment solar or wind power generation. In short, hydro power seems to be a minor potential benefit to help sell this reservoir project.

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63	24	3/29/2022	Email	Public		Richard Spotts	1	Purpose and Need	On the Virgin River ESA listed species issue, the EA analysis essentially relies on a vague and potentially illusory commitment. On EA page 28 (and elsewhere), it says that "The proposed reservoir would provide up to 882 acre-feet of water annually during the summer months to augment endangered fish and flycatcher habitat." The conditional text of "up to" indicates that 882 acre-feet is the ceiling or greatest amount of water that may be used for this ESA listed species purpose. However, the EA does not disclose whether there is any floor or minimum amount of water that must be released each summer. The EA is also unclear about who would decide how much water should be released each summer, including during severe droughts when the reservoir may be at or near its minimum conservation pool. In short, it appears that the U.S. Fish and Wildlife Service (FWS) and Utah Division of Wildlife Resources (UDWR) were improperly willing to rely on this "up to" commitment without any guarantees about the actual amount of future summer water releases. Absent a clear contractual commitment or firm permit condition enforceable by outside entities, I am skeptical that these promised benefits to ESA listed species may occur, especially in drought years. For example, in a similar situation, I understand that the Washington County Water Conservancy District (WCWCD) may not have fulfilled such a water release requirement when it acquired federal approval for another reservoir or pipeline project. Utah public officials have a history of not keeping their conservation promises. And too many federal and state public officials have backbones of jello and a history of being successfully intimidated by bullying local Utah officials.
64	24	3/29/2022	Email	Public		Richard Spotts	1	Biological Resources	In terms of whether this water diversion and proposed reservoir could benefit these ESA listed species, the EA makes several dubious and unproven assumptions. For example, it says that the summer releases (if they actually occur) would benefit downstream riparian habitats used by southwestern willow flycatchers. This ignores the reality of how the Virgin River watershed has operated ecologically and hydrologically over the past thousands of years. Heavy spring and summer (monsoonal) flows are natural and healthy. The ESA listed species evolved with them. These large flows cause natural sediment transport, bank erosion, and channel migration processes that create and maintain a diversity of natural habitat conditions. They bring woody debris into the system as an important source of carbon. They recharge the river bed sediments and shallow groundwater to sustain riparian vegetation over the dry periods. The scouring flows help to establish new native cottonwoods and willows. They expose gravel beds and create riffles that some fish need. The EA acknowledges that past disruptions in natural Virgin River flow patterns caused significant adverse impacts, yet the EA then hypocritically goes on to promote the new Cove Reservoir diversion as a purported benefit. The EA assumes but does not explain how the reservoir releases would add to these natural benefits, nor increase the quality or quantity of riparian habitats along the river. Speaking of riparian habitats, the EA assumes that the new reservoir would enable the establishment of new riparian habitat around it that would benefit associated species. I seriously question this assumption. Depending on the amount of annual average draw down and the soil substrate, many existing reservoirs tend to exhibit a "bathtub ring" around most of their edges, not healthy and persistent riparian vegetation. As such, there is no guarantee that the professed reservoir riparian habitat benefit would be fully or partially realized.
65	24	3/29/2022	Email	Public		Richard Spotts	1	Purpose and Need	Under NEPA, the applicant and federal agency's purposes and needs are used to determine the overall scope of the environmental analysis and which alternatives should be carried forward for detailed analysis. In this case, as previously described, the EA's purpose and need are improperly too narrow, biased, and myopic. That results in this ridiculous "take it or leave it" EA that only takes a "hard look" at the proposed action/preferred alternative Cove Reservoir and the obligatory no action (status quo) alternative. The alternatives analysis is the "heart" of the NEPA process but sadly this EA has no heart. A whole spectrum of alternatives that would be much less costly, less energy intensive, and less environmentally destructive were basically given short shrift or entirely ignored. Relevant modern issues of growing public concern, like climate change, environmental justice, landscape ecology, and aquatic nuisance/invasive species were neglected.
66	24	3/29/2022	Email	Public		Richard Spotts	1	Cumulative Effects	Under NEPA, the required cumulative effects analysis must evaluate all past, present, and reasonably foreseeable future actions that may affect any of the resources or uses carried forward for analysis. The cumulative effects analysis in this EA is patently inadequate. It is superficial, conclusory, and ignores many relevant projects. For example, it omits the WCWCD's proposed Ash Creek reservoir and pipeline project in the same Virgin River watershed. It omits the recent funding of a new flood control project along the Virgin River. It omits many past and proposed future projects that would affect the same vegetative communities and species in this watershed, such as BLM mastication and chaining efforts in these same sagebrush and pinyon-juniper habitats. It omits consideration of aquatic invasive species that have seriously harmed aquatic ecosystems and could do the same in Cove Reservoir (and, from releases, be carried down river). (At the December 9th virtual meeting, on this issue, it was answered that only nonmotorized boating would occur. However, the EA says that "small motors" could also be used, and these boats may transport harmful aquatic invasive species).

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67	24	3/29/2022	Email	Public		Richard Spotts	1	NEPA Process	The Trump administration's CEQ recently adopted weakening changes to the NEPA regulations in mid-September. These changes are now subject to several court challenges and they may be overturned in the next session of Congress or by the incoming Biden administration. In any case, these changes should not apply to this EA. The policy is that the applicable CEQ regulations are those in legal effect when the relevant NEPA process was initiated. In this case, the official scoping for this EA occurred in mid 2018, and the BE and other relevant documents were done in 2019. It is clear that this EA was not only initiated but also much of the background analysis was done prior to September of this year. As such, the previous or original CEQ NEPA regulations apply to this EA. The Bureau of Land Management (BLM) and National Park Service (NPS) are cooperating agencies on this EA. It is not clear to what extent these agencies may adopt or supplement this EA for the purpose of NEPA compliance for any authorizations that they execute which may allow, facilitate, or be connected to this proposed Cove Reservoir project. I generally follow the BLM and NPS NEPA notification web sites, and I am not aware of any notice on either site that the agency may use this NRCS EA for the purpose of achieving that agency's NEPA compliance for an authorization. As such, people like me who follow BLM and NPS NEPA may not be aware of this current opportunity to review and comment on this pending NRCS EA. Similarly, I am not aware of any such notice for the previous EA scoping period in the summer of 2018. As such, I do not believe that the NPS and BLM may have provided adequate public notice of this EA process and associated "connected actions" involving BLM and NPS managed lands and resources.
68	24	3/29/2022	Email	Public		Richard Spotts	1	Wild and Scenic Rivers	I understand that there was a Zion National Park NPS negotiated reserved federal water right agreement for in-river flows from the 1990s. I also understand that there was a subsequent Wild and Scenic River designation for this same Zion river segment. It is not clear in the EA how these two things (an administrative agreement versus a statutory designation) are or should be reconciled, and whether there is a potential conflict that may need resolution. In my mind, a wild river segment should include the allowance and continuation of natural hydrological flow patterns through that segment. As such, an unnatural diversion up-river may be harmful to that conservation purpose.
69	24	3/29/2022	Email	Public		Richard Spotts	1	ACEC	In addition, BLM has down-river designated Areas of Critical Environmental Concern (ACECs) in Arizona and Nevada intended to protect riparian habitats and ESA listed species dependent upon natural flow regimes. The EA does not acknowledge these ACECs nor whether they have or should have any dedicated reserved federal water rights to maintain essential river flows. I believe that BLM has an affirmative obligation to assert such reserved federal water rights when necessary to protect and maintain the resource values that they manage and have designated for such protection. I am concerned that BLM may have failed to do so in connection with the now constructed Jackson Flat Reservoir. Any diversion of water that would otherwise flow down Kanab Creek could reduce or harm the riparian habitats and associated species intended for protection in BLM's Kanab Creek ACEC.
70	24	3/29/2022	Email	Public		Richard Spotts	1	Effects Analysis	The EA acknowledges the "connected actions" of needing BLM approval for use of two existing and one new borrow pit for construction of the dam and reservoir. However, except for Visual Resource Management (VRM), the EA is missing information that BLM would need as part of its required NEPA analysis. For example, as previously described, BLM should not rely on this NRCS EA's improperly narrow purpose and need, myopic alternatives, and deficient cumulative effects analysis. This NRCS EA also does not describe all of the relevant BLM Kanab Field Office (KFO) Resource Management Plan (RMP) decisions and how the proposed action would conform to those decisions. As such, BLM should not adopt this NRCS EA for the purpose of NEPA compliance for authorization to use or expand these BLM borrow pits. If BLM nevertheless proceeds to do so, I hereby request actual notice when BLM approves any such authorization so that I may pursue any appropriate administrative remedies.
71	24	3/29/2022	Email	Public		Richard Spotts	1	NEPA Process	The EA acknowledges that, prior to project construction, one or more permits would be necessary from the Army Corps of Engineers (ACOE) under Section 404 of the Clean Water Act. However, the ACOE is not a cooperating agency for this EA and it is unclear how they would achieve their NEPA compliance prior to permit issuance. I believe that the ACOE has an obligation to consider feasible alternatives, which this NRCS EA does not do.
72	24	3/29/2022	Email	Public		Richard Spotts	1	Economics	On EA pages 60 and 61, under Public Health and Safety, the EA acknowledges that this proposed dam and reservoir have a "high" hazard classification and that 10 to 15 people would be at mortal risk from dam failure. The EA also acknowledges that construction related traffic would increase the risk of traffic accidents and damage up to 20 miles of existing dirt and gravel roads. I did not see how or whether the EA factored these risks and potential damages into the cost-benefit calculations. Water marketing or other feasible alternatives would not pose these risks or potential damages, but sadly the EA ignores those options.
73	24	3/29/2022	Email	Public		Richard Spotts	1	Effects Analysis	On EA page 63, in describing the proposed Lake Powell Pipeline and Cove Reservoir, it says that "Both projects would result in a combined increase in water scarcity in Kane County." Please explain this sentence as it makes no sense in this context.
74	24	3/29/2022	Email	Public		Richard Spotts	1	Economics	And the EA Cost Benefit Summary is biased and confusing. In one place, it says the cost benefit ratio is 1.19 to 1. In another place, it says that ratio is 1.03 to 4.4. The estimated agricultural benefit from increased alfalfa production is $826,000 and the recreational benefit is $176,000. These relatively minor estimated benefits do not come close to justifying NRCS in spending over $20,000,000 in federal funds. This funding could be much better and more efficiently and equitably spent on genuine watershed restoration and water conservation measures in the public interest.

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75	24	3/29/2022	Email	Public		Richard Spotts	1	General	For the preceding and other reasons, I strongly oppose the EA proposed action/preferred alternative to build and operate the Cove Reservoir project. This proposed boondoggle is wasteful, ridiculous, and politically driven for the benefit of the few at the expense of the many. The various public officials at NRCS, BLM, NPS, FWS, and ACOE who have apparently been cooperative and supportive of this boondoggle should be ashamed. These officials should realize that times have changed, progressive and creative reforms are long overdue, and more status quo dam building is regressive and foolish. In light of my comments, I believe that NRCS and the other cooperating federal agencies have only two choices. On the one hand, they can support and approve the EA No Action Alternative and deny the associated funding requests and permit applications. On the other hand, they can prepare a supplemental EA that remedies or corrects all the current EA's many deficiencies and omissions. This supplemental EA should then be made available for another round of public review and comment and posted on the NPS and BLM NEPA web sites as well as the NRCS site. At minimum, NRCS and Congress should not provide any funds for this project until adequate public notice and NEPA compliance have occurred. I reserve the opportunity to add to these comments if new issues or information come to my attention prior to the EA comment deadline. Please add me to the relevant mailing list for this proposed project and send me all notifications relating to it. Please also let me know if you have any questions about my comments. Thank you very much for your consideration.
76	24	3/29/2022	Email	Public		Richard Spotts	1	General	Reference to Utah Rivers Council Comments submitted on December 31, 2020.
77	25	4/18/2022	Email	Agency	NPS	Michael Reynolds	21	General	Dear Ms. Fife, The National Park Service (NPS) appreciates the opportunity to provide comments during the scoping period of the Watershed Plan and Environmental Impact Statement for the Cove-East Fork Virgin River Watershed Project and accepts the request to become a formal cooperating agency with the United States Department of Agriculture, Natural Resource Conservation Service (NRCS). The NPS within Zion National Park (ZION) manages a portion of the East Fork of the Virgin River within the park and holds special expertise regarding Wild and Scenic River, Endangered Species Act, Migratory Bird Treaty Act and Wilderness management. At your earliest convenience, please send ZION a draft of the proposed Memorandum of Understanding for NPS review. In addition to the comments and information requests outlined below, we strongly encourage NRCS to provide information related to impacts this project may have on regional dark night skies and mitigations planned to reduce those impacts.
78	25	4/18/2022	Email	Agency	NPS	Michael Reynolds	21	Water Resources	**1. 1996 Zion National Park Water Rights Settlement Agreement** Notably, in 1996 the NPS, State of Utah, Washington County Water Conservancy District, and Kane County Water Conservancy District entered into a historic agreement to establish federal reserved water rights memorialized in the Zion National Park Water Rights Settlement Agreement (SA). In the SA, the NPS agreed to subordinate its senior water rights to limited future water development in the East Fork of the Virgin River. This includes a cap on cumulative storage capacity in one or more reservoirs not to exceed 6,750 acre-feet and a limitation of individual new reservoirs with total storage capacities greater than 20 acre-feet not to exceed 10 (SA Article II.D.1.a&b). With this limitation on new reservoir development addressed in the SA, restrictions on flow were also established for any new diversion structures constructed for new, large reservoirs (SA Article II.D.3), as well as the timing of diversion for any diversions associated with the new reservoirs with a storage capacity greater than 20 acre-feet (SA Article II.D.6). In addition, limits were set on the bypass flows below any new reservoirs (SA Article II.D.4) and reservoir discharge (SA Article II.D.5). We respectfully request the following information to determine if this proposed project is in compliance with the terms of the SA: **1.A.** The location of any diversions associated with this proposed reservoir and the flow planned to be maintained below any new surface water diversions associated with the proposed reservoir. **1.B.** The planned timing and diversion rate on all diversions associated with the proposed reservoir. **1.C.** The proposed location, timing, and volumetric flow rate of releases and any return flow associated with the proposed reservoir. The NPS anticipated development of this proposed reservoir whose terms were outlined in the SA. In addition, the NPS is required to evaluate the proposed development for compliance with other federal laws as described below. Therefore, the NPS requests additional information in order to complete the required analyses.
79	25	4/18/2022	Email	Agency	NPS	Michael Reynolds	21	Wild and Scenic Rivers	**2. Wild and Scenic River Act** As a water resources project requiring federal assistance located upstream of a designated Wild and Scenic River, the East Fork of the Virgin River, this project is required to be evaluated using Section 7 of the Wild and Scenic Rivers Act, to determine if it will invade the river area or unreasonably diminish the river's scenic, recreational, fish, or wildlife values. This evaluation will be completed by the NPS as the river administering agency. The NPS will use information available in the project's National Environmental Policy Act (NEPA) documents to complete the Section 7 Determination. The NPS requests specific information and analysis to be completed in the Watershed Plan and Environmental Impact Statement to inform its Section 7 Determination. The East Fork of the Virgin River designated Wild and Scenic River provides habitat for four native fish species: desert sucker (Catostomus clarkia), flannelmouth sucker (Catostomus latipinnis), virgin spinedace (Lepidomeda mollispinis) and speckled dace (Rhinichthys osculus). The desert sucker, flannelmouth sucker and Virgin spinedace are each listed as a Utah Species of Greatest Conservation Need by the Utah Department of Natural Resources. Flow depletion and dewatering caused by stream diversions for agricultural, municipal, and industrial uses are among the primary threats to the desert sucker, flannelmouth sucker, and Virgin spinedace. Prolonged periods of drought and increasing stream temperatures are compounding threat factors that are further exacerbated by flow depletion from stream diversions. Other threat factors listed for fish species native to the East Fork Virgin River include pesticides and other pollutants introduced by return flows from municipal and agricultural drains and runoff, invasive wildlife species, invasive plant species, and the introduction of aquatic invasive parasites and diseases. We respectfully request the following information to help inform the Section 7 Determination:

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80	25	4/18/2022	Email	Agency	NPS	Michael Reynolds	21	Biological Resources	**2.A.** The effects this water development project may have on Virgin spinedace, desert sucker, and flannelmouth sucker population and habitat maintenance in the East Fork of the Virgin River must be assessed in the EIS. The 2002 Conservation Agreement and Strategy for Virgin spinedace placed management of the recovery and conservation of Virgin spinedace with the Virgin River Resource Management and Recovery Program (VRRMRP), a multi-agency cooperative program. Please work with the VRRMRP to assess potential impacts and develop mitigations to reduce negative impacts on Virgin spinedace population and habitat in the East Fork of the Virgin River which may include the establishment of population maintenance flows or minimum flow requirements.
81	25	4/18/2022	Email	Agency	NPS	Michael Reynolds	21	Wild and Scenic Rivers	**2.B.** Analysis of how this proposed project will impact natural flow regimes (including the magnitude, frequency, and timing of flood flows) and flow-related habitat variables (including water temperature, turbidity, and sediment transport) under a variety of scenarios including low, normal, and high-water years through the East Fork of the Virgin River Wild and Scenic River.
82	25	4/18/2022	Email	Agency	NPS	Michael Reynolds	21	Invasive Species	**2.C.** Mitigation(s) to prevent non-native fish and aquatic invasive species from escaping into the East Fork of the Virgin River from the proposed reservoir associated with this project.
83	25	4/18/2022	Email	Agency	NPS	Michael Reynolds	21	Water Resources	**2.D.** Analysis of how municipal and agricultural runoff as well as chemical and pesticide loads will be altered as a result of this proposed project. If increased runoff is expected, please provide information regarding mitigation measures to reduce runoff into the East Fork of the Virgin River.
84	25	4/18/2022	Email	Agency	NPS	Michael Reynolds	21	Climate Change	**2.E.** Analysis, including any mitigation measures, on the anticipated effects climate change may have on this proposed project, including a reduction in snowpack in the East Fork of the Virgin River Watershed and spring runoff as well as increased air temperatures.
85	25	4/18/2022	Email	Agency	NPS	Michael Reynolds	21	Sensitive Species	**3. Endangered Species Act and Other Sensitive Species** Mexican Spotted Owl (MSO) and MSO Critical Habitat: The East Fork of the Virgin River and its tributaries are inhabited by MSO and the entirety of ZION is designated critical habitat for MSO. Two breeding territories have been confirmed near the East Fork of the Virgin River. Inventory surveys have not been conducted in the majority of potential breeding habitat that exist along the East Fork, and it is likely more territories exist. Water development, including water diversion and reservoirs can degrade, reduce, and/or fragment MSO habitat and/or disrupt migration corridors, inhibit gene flow, alter prey habitat and/or alter grazing patterns by wild ungulates. Data on the timing of the discharges from the reservoir and how these discharges will alter the natural hydrological cycles and flow rates of the East Fork of the Virgin River (as requested in 2.B) will be needed to evaluate impacts to this protected species and habitat and consult with the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act.
86	25	4/18/2022	Email	Agency	NPS	Michael Reynolds	21	Sensitive Species	**Southwestern Willow Flycatcher (SWFL) and Yellow-Billed Cuckoo (YBCU):** The riparian habitat along the East Fork of the Virgin River provides migratory stop-over habitat and marginal breeding habitat for SWFL and YBCU. Both species have been detected along the Virgin River in ZION or Springdale, UT during migration. Water development can modify, degrade, or reduce SWFL and YBCU habitat especially if water in riparian ecosystems and associated subsurface water tables are reduced. Reduced flows during spring runoff may degrade/alter the quantity of prey (insects) available to migrating SWFL and YBCU. An increase in upstream establishment of non-native vegetation, such as tamarisk and Russian olive, will increase the rate of establishment of these species downstream which can negatively alter SWFL and YBCU habitat. Data on the timing of the discharges from the reservoir and how these discharges will alter the natural hydrological cycles and flow rates of the East Fork of the Virgin River (as requested in 2.B) will be needed to evaluate impacts to these protected species and consult with the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act.
87	25	4/18/2022	Email	Agency	NPS	Michael Reynolds	21	Invasive Species	**3.A.** Provide information on how non-native vegetation will be controlled near the proposed reservoir.
88	25	4/18/2022	Email	Agency	NPS	Michael Reynolds	21	Sensitive Species	**Sensitive and State-listed Species/Other Native Wildlife:** The East Fork of the Virgin River provides habitat for numerous native wildlife species, including State-listed species such as the Arizona toad. Water development projects have the potential to negatively affect wildlife if riparian habitat, fish communities, or aquatic invertebrate populations are negatively altered. Ecologically, if one functional group of wildlife is negatively impacted those effects will cascade to other wildlife species (e.g., if aquatic invertebrates are negatively affected numerous species of bats, birds, amphibians, and reptiles will also be affected). Data on the timing of the discharges from the reservoir and how these discharges will alter the water temperature, natural hydrological cycles and events and flow rates including the magnitude, frequency, and timing of flood flows (as requested in 2.B) will be needed to evaluate impacts on these species.
89	25	4/18/2022	Email	Agency	NPS	Michael Reynolds	21	Migratory Birds	**4. Migratory Bird Treaty Act** The riparian habitat along the East Fork provides breeding, stop-over, and/or winter habitat for many species of migratory birds. Water development projects can negatively impact the quality and quantity of various habitat components (food, shelter, etc) which can reduce their breeding success or survival. An increase in upstream establishment of non-native vegetation, such as tamarisk and Russian olive, will increase the rate of establishment of these species downstream which can negatively affect migratory birds. Data on timing of the discharges from the reservoir and how these discharges will alter the natural hydrological cycles and flow rates of the East Fork (as requested in 2.B) will be needed to evaluate impacts on these species. Data (as requested in 3.A) on how non-native vegetation will be controlled near the proposed reservoir will also be important to identify.

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90	25	4/18/2022	Email	Agency	NPS	Michael Reynolds	21	ACEC	**5. Wilderness Act and Research Natural Areas** The East Fork of the Virgin River flows within congressionally designated Wilderness at ZION and is a primary feature that defines the Wilderness Character of the park. Three characteristics of Wilderness have the potential to be adversely impacted by the proposed water development project: Natural, Untrammeled, and Other Features of Value. NPS management focuses on maintaining this ecological system as substantially free from the effects of modern civilization (Natural) and unhindered and free from initial actions of modern human control or manipulation (Untrammeled). This area also holds unique features of ecological, geological, scientific, educational, scenic, and historical values (Other Features of Value). The presence of human civilization has long resided within Parunuweap Canyon which was only made possible by the river. This area is also managed by ZION as a Research Natural Area (RNA). In accordance with the NPS Natural Resource Management Reference Manual (DO-77), RNAs are areas designated to be permanently protected and maintained in natural conditions. The ZION General Management Plan specifically calls out Parunuweap Canyon to be managed as an, “undisturbed watershed and riparian corridor.” The East Fork of the Virgin River is a critical component of the Parunuweap RNA which contains a unique ecosystem, ecological features, rare and sensitive species of plants, animals, and their habitats, and provides a high-quality example of a natural ecosystem. ZION manages the East Fork as an RNA to protect the area as a prime example of natural resources and processes, including significant genetic resources that have value for long-term observational studies or as control areas for manipulative research taking place outside of NPS lands. Again, this aspect of the river emphasizes the need to establish a firm understanding of natural streamflow rates and how these might be altered with any water development infrastructure upstream within the drainage. Data on the timing of the discharges from the reservoir and how these discharges will alter the natural hydrological cycles and flow rates of the East Fork of the Virgin River (as requested in 2.C) will be needed to evaluate impacts to wilderness and the RNA. Identifying and communicating strategies for managing flows, to include anticipated discharge schedules and pulse volumes, will be of critical importance in order for the NPS to remain involved in for the life of the project. Any impacts or changes to winter, scouring flows may alter the riparian corridor and how flow rates would be managed to address low water years when pulses cannot be released will be essential for the NPS to understand.
91	25	4/18/2022	Email	Agency	NPS	Michael Reynolds	21	ACEC	**5.A.** Please provide an analysis of impacts this project may have on Wilderness characteristics within the East Fork of the Virgin River in Zion National Park.
92	25	4/18/2022	Email	Agency	NPS	Michael Reynolds	21	General	We appreciate the opportunity to identify information needs, important needed analyses and to provide comments during the scoping period of the Watershed Plan and Environmental Impact Statement for the Cove-East Fork Virgin River Watershed Project. Further, we request the information and analyses discussed above be initiated in consultation with all cooperating agencies. Please work directly with ZION staff to advance the responsibilities and expectations that will be assigned in the memorandum of understanding for cooperating agencies. If you have any questions, please contact Jeff Bradybaugh, ZION Superintendent, as the primary point of contact by phone at
93	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	General	The U.S. Environmental Protection Agency Region 8 has completed a review of the Notice of Intent (NOI) for the Cove-East Fork Virgin River Watershed Plan Project Environmental Impact Statement (EIS) prepared by the USDA Natural Resources Conservation Service (NRCS). The following scoping comments were prepared in accordance with our responsibilities under the National Environmental Policy Act (NEPA). The Project purpose is identified “to increase and maintain a reliable supply of water for local agricultural use and existing storage needs, increase water conservation, and improve water delivery efficiency in the Upper Virgin Watershed…” in Kane and Washington Counties, Utah. The Project proposes three alternatives, including the No Action Alternative. The other Proposed Alternatives include the construction of Cove Reservoir and construction of an alternative reservoir site. EPA has identified the following key topics we recommend evaluating in the Draft EIS to fully understand the potential impacts to public health and the environment: (1) purpose and need, (2) alternatives, (3) water resources, (4) air resources, (5) mitigation, (6) threatened and endangered species, (7) construction and failure response, and (8) environmental justice and NHPA. We appreciate your consideration of the enclosed comments. We are providing a copy of our December 22, 2020, Cove Reservoir Environmental Assessment (EA) comment letter. These comments remain valid for the NRCS to consider as it develops the Draft EIS with Cove Reservoir construction identified as the Preferred Alternative. We value the opportunity to review and provide comments on the NOI. We look forward to working with you and will continue to provide Project assistance on the NEPA process and Clean Water Act (CWA) Section 404 guidelines related to the development of the Draft EIS. If further explanation of our comments is desired, please contact me at or Philip Strobel, Branch Chief, at .

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94	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	Purpose and Need	**(1) Purpose and Need** We are pleased to see a better-defined purpose and need statement and the inclusion of an additional alternative in the NOI. We reiterate some of the following information to aid the NRCS in development of the EIS. The previous Cove Reservoir Environmental Assessment (EA) and current NOI documents indicate this Project will require a Clean Water Act Section 404 permit for impacts to aquatic resources. For the purpose of complying with both the CWA and NEPA, EPA recommends ensuring that the purpose and need statement is broad enough to encompass an appropriate range of both "reasonable" (per NEPA) and "practicable" (per CWA Section 404) alternatives to meet the basic (i.e., underlying) project purpose, including the proposed action and other available water supply and management options. A broad purpose and need statement allows for the analysis of a range of water supply alternatives without eliminating less environmentally damaging alternatives that may be considered practicable under the CWA Section 404 implementing regulations (e.g., water conservation and identification of existing nearby water supply sources). Developing an agency-coordinated purpose and need statement is critical prior to establishing subsequent screening criteria or identification of alternatives. Efforts to develop a purpose and need statement that meets the requirements of both NEPA and CWA Section 404 can provide for a more efficient regulatory process, while the use of a narrow project purpose to determine the scope of studies has the potential to result in the need to prepare additional NEPA documentation to meet NEPA and CWA Section 404 requirements. When creating the Project purpose and need statement, we recommend that the Draft EIS describe the quantity of water that is needed above the current supply and the reasoning behind the need. The NOI Preferred Alternative identifies two different volumes for Cove Reservoir, which could be considered two independent alternatives should the impacts vary. Important considerations further include identifying project participants and recent growth projections (e.g., per State Demographer information) in the demand analysis and documenting existing use by each entity utilizing consistent methodology (e.g., gallons per day or gallons per capita). It is informative to describe current community master planning build-out scenarios (i.e., recreational, industrial, residential, or agricultural development plans) and boundaries and estimate demand for these scenarios. If available, it is also helpful to provide similar community-type demand estimates or ranges for comparison purposes. We also recommend quantifying potential reductions to current demand through the implementation of water resource infrastructure improvements and conservation measures within both the description of need and the proposed Project alternatives.
95	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	Alternatives	**(2) Project Alternatives** For an alternative to be practicable, it must be reasonably available or obtainable and may include options beyond the authority of the lead agency. To assure that an alternative is permittable, it is essential that the Draft EIS include a range of alternatives with the goal of avoiding and minimizing impacts to waters of the U.S. while meeting the basic purpose of the action. We recommend that the Draft EIS summarize the regulatory criteria and processes utilized to develop the reasonable and practicable alternatives, including any environmental, logistical, technological, and cost criteria applied to identify and screen potential alternatives. Details of the reasoning used to screen or eliminate alternatives is valuable for understanding the decision process. As required by regulation, the rationale must be consistent with the practicability definition and criteria outlined in the preamble language of the CWA 404(b)(1) Guidelines (40 CFR § 230.10). EPA recommends exploring a suite of structural and non-structural options to meet the underlying project purpose when considering a range of alternatives. A combination of non-structural and structural components could serve to meet the basic project purpose, and together may reflect a practicable alternative that is potentially less damaging than a single larger structural option. For example, assess to what extent the need for supplemental water supply could be reduced or resolved through conservation and for any remaining need, if it could be partially or fully met through temporary or permanent agreements for use of agricultural water rights, drought time water use restrictions, water reuse, conjunctive use of groundwater and surface water supplies, alternative development of additional storage, alternative storage sites within the basin, purchase of other water rights that may be less damaging to aquatic resources, blending raw water, regulating development in a service area, or a combination of these ideas. Because non-structural options (e.g., conservation, water rights leasing) may individually contribute less towards meeting the Project purpose than structural options (e.g., new or expanded reservoir storage), we recommend designing screening criteria so that these non-structural components are not eliminated solely on the basis of their potentially smaller individual contributions to meeting the Project purpose and need.
96	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	Affected Environment	**Baseline Environmental Conditions** When evaluating effects of alternatives, we recommend using existing environmental conditions as the baseline for comparison of impacts across all alternatives, including the No-action Alternative. Comparing the alternatives to existing conditions is important for understanding and quantifying each Alternative's impacts and potential benefits. This is especially true when there are environmental protections in place that are based on current conditions or special designations of downstream waterbodies such as the Wild and Scenic designation of the Virgin River in Zion National Park. EPA recommends that the NEPA analysis compare and present impacts to resources against the existing conditions baseline using a consistent method to measure project impacts on these critical resources for all alternatives. We recommend that NRCS consider the following when defining baseline conditions: • Verify whether historical data (e.g., data 5 years or older) are representative of current conditions. • Provide a detailed hydrologic analysis in diverted waterways and storage areas to adequately assess the Project's potential biological and geomorphic impacts. At a minimum, include wet, average, and dry year analyses at a daily time-step. Also consider potential influences of temperature and precipitation trends on future hydrology. • Include resources directly impacted by the Project footprint within the geographic scope of analysis (i.e., reservoir locations and pipeline, canal and road routes), as well as the resources indirectly (or secondarily) impacted by the Project. These indirectly impacted areas may include downstream segments, source streams where water diversions will occur and any other resource areas which may be affected by changes in water management or operations.

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97	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	Water Resources	**(3) Water Resources** Analysis of Water Supply Reliability We recommend including information on safe yields from streams and groundwater, water demand, and drought management. Reviewing previously conducted studies by the Institute for Water Resources of the Corps of Engineers may be useful (See "An Evaluation of the Risk of Water Shortages in the Lower Peninsula, Virginia," Revised Report, August 15, 2001, IWR Special Study, U.S. Army Corps of Engineers). An evaluation of potential influences of climate change on the proposed Project is also a valuable component for assessing water supply reliability. The Utah Department of Natural Resources has made projections on climate change attributed changes to annual temperatures and precipitation over the next century that would apply to the Project area (Khatri, K.B. and Strong, C., 2020 Climate Change, Water Resources, and Potential Adaptation Strategies in Utah. Utah Department of Natural Resources, https://water.utah.gov/water-data/water-reports/). Climate change influences on the Project may translate into modified design and operational assumptions for determining resource supplies, system demands, system performance requirements, and operational constraints (Brekke, L.D., Kiang, J.E., Olsen, J.R., Pulwarty, R.S., Raff, D.A., Turnipseed, D.P., Webb, R.S., and White, K.D., 2009 Climate change and water resources management – A federal perspective: U.S. Geological Survey Circular 1331, p.65). We recommend including an analysis of how climate change vulnerabilities have been incorporated into alternative selection and design in the Draft EIS and if or what additional work may be needed to address these points in the future within the watershed.
98	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	Water Resources	**Water Quality Impacts** Should the Project modify water resources through operational changes, construction activities, placement of new infrastructure, increased diversion of water, or introduction of new water sources, we recommend the Draft EIS include an analysis of water quality that evaluates the following areas: • Current and post-project water quality at a critical flow condition and expected changes to assimilative capacity or permit limits for any National Pollutant Discharge Elimination System (NPDES) or state discharge permits downstream of the diversion or impoundment. This analysis should include: o A comparison of current water quality, post-project water quality, and the applicable water quality standard (i.e., nutrient loads and temperature changes downstream in the East Fork Virgin River); o The utilization of state methods to assess water quality and determine water quality-based effluent limits; o An account of changes in background water quality for water quality modeling and determinations of assimilative capacity; o Water quality impairments per State CWA Section 303(d) lists, draft or established Total Maximum Daily Loads (TMDLs) and potentially affected dischargers; o Details of any water quality-limited segments within the affected area; o Source Water Protection Areas and an explanation of how the Project will be consistent with Source Water Protection planning measures; o Direct or indirect effects from the proposed borrow pit(s) on BLM land; and o Potentially affected water treatment providers and possible changes to treatment processes.
99	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	Water Resources	**Groundwater** In assessing the potential impacts of an alternative on groundwater systems in the region of the Project site, EPA recommends that the Draft EIS examine the potential for changes in the volume, storage, flow and quality of ground water through data obtained from ground water resource characterization efforts and ground water use. Projected construction, operation, or maintenance of a project and its associated infrastructure may have significant impact on groundwater resources. EPA therefore recommends highlighting potential impacts to: • Spring and seep emergences and their associated discharge rates and quality; • Regional subsidence associated with groundwater withdrawal; • Sensitive aquifers, sole source aquifers, drinking water well yield and quality; and • Regional aquifer quality, aquifer quality near potential underground storage areas, and areas of groundwater/surface water exchange. EPA recommends the NEPA analysis identify and discuss how groundwater will be protected or impacted by project activities and any changes in the system that may result from the implementation of an alternative. If the Project will impact groundwater, we recommend the analysis consider mitigation measures that: • Avoid impacts on groundwater; • Limit the degree or magnitude of impacts on groundwater; • Reduce impacts by long-term maintenance operations; • Repair or restore groundwater resources; and/or • Compensate for groundwater impacts by replacement or substitution. The EPA recommends the NEPA analysis include: • A list of Best Management Practices (BMPs) that will be required to protect water resources; • A discussion of the circumstances under which the BMPs would be applied (e.g., proximity to surface water resources, presence of erosive soils, slope, sensitive aquifers, spring emergences, etc.); and • An explanation of how NRCS or another government entity would ensure that the BMPs would be monitored to ensure timely and correct implementation.

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100	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	Water Resources	**Streamflow** EPA recommends that the analysis of each alternative, with respect to the affected stream system(s), account for alterations of streamflow quantity and subsequent impacts to aquatic life. In order to understand Project effects on streams, include in the analysis any stream resources in the immediate Project area, downstream of the Project area, and any areas that would be affected by inundation, diversions, or operational modifications within the scope of the impact analysis. For the impact analysis we recommend selecting reaches based upon their representativeness of geographic scope and the type of modification. To ensure that critical resources are considered and the scope of analysis is appropriate, we recommend conducting interagency coordination when selecting stream reaches. For example, it would be valuable to include consideration of species recovery areas, recreational areas, critical habitat for threatened or endangered species, Wild and Scenic designated segments, segments impaired per Section 303(d) of the CWA, segments for which TMDLs have been established, receiving waters for permitted dischargers, and source water protection areas for surface water intakes. We also recommend considering stream impacts regionally within the context of the cumulative analysis portion of the review. If an alternative will alter in-stream flow quantity, we recommend that the Draft EIS include analysis of the following: • Quantify any existing diversions diversions into or out of the water sources affected by the Project; • Present and compare pre- and post-project flows as characterized in Table 1 on the next page. • Assess impacts to the flow regime with an emphasis on the implications of changes to channel complexity, channel maintenance, aquatic habitat availability, and life history adaptations which includes; and, • Assess the cumulative effect to streams of past diversions, project diversions, and any reasonably foreseeable future diversions.
101	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	Water Resources	Include analysis of the following: - SEE TABLE OF FLOW METRICS • Impacts to stream morphology and sediment transport due to reservoir construction/expansion, changes in stream flow, or changes in land use including: o Identify affected riffle-pool complexes; and o Assess impacts from pre- and post-project flows to sediment transport, channel maintenance and channel complexity. • Impacts to resident fish species and invertebrate assemblages which includes: o Baseline data regarding functional species composition, diversity, evenness, abundance, and, for macroinvertebrates, %EPT (Ephemeroptera, Plecoptera, and Trichoptera) and some characterization of flow preference. EPA's rapid bioassessment protocol, or a statespecific method, may be used to describe baseline habitat quality; o Characterization of shifts in species composition, impacts to less tolerant species, and changes in functional composition between current baseline and post-project environment; o Impacts to physical habitat, including availability, heterogeneity, connectivity, and longterm habitat maintenance; o Consideration of multiple metrics or factors that influence habitat such as loss of flushing flows, reduced floodplain connectivity, temperature, and changes to ecologically significant flows; o Analysis of aquatic resource impacts, which integrate any results from flow, stream morphology and water quality analyses; • Impacts associated with reservoir construction/expansion and subsequent inundation and include quantification of lost aquatic and riparian habitat areas and impacts of conversion from lotic to lentic habitat types; and • A description of mitigation measures for potentially adverse impacts to stream resources and aquatic life.

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102	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	Wetlands	The protection and restoration of wetlands and riparian areas is a high priority. These resources increase landscape and species diversity, support many species of wildlife, and are critical to the protection of water quality and designated beneficial water uses. To illustrate effects to wetlands in the area, we recommend that the Draft EIS specifically include the following analyses or descriptions: • Description of impacts under individual or nationwide permits authorizing the discharge of fill or dredge materials to waters of the U.S.; • Clear maps, including wetland delineation and regional water features; • Wetland delineation and descriptions, including ecological function analysis if there is any potential that an alternative will cause impacts; • Analysis of the direct, indirect, and cumulative impacts to all wetlands in the geographic scope, including impacts to wetlands from changes in hydrology even if these wetlands are spatially removed from the construction footprint. Include in the analysis the indirect impacts to wetlands from loss of hydrology from water diversion/transfers and the cumulative impacts to wetlands from future development scenarios based on population and growth estimates; • Detailed analysis of potentially adverse impacts to aquatic resources from reasonably foreseeable development; • Impacts associated with infrastructure and reservoir construction/expansion and subsequent inundation with a quantification of lost aquatic and riparian habitat areas • Specific and scientifically-derived evidence to support downstream increases to riparian habitat resulting from reservoir development as described in the EA; and • An evaluation of specific mitigation requirements and BMPs applicable for construction, maintenance, and reclamation activities to prevent adverse impacts to aquatic resources downslope of the Project site. We recommend that the Draft EIS demonstrate that the destruction, degradation, and modification of all wetlands, both jurisdictional and non-jurisdictional, is being avoided and minimized on federal land as outlined in EO 11990. It is the responsibility of NRCS to comply with EO 11990 for impacts on federal lands if any of the project alternatives cross into the surrounding BLM lands. This would involve mapping all wetlands within the project site, including springs and seeps, and assuring all avoidance measures are incorporated into the Project. If non-jurisdictional wetlands on federal lands are going to be impacted, offsetting mitigation efforts will also need to be incorporated.
103	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	Air Quality	**(4) Air Resources** Protection of air quality is important to address in the Draft EIS. We recommend that the amount of stationary, mobile, and non-road source emission activities associated with construction, including hazardous air pollutants, be quantified and disclosed. We recommend evaluating and disclosing any air quality impacts and if necessary, identifying mitigation steps that will be taken to minimize associated adverse impacts. Components to be presented in the documentation include the existing air quality conditions in the Project vicinity, and an assessment of any impacts on National Ambient Air Quality Standards, Prevention of Significant Deterioration standards, and air quality related values or Air Quality Related Values. Also, to be addressed are particulate emissions from construction and ongoing operation of maintenance or access roadways.
104	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	Monitoring and Mitigation	**(5) Mitigation** EPA recommends that each alternative in the Draft EIS identify appropriate mitigation where impacts to water quality, air quality, stream morphology, or aquatic life are expected. The higher the uncertainty surrounding project impacts, the more emphasis there should be on providing mitigation details (including adaptive management) to assure protection of resources. At a minimum, include the following mitigation information in the Draft EIS: • Identify the entity responsible for implementing each mitigation commitment; • Define a mitigation effectiveness monitoring plan, including baseline monitoring if data are lacking; • Define specific management decision points based upon protecting the minimum desired environmental conditions (thresholds) in the Project area which would trigger modification or improvement actions; • Identify funding sources to sustain mitigation commitments. • Establish mechanisms for public disclosure of the analysis and management decisions; and • Ensure that mitigation details presented are consistent with the 2008 Rule on Compensatory Mitigation for Losses to Aquatic Resources for related impacts if a CWA 404 permit will be required.
105	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	Sensitive Species	**(6) Special-Status and Threatened and Endangered Species** The Project area contains special status species, including the Virgin River chub and woundfin species at Pah Tempe Hot Springs, as well as the southwestern willow flycatcher. EPA recommends engaging the U.S. Fish and Wildlife Service (FWS) as early in the analysis as possible to assure that the proposed alternatives responsibly account for or are in compliance with the following: • River restoration, flow and channel modifications, wetlands, and habitat fragmentation regarding species' habitat requirements; • Migratory Bird Treaty Act; • A management plan for surrounding land uses (e.g., pesticide, nutrient, weed, and recreation management), for new reservoir construction alternatives; and To best inform decision-makers and the public, we recommend the Draft EIS: • Summarize the status and trends of the Project area for threatened, endangered, and sensitive (TES) species and potential suitable habitat acreage; • Disclose of any impacts to TES species and habitat resources (including habitat fragmentation) associated with the proposed Project; • Include design criteria, mitigation, and monitoring measures developed in coordination with the FWS and State to ensure the proposed Project and resulting development do not negatively impact habitat for migratory birds, bald eagles, or other species; and • Any FWS recommendations to reduce potential impacts to TES species from the proposed Project.

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106	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	Invasive Species	**Invasive species** The EPA recommends that the Draft EIS analyze the Project's potential to increase the spread of invasive species. Invasive species in aquatic environments [i.e., zebra (Dreissena polymorpha) and quagga (Dreissena bugensis) mussels, tamarisk (Tamarix spp.), New Zealand mudsnail (Potamopyrgus antipodarum), and rusty crayfish (Orconectes rusticus)] have been documented across the United States and may apply to any new lands being converted into additional water storage. If the Project has the potential to facilitate spread of invasive species, we recommend evaluation of the impacts to Special-Status and TES species as well as incorporating measures to prevent or mitigate those effects.
107	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	Alternatives	**Proposed Alternative Construction** We recommend including specific information about water resource storage construction so that anticipated impacts can be considered when selecting between alternatives. These details include a description of the following factors: • Structural specifications, materials, and locations; • Anticipated support facilities including pipelines, canals, structural yards, maintenance buildings and roads, construction camps and materials sites; • Anticipated temporary land use locations; • Sensitive plant and animal life in the construction area; and • Topography, geology, and surficial hydrology in the vicinity of each structure. Based on these criteria, we recommend choosing structure locations and aesthetics for each alternative in cooperation with the municipalities of Kane and Washington Counties and any other relevant state or federal land managers.
108	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	Health and Safety	**Failure Response** We recommend the Draft EIS include an evaluation of potential adverse impacts from the structural failure of the potential constructed water storage alternatives. This evaluation should include potential adverse impacts to surface waters, public or private water supplies, human health, economics, vegetation, and wildlife. In this part of the analysis, it would be useful to discuss the probabilities and likely frequencies of different types and volumes of potential failure events over the life of each alternative and we expect that this information will be useful in determining future emergency transportation corridor locations.
109	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	Environmental Justice	**(8) Environmental Justice and National Historic Preservation Act (NHPA)** According to our review of EJScreen data (https://www.epa.gov/ejscreen), there are people of color, low-income and indigenous communities within the geographic scope of the planning area. Executive Order 12898 – Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations – applies to federal agencies that conduct activities that substantially affect human health or the environment. In addition, Executive Order 13985 – Advancing Racial Equity and Support for Underserved Communities Through the Federal Government – sets expectations for a whole government approach to advancing equity for all. Consistent with these executive orders and CEQ's Environmental Justice Guidance Under NEPA (available along with other environmental justice resources at https://www.epa.gov/environmentaljustice/environmental-justice-and-national-environmental-policy-act), the EPA recommends the Draft EIS: • Identify communities described above within the geographic scope of the impact area, including the sources of data and a description of the methodology and criteria utilized; and • Document meaningful engagement of such communities with respect to NRCS's decisions on the reservoir selection and Watershed Plan. In particular, and consistent with the Memorandum on Tribal Consultation and Strengthening Nation-to-Nation Relationships, we recommend initiating Tribal Consultation. We also recommend discussing the role in the decision-making process of the tribes and individuals in whose beneficial interest the land is held in trust and notifying the Tribal Historic Preservation Officer if cultural or historical artifacts are found in the Project area (see comment below for more information). • Assess environmental justice and other socioeconomic concerns for any people of color, low-income, and indigenous communities, including: o A discussion of the potential direct, indirect and cumulative environmental impacts of the proposed Project on the health of these communities, with consideration of any existing disproportionate impacts being experienced (e.g., if this Project would adversely impact water quality, aquatic ecosystem functions or air quality); o An evaluation of the socioeconomic impacts to the local communities, including the potential for any additional burden placed on local communities' abilities to provide necessary public services and amenities (e.g., reservoir construction affecting existing recreational, spiritual or small business uses for communities and individuals that utilize the East Fork Virgin River. Further, creation of a new major recreation area may place a financial burden on marginalized communities if costs to use the lake are prohibitive to their use by these populations); and o A determination of whether and how there may be disproportionately high and adverse human health or environmental effects, including cumulative impacts, associated with the proposed Project on the identified communities. • Identify mitigation measures or alternatives to avoid or reduce any disproportionate adverse impacts. We recommend involving the affected communities in developing the measures. The EPA recognizes the need for early involvement of the local communities and supports the meaningful participation of community representatives in the NEPA process.
110	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	Tribal and Cultural Resources	**NHPA Consultation** We recommend the USFS conduct consultation under the NHPA with the Tribes, as well as the Tribal and State Historical Preservation Offices. It has been our experience that these contacts change frequently and must be verified with each action. To ensure that consultation requirements are met, provided below are two resources which are updated and maintained online: • The National Association of Tribal Historic preservation Officers – Find a THPO https://www.nathpo.org/thpos/find-a-thpo/; and • The National Conference of State Historic Preservation Offices – Directory https://ncshpo.org/directory/ We recommend that an updated contact list for THPOs and SHPOs be cited in the Draft EIS to provide the public with full disclosure on the consultation requirements under the NHPA.

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111	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	General	**Enclosure 2. EPA Comments on Cove Reservoir Draft Plan EA** We are enclosing a copy of our December 22, 2020, letter providing EPA's comments on the Draft Plan EA for Cove Reservoir. The purpose for including this letter is to reiterate comments that may continue to be applicable for the NRCS to evaluate during Draft EIS development considering the NOI identification of Cove Reservoir construction as the Preferred Alternative. The U.S. Environmental Protection Agency Region 8 has reviewed the USDA Natural Resource Conservation Service's November 25, 2020, Draft Plan Environmental Assessment (EA) for the Cover Reservoir Watershed Project. The NRCS has prepared a Draft Plan EA primarily to address summer agricultural irrigation shortages for nearby farms in the watershed. The Draft Plan EA identifies two alternatives for consideration; the Preferred Alternative to construct a dam at the Cove Reservoir site with a 6,055 acre-feet storage capacity and the No Action alternative. In accordance with our responsibilities under the National Environmental Policy Act (NEPA), we are providing the following comments on purpose and need, water quality and aquatic resources, as well as general feedback for consideration as you move into the next phase of NEPA development.
112	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	Purpose and Need	**Project Purpose and Need:** The Draft Plan EA identifies that the primary purpose of the project is to capture high winter flows in storage in order to fulfill the need to provide additional water to irrigators during low-flow summer months. The ancillary purposes of this project based on the preferred alternative selection are to create recreation opportunities, relocate and upgrade the Glendale hydroelectric power plant, and generate consistent summer flows to enhance downstream habitat for threatened and endangered species. The Draft Plan EA discusses alternatives that were considered but screened out, leaving construction of a new dam at the Cove Reservoir site as the single preferred action. Because the Draft Pan EA identifies that Cove Reservoir will likely require a Clean Water Act (CWA) Section 404 individual permit for impacts to waterbodies in the proposed reservoir footprint, we recommend that 404 processes and NEPA be merged to increase efficiency. As such, 404 permitting requires that all feasible alternatives be evaluated to determine that the selected alternative is the least environmentally damaging practicable alternative (LEDPA). Our review indicates at least one feasible alternative that would provide approximately 3,000 acre-feet of storage was screened out from evaluation in the Draft Plan EA due to cost, and other alternatives, including non-construction actions (e.g. conservation and modified irrigation practices), were not considered as they did not meet water storage requirements of the purpose and need. We recognize that some alternatives were screened out due to unfavorable conditions, but we recommend that all feasible alternatives be evaluated if they can meet the primary goal of providing additional water needs for existing agriculture activity in the project area. Providing this information will increase the efficiency of CWA 404 permitting in addition to completing a robust analysis for NEPA purposes. We recommend that discussions on purpose and need clearly indicate that the Cove Reservoir location has already been purchased by the Kane County Water Conservation District (proponent). It is not immediately clear in the documentation how the existing land acquisition is factored in the alternatives screening cost evaluation. This information will be relevant for CWA 404 permitting and determining if the preferred alternative is the LEDPA.
113	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	Water Resources	**Water Quality and Aquatic Resources:** Cove Reservoir would utilize diversion of peak flows from the East Fork Virgin River (East Fork) during winter to fill the pool. The East Fork is classified by the State of Utah as a Category 1 high functioning surface waterbody under its antidegradation policy and is currently assessed as unimpaired. As such, activities in or near the waterbody that could result in degradation should be scrutinized and avoided. The Draft Plan EA determines that no change in water quality would occur as a result of Cove Reservoir. Our review of the Draft Plan EA resulted in the following observations that we recommend be addressed to evaluate that determination: •The Draft Plan EA identifies that the diversion and retention of water in Cove Reservoirwill provide a beneficial use due to annual releases of up to 882 acre-feet downstream toprotect federally-listed Virgin River chub and woundfin species at Pah Tempe HotSprings. Additionally, the Draft Plan EA identifies the potential for increased riparianhabitat growth to benefit the listed southwestern willow flycatcher. The Draft Plan EAstates that "up to" 882 acre-feet will be discharged but does not elaborate on what criteriawill be established to determine flows aside from the agreement between the proponentand Zion National Park to not exceed certain flows rates. We recommend the documentanalyze and discuss the potential for adverse effects on listed (state and federal) and non-listed species. We further recommend the document outline whether beneficial flowswould be curtailed due to a priority to meet irrigation needs should there be a droughtyear (or years) and the reservoir does not fill to capacity. As both irrigation and storageand beneficial flows are identified as project purposes, we recommend that the documentidentify if they will have equal weight. Recreation is also a project purpose, and thedocument should address ability to meet recreational needs under similar conditions andidentify if specific purposes will outweigh others should conditions occur where the poolcannot be filled during the high flows season. •The Draft Plan EA does not analyze or discuss the possibility of nutrients or other potential constituents that could accumulate in the reservoir and be released downstream.We recommend evaluating soils and land uses upgradient of the reservoir location to assist in anticipating potential water quality issues. Due to the sensitive and protected nature of the East Fork, we recommend that identification and anticipation of any potential impairments in the East Fork resulting from the reservoir be evaluated so they can be fully disclosed, mitigated or avoided.

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114	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	Cumulative Effects	•The Cumulative Effects section (4.4.2.2.) identifies that Jackson Flat Reservoir and theproposed Cove Reservoir would collectively provide irrigation water for Kane Countyagriculture. The Draft Plan EA introduction identifies in section 1.4 that there is currentlyno water storage structure available for irrigators in the area, but this information appearsto contradict that. It is unclear from this section how the water from both sources will becollectively utilized. For clarity, we recommend the document elaborate on this collectiveuse and how it is factored in the water needs projections. If there are plans to combineand convey water from both reservoirs, we recommend the document analyze thepotential in-reservoir and downstream water quality effects that could occur if water is shared between reservoirs. If the reservoirs are independently utilized, that clarificationwill be beneficial to avoid confusion.
115	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	Water Resources	•The Draft Plan EA highlights that the reservoir will increase water quality in the EastFork by retaining some sediments from high water or flash flood events. It is unclear inthe Draft Plan EA if there are anthropogenic sources of increased sediment or if thesediment is part of the natural regime of the watershed. For clarification, we recommendthat the document identify if the capturing of sediments will alleviate anthropogenicinfluences on sediment loads in the watershed and East Fork or if the capture ofsediments may alter the natural sediment regime.
116	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	Invasive Species	•Recreation is identified as one of the project purposes. We note that the project area is inproximity to Lake Powell and other state reservoirs that provide recreation opportunities.These reservoirs, especially Lake Powell, provide education, inspections, andrequirements to prevent introduction of quagga and zebra mussel invasive species into thereservoirs. We recommend that the proponent identify and commit to measures to avoidintroduction of invasive species by recreational watercraft usage of the reservoir. This isespecially important due to the high quality of the downstream water and federally-listedspecies in addition to the maintenance of the irrigation and power-generatinginfrastructure associated with the project.
117	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	Sensitive Species	•The Draft Plan EA identifies that the beneficial summer flows would increase riparianhabitat for the southwestern willow flycatcher. This statement implies certainty of abenefit. Due to the flash flood regime of the watershed, the document would benefit thereader with an analysis and discussion as to whether potentially new habitat growthwould remain established in the downstream environment. If the habitat is not sustainablethe beneficial impact may not be as effective as the Draft Plan EA proposes
118	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	Effects Analysis	•The Draft Plan EA identifies that construction activity will require traffic at crossings ofthe East Fork. We appreciate the proponent's construction BMPs to mitigate impacts tothe waterbody, and strongly encourage investigation of any alternate routes that couldfurther minimize or avoid, if possible, directly impacting the East Fork.
119	26	4/26/2022	Email	Agency	EPA	Matthew Hubner	22	General	The Draft Plan EA identifies the development of an approximately 4.1-acre recreation area. We recommend that BMPs be incorporated to prevent water quality impacts from disturbance and impacts to the watershed, reservoir and surrounding are by increased recreational activity. The maps (Figures 1-2 and 1-3) would benefit from the inclusion of the jurisdictional waterbodies in relationship to the proposed infrastructure. If any of the comments above warrant additional analysis and discussion (i.e. collective use of Jackson Flat and Cove Reservoirs), maps of the involved infrastructure and waterbodies would be useful for the reviewers. Lastly, due to the general unknowns regarding the impacts (positive and negative) to the East Fork immediately downstream of the reservoir project infrastructure, the waterbody Category 1 designation, downstream federally-listed species, and proximity to the Wild and Scenic designated segment of the Virgin River in Zion National Park, we recommend that the NRCS work with the proponent and other stakeholders (particularly ZNP, USFWS and the State of Utah) to develop a monitoring plan to ensure the high functioning nature of the East Fork and Virgin River is maintained should the Preferred Alternative be selected.
120	27	4/28/2022	Email	Agency	BLM	Jamie Pool, Natural Resources Litigation Advisor	23	General	The BLM Utah State Office does not have specific comments on the NOI. Our understanding is that we will be a cooperating agency on the development of this EIS. The instructions provided by our HQ office/DOI are a little vague – do I also need to submit a no comment response via the Federal eRulemaking Portal (docket ID NRCS-2022-0002)?
121	28	4/28/2022	Email	Public		Tracy Hiscock	24	General	It is 11:10pm on April 28, 2022. I just attempted to submit my written comments for the Cove Reservoir project. The portal rejected my comments, stating that " We were unable to successfully submit your comment at this time due to a submission error at Regulations.gov: NRCS-2022-0002-0001 is not open for comment. " I am shocked by this, as there are still 45 minutes or so left in April 28. I will attach my comments below and request that you accept them into the EIS as sent in a timely manner.

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122	28	4/28/2022	Email	Public		Tracy Hiscock	24	General	Docket No. NRCS-2022-0002 I am a long term resident, attorney and taxpayer in Kane County, Utah. I am an avid hiker of Zion National Park and nearby public lands. As such, and as a taxpayer and local citizen, I appreciate the opportunity to provide input "into the scope of the analysis and identification of relevant information" for the Environmental Impact Statement (EIS) for the proposed Cove-East Fork Virgin River Watershed Plan EIS Project as required under the National Environmental Policy Act (NEPA). This proposed Cove Reservoir project has huge potential impacts on downstream Zion National Park, the spectacular public treasure of southern Utah, through which flows the Virgin River, a federally designated Wild and Scenic River, and in which live several Endangered Species of fish, as well as the Parunaweap Wilderness Study Area. The proposed dam to create the reservoir would permanently change the river's natural flow and disrupt the already fragile riparian ecosystems in these areas. It would alter water flows and change flow rates, affecting the wild qualities of the river. It could negatively impact the plants, soils, fish, wildlife and interconnected ecosystems they rely on. Each of these issues must be addressed in an EIS. Significant scientific data is required to adequately analyze all of the potential environmental impacts of this proposal, as required by NEPA in an EIS.
123	28	4/28/2022	Email	Public		Tracy Hiscock	24	Climate Change	And the issue which cannot be ignored- the megadrought that the area has been experiencing for the last 22 years- yes, climate change, must be addressed in the EIS. A project such as this, at this time, seems ill advised. It could greatly exacerbate the changes already happening in the timing, amount, and natural flow of the river that would negatively impact the trees, soils, plants, fish, wildlife, and interconnected ecosystems of the Virgin River, Zion National Park and the Parunaweap Wilderness Study Area. Indeed, an EIS must examine and analyze cumulative impacts as well. A related issue to be considered when proposing the building of a dam is that they worsen the impact of climate change. They release greenhouse gases, destroy carbon sinks in wetlands, deprive ecosystems of nutrients, destroy soils and habitats. Additionally, significant amounts of water are wasted by evaporation in a reservoir. These issues should be analyzed in light of the megadrought and climate change.
124	28	4/28/2022	Email	Public		Tracy Hiscock	24	Economics	An important social issue which should be addressed is the uneven and limited economic benefit of the proposal. If built, this water project will benefit a small number of "local agricultural users," ranchers who grow alfalfa, further subsidizing their agricultural activity, as well as several real estate developers; at taxpayer expense. The proposal primarily serves private interest at public cost. The proposal proponents claim that the annual shortages that occur during the summer months are " primarily due to a lack of storage capability, " are not entirely true. The recent annual shortages in the summer are happening because there is less snow every recent winter to feed the watershed and because the area is no longer seeing the summer rainy season that used to be. Climate change is drying up the west and proposals to build dams ignore these facts and science. Ranchers are not guaranteed that there will be water to use to water their alfalfa. They are not guaranteed infrastructure at public expense to use their water rights. The needs of these few should not be prioritized at the expense of taxpayers. There is no demonstrable public purpose or documented need for the project, no public problem to be solved. This economic justice issue must be analyzed in the EIS.
125	28	4/28/2022	Email	Public		Tracy Hiscock	24	Recreation	The stated need for recreation as a public benefit must be based on facts. I am a regular user of Jackson Flat Reservoir in Kanab. It is not overused by any stretch of the imagination. I have not observed that "water-based recreation activities are in high demand in Kane County" as is stated in the notice document. The fact that nearby national parks have become overcrowded will not be alleviated by another small reservoir in the area. Tourists who are coming to visit Zion National Park, Bryce Canyon National Park or Lake Powell National Recreation Area are unlikely to visit Cove Reservoir instead. Lake Powell is huge and not overcrowded for those who seek and enjoy water recreation. This proposed project, again, does not serve a strong public interest, but benefits a few fortunate, land owning, agricultural users. Please include the issues I have raised in the upcoming EIS for the Cove Reservoir proposal. Thank you for consideration of my comments.

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126	29	4/29/2022	Email	NGO	American Whitewater	Kestrel Kunz	25	General	Thank you for the opportunity to provide scoping comments on the Cove Reservoir Environmental Impact Statement (EIS). American Whitewater is a national non-profit 501(c)(3) river conservation organization founded in 1954. We have over 6,200 members and 100 local-based affiliate clubs, representing approximately 80,000 whitewater paddlers across the nation. American Whitewater's mission is to protect and restore America's whitewater rivers and to enhance opportunities to enjoy them safely. As leaders and partners in river management nationwide and as representatives of the paddling community, American Whitewater has an interest in the exemplary management of the East Fork of the Virgin River as well as the main stem of the Virgin River. A significant percentage of American Whitewater members travel to the Virgin River downstream of the proposed project for recreation and the paddling community enjoys the outstanding packrafting opportunities in Parunuweap Canyon on the East Fork. American Whitewater has actively participated in this project, providing substantial comments on the Environmental Assessment (EA) in 2020 (American Whitewater letter dated December 23, 2020) and participating in multiple public scoping meetings on the EA and EIS. In response to extensive concern from stakeholders, the Natural Resources Conservation Service (NRCS) made the appropriate decision to conduct a full EIS instead of an EA. Now, the NRCS needs to ensure all of the outstanding issues raised in the EA are addressed in the EIS process. The scoping document suggests that the proposed alternative is very similar to the proposed action in the EA, indicating that significant public comment and identified issues with the proposed action are still being overlooked. Our comments request more diligence and transparency on the project's purpose and need, and go into further detail on what must be analyzed in the EIS.
127	29	4/29/2022	Email	NGO	American Whitewater	Kestrel Kunz	25	General	The EA for this project was severely deficient in its explanation, analysis, and findings regarding the project impacts on downstream ecological and recreational values and details of project benefits. In addition, it is apparent that the project's purpose and need are misleading and should be clarified. Prior to addressing the deficiencies of the original EA, the NRCS and project partners need to accurately define the project area and project purposes and financials. It is unclear how much water will be used for M&I water versus agriculture water and this needs to be more transparent in the purpose and need for the project's Scoping Notice. While the EIS scoping materials mention the use of water demands in Washington County, M&I water is not listed as a primary project objective which is contradictory based on the number of times that M&I water needs are referenced in the EIS purpose and need section and previously mentioned throughout the EA. The EIS needs to clearly delineate the amount of water for present and future M&I use, agricultural use, and any other anticipated uses. Regardless of the project's purpose and need, there are still serious deficiencies with the proposed alternatives that need to be addressed. Core to the project is the diversion of significant flows outside of the summer season. The EIS needs to provide a detailed report on the impacts of diminishing or eliminating the seasonal high flows experienced by the river downstream that play important roles in riparian vegetation, geomorphology, biological cues, fish habitat, and recreation. In addition, the stated benefits to hydropower and recreation are grossly exaggerated and the purported benefits either need to be removed or more appropriately described in the EIS. Given the obvious deficiencies in the project purpose and claimed benefits, and the clear impacts to the downstream river segments, we request that the project be abandoned entirely. If the project is not abandoned, we request that the following analyses and information is explicitly included in the EIS.
128	29	4/29/2022	Email	NGO	American Whitewater	Kestrel Kunz	25	Water Resources	**1. The impacts of instream flow diversions must be fully considered.** The EA made it unclear how much water will be withdrawn and when from the East Fork of the Virgin River under this proposal. The EA and supporting documents suggested in piecemeal that annual diversions of up to 30% of flow volume would be diverted into the reservoir between November 1 and May 31. If this were true however, the originally proposed 6,055 acre-foot reservoir would have filled barely halfway in two of the past ten water years, and more typically filled a third or less of its volume based on an analysis of the Glendale USGS Gage. It seems that the project is actually scaled to divert all of the flow in the East Fork of the Virgin River from November 1 to May 31 each year. Only then would the reservoir be likely to fill. We request that a supplemental analysis be produced that models and depicts proposed daily flow diversions and releases associated with both sub-alternatives (6,055 and 4,000 AF reservoir) using stream flow data from the past 10-year period.
129	29	4/29/2022	Email	NGO	American Whitewater	Kestrel Kunz	25	Recreation	**a. The EIS must consider diversion impacts to downstream recreation.** Downstream of the proposed project there are numerous beneficial and existing uses of the East Fork of the Virgin River and the Virgin River itself that were erroneously left out of the EA. Nowhere does the EA or the EIS scoping materials mention the whitewater boating that occurs downstream on the Virgin River. At least three whitewater runs are downstream of the project that rely on high spring flows to support recreational use: ● Zion National Park to Virgin1 ● Timpoweap Canyon2 ● La Verkin to Hurricane3 Given the extremely short and stochastic season that paddling on the Virgin River provides, even small reductions in spring run-off could have deleterious effects, making these reaches unrunnable due to flow reduction from reservoir operations.

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130	29	4/29/2022	Email	NGO	American Whitewater	Kestrel Kunz	25	Recreation	In addition, Parunuweap Canyon lies downstream of the proposed project on the East Fork of the Virgin River. Parunuweap Canyon offers relatively popular hiking and canyoneering opportunities within the BLM boundary and the lower section is a Natural Research Area managed by Zion National Park. Traveling through Parunuweap Canyon is considered by many to be more spectacular than the Zion Narrows.4 There have also been packrafting descents of Parunuweap upstream of the Park and it has been called a “new 5 star packrafting run”.5 Packrafting is an increasingly popular recreational activity that allows paddlers to explore remote, low volume streams. With already minimal flows on the East Fork of the Virgin, slight reductions to stream flows could make packrafting through Parunuweap Canyon impossible. The proposed artificial increases in summer flows, and elimination of winter and spring flows, could impact these uses. “Parunuweap” means roaring water, and this proposed project would silence the river in most years. The Wilderness character would be greatly diminished by the removal of variable and high flows and the unique geomorphologic and ecological characteristics that are attributed to natural flooding events would deteriorate.
131	29	4/29/2022	Email	NGO	American Whitewater	Kestrel Kunz	25	Water Resources	**b. The EIS must consider diversion impacts to downstream riparian vegetation and geomorphology.** In an egregious oversight, the EA failed to seriously explore or disclose the likely severe impacts on riparian vegetation and geomorphology associated with the proposed diversion. Winter and Spring high flows play critical roles in maintaining channel width, pool depth, and other key geomorphological variables. Elimination of high flows in other rivers has proven that without these flows riparian vegetation encroaches into the stream channel, and fine sediment builds up in what little channel is left. The Final EPA-USGS Technical Report: Protecting Aquatic Life from Effects of Hydrologic Alteration summarizes this well-understood and predictable impact as follows: *“It is critically important to maintain extremes (floods and droughts) within the bounds of the natural flow regime to support the ecological structure and function of streams and rivers. However, alterations in low or high flows that are human-induced, affect and can control many ecosystem patterns, such as habitat extent and condition, water quality, connectivity, and material and energy exchange. These patterns can in turn affect many ecosystem processes, including biological composition, distribution, recruitment of biota, and ecosystem production (Rolls and others, 2012).* *Although low flows serve a critical role in ecosystem function, current scientific research indicates that flow criteria ideally should support the natural flow regime as a whole, and that criteria for minimum flow alone (that is, a single minimum discharge value or a minimum passing flow) are not sufficient for maintaining ecosystem integrity (Annear and others, 2004; Bunn and Arthington, 2002; Poff and others, 1997). Minimum flow criteria do not address the full range of seasonal and interannual variability of the natural flow regime in most rivers and streams.* *The natural fluctuation of water volume and levels in rivers and streams is critical for maintaining aquatic ecosystems because aquatic biota have developed life-history strategies in response to these fluctuations (Hill and others, 1991; Lytle and Poff, 2004; Mims and Olden, 2012, 2013; Postel and Richter, 2003; Stalnaker, 1990). Comprehensive flow criteria not only identify flow needs (that is, magnitude) but may also address the rate, frequency, timing, and duration of streamflow required to support ecosystem health (Poff and others, 2010). The Instream Flow Council (a non-profit organization working to improve the effectiveness of instream flow programs and activities: http://www.instreamflowcouncil.org/) recommends developing criteria that incorporate natural patterns of intra- and interannual variability in a manner that maintains and (or) restores riverine form and function to effectively maintain ecological integrity (Annear and others, 2004). Therefore, narrative hydrologic criteria and their implementation ideally should address several flow-regime components (frequency, duration, timing, rate of change) in addition to flow magnitude. The components necessary are determined on a case-by-case basis, depending on which values are most ecologically relevant.”6*
132	29	4/29/2022	Email	NGO	American Whitewater	Kestrel Kunz	25	Water Resources	American Whitewater has significant organizational experience with the elimination of high flows, and their restoration. On rivers like the North Fork Feather (CA), Dolores (CO), and Cheoah (NC) we’ve struggled to restore dewatered rivers overtaken with overstory trees and shrubs. On rivers like the Bear (ID) we’ve seen sediment build up in the river channel each year when high flows do not flush it downstream and move it out of the channel laterally, and the effects that has had on macroinvertebrate communities and habitat are severe. The proposed project’s impacts to the frequency, magnitude, duration, season, and rate of change of the high flow regime would cause significant sediment build up, channel geomorphology impacts, vegetation encroachment, and eliminate important biological cues for plant and animal species for many miles downstream. Failing to disclose, explore, and weigh these impacts is a critical law in the project, and needs to be addressed in the EIS. The high flow regime was not the only oversight in the EA. The EA states that evaporation will remove 193 acre feet from the annual flow regime. This is 10% of the flow regime in most years. Also quite clear is that the 6,055 AF sub-alternative will eliminate another 4,500 acre feet or more as irrigation diversions. Together these losses appear to account for over half of the volume of annual flow in the river. The cumulative flow reductions for both all alternatives and sub-alternatives need to be explicitly described in the EIS. Lastly, the proposed summer releases of the 882 acre feet for the 6,055 AF alternative are likely to be released as peaking flows that could further destabilize and unravel the downstream ecosystem. The EIS needs to provide an analysis of the full picture of proposed flow regime alteration. The flow alterations associated with the preferred alternative would have significant and unacceptable impacts on the existing and beneficial uses protected under the Clean Water Act downstream.

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133	29	4/29/2022	Email	NGO	American Whitewater	Kestrel Kunz	25	Economics	**2. The benefits of the proposed hydropower projects are overstated and moot.** The EA and EIS scoping materials seek to include the benefits of the proposed hydropower projects in the decision to build the reservoir, however those benefits are both misrepresented and uncertain, the costs undisclosed, and the hydroprojects are unrelated to this project in terms of permitting. The EA estimated that the Orderville plant would yield gross revenue of $19,000, and based on generation estimates the Glendale plant would yield $8,600 to $23,300. It defies logic that these projects will pay for themselves, ever, and the baseload power they generate has little value to the grid. We request that the project costs in EA Table S-2 be broken out in the EIS to reveal the construction, annual operation, and annual maintenance costs of the proposed hydropower projects. Given the undisclosed and likely uneconomical cost-benefit analysis of the hydropower projects, we do not feel that it is likely these projects will actually be built and thus their benefits should not be included in this proposal or analysis. Regardless, they would require an entirely separate permitting process through the Federal Energy Regulatory Commission, so it would be appropriate to remove the hydropower projects from this proposal and EIS. The EIS scoping materials fail to list FERC as one of the required project permitters, which will be necessary if any of the proposed modifications to hydropower are pursued in this project, and as previously mentioned is an entirely separate permitting process. This is a gross oversight and needs to be addressed in the EIS or hydropower needs to be entirely removed from the project design.
134	29	4/29/2022	Email	NGO	American Whitewater	Kestrel Kunz	25	Economics	**3. The project is woefully uneconomic and should be rejected as such.** Using the annual net economic benefits of $163,900 in the EA, the preferred alternative as described in the EA would take 182 years to make any returns; the reservoir has a 100 year life expectancy.7 This is not a responsible use of public funds and merits the complete abandonment of the project.
135	29	4/29/2022	Email	NGO	American Whitewater	Kestrel Kunz	25	Recreation	4. The project's recreational benefits are overstated and pale in comparison with its impacts. The EA's recreational analysis was one-sided and unclear. First and foremost, as we stated in Section 1 the proposed project is likely to have significant deleterious recreational impacts on hiking and packrafting in Parunuweap Canyon which is an incomparable Wilderness Study Area setting, and also on paddling at least three sections of the Virgin River downstream. In addition, vegetation encroachment and habitat failure associated with the proposed flow diversion is likely to negatively impact riverine angling downstream. Regardless of the recreational benefits, the EIS must also disclose and consider these negative recreational impacts. As to the purported benefits, we have questions. The proposal for the 6,055 AF reservoir would create a reservoir that each Spring and Summer gradually drops from 188 acres8 to the 34 acre conservation pool.9 Over the course of the recreation season the usable reservoir would shrink dramatically and the unsightly varial zone would grow. The boat ramp depicted in EA Figure 3-1 would appear to not reach the water early in the season, preventing trailered boat access. It is unclear that the shrinking and warming reservoir would be cold enough to support trout at the end of the season as claimed, or if stocking presumably non-native trout upstream of the wild portions of the river could have unintended ecological impacts. From a recreational point of view, the proposed project would severely impact a wild river system with significant and high quality recreational experiences in order to create a small reservoir with unproven and questionable value. We appreciate the consideration and inclusion of recreational infrastructure in the project proposal, but the recreation cost/benefit analysis provided in the EA is a reason not to build the project rather than a reason to build it. The EIS will need to provide an accurate assessment of the recreation opportunities that are lost and gained due to the project.

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136	29	4/29/2022	Email	NGO	American Whitewater	Kestrel Kunz	25	Wild and Scenic Rivers	5. The project is incompatible with downstream Wild and Scenic River protections. A 7.53 mile section of the East Fork of the Virgin River downstream of the proposed project is a federally designated Wild and Scenic River, with the most protective classification of “Wild.” The Outstanding Remarkable Values (ORVs) protected under the designation are cultural, geological, ecological, wildlife, and fish values, with the management and values of the river described in the 2013 Comprehensive River Management Plan (CRMP) for the Virgin River system.10 The Winter and Spring high flows, which the proposed project would greatly diminish or more likely eliminate entirely, are directly responsible for the creation and maintenance of the protected ORV’s of the river. The Wild and Scenic Rivers Act will require a Section 7 determination by the National Park Service because the proposed project is upstream of the designated reach, requires a Federal permit and funding, and is likely to affect the river’s fish, wildlife, and scenic values. We appreciate that the required Section 7 analysis is correctly listed as one of the necessary permits in the EIS scoping materials. Once the preliminary alternatives are determined, the NRCS should work with the NPS to carry out the Section 7 analysis before millions of dollars are invested in the remaining EIS process. We acknowledge that the CRMP claims that the 1996 Zion National Park Water Rights Settlement Agreement protects the ORVs of the river, but this is false. This 24-year old agreement pre-dates the Wild and Scenic designation and represents an outdated and erroneous depiction of the instream flow needs of a river, ignoring the essential effects that high flows have on ORVs and the impacts that hydropower peaking flows could have in the summer. While the 1996 agreement may yield certain water rights that could be exploited by the proposed project, it does not preemptively waive Section 7 of the WSRA and allow the use of public funds to create a water resources project that will damage the downstream Wild and Scenic River reach. While the 1996 agreement may appear to require the NPS to allow the proposed reservoir, Section 7 of the WSRA clearly prohibits use of public funds for its creation, if not also certain federal permits. Simply put, the Section 7 determination will be a finding that the proposed project will have a direct and adverse effect on the values for which the river was added to the system. This determination will block the use of public funds for the project and is again why the Section 7 analysis should be done now, before more public money is spent.
137	29	4/29/2022	Email	NGO	American Whitewater	Kestrel Kunz	25	General	The EIS must address the deficiencies outlined in these comments, including but not limited to a detailed analysis of proposed streamflow changes and their impacts on recreation, aquatic organisms, riparian vegetation, and geomorphology downstream at least as far as Hurricane, UT. We request that this analysis inform and integrate the Section 7 of the Wild and Scenic River Act analysis that must and will prohibit federal funding of the proposed project. Based on the EA and EIS scoping materials, it is clear that the proposed project would have significant and unacceptable negative impacts on the East Fork of the Virgin River and the mainstem of the Virgin River, and that the project is uneconomical and illegal to fund with Federal dollars. For these reasons we oppose the project, and request the selection of the No Action alternative.
138	30	4/28/2022	Email	Public		Many		General	Dear Brian Parker, Thank you for the opportunity to provide comments on the Cove Reservoir - East Fork Virgin Environmental Impact Statement. As a river enthusiast who cherishes wild and free-flowing rivers, I implore the National Resources Conservation Service and other project partners to abandon the proposed project as described in both the previous Environmental Assessment and the EIS scoping notice by choosing the No Action Alternative. If the project proceeds, the NRCS needs to fully assess all downstream impacts of the project, including impacts to recreational, ecological, and other values. This should include a complete review of different annual hydrograph scenarios. Naturally varying river flows support a myriad of important ecological attributes, including sediment transport and vegetation management., On the East Fork of the Virgin River’s spring peak flows provide the only possible time of year to go boating. Downstream reaches on the mainstem of the Virgin are very well-known amongst recreators and flows are dependent upon high spring streamflows in the East Fork Virgin River. The project as proposed would have severe environmental and recreational impacts, is not economically feasible and is a misuse of taxpayer money. Thank you for considering my comments on this project.
139	31	4/25/2022	Email	Agency	PLPCO	Sindy Smith	4	Land Use	The State of Utah (State) appreciates the opportunity to provide additional scoping comments on the Cove-East Fork Virgin River Watershed Project Environmental Impact Statement (EIS). The State submitted comments on the project’s Environmental Assessment on December 31, 2020 and scoping comments on the Environmental Impact Statement November 9, 2021. The State incorporates these comments by reference. The State provides the following scoping comments for your consideration. The State restates that the proposed action be consistent to the fullest extent with Kane County’s Resource Management Plan,1 specifically to “provide for sustainable productive watersheds for a continued supply of waters for Kane County's irrigated agriculture, sector which is dependent on both stream flows and water storage” (page 264).

CID	Doc ID	Received	Type	Group	Entity	Commenter	Commenter ID	Category	Comment
140	31	4/25/2022	Email	Agency	PLPCO	Sindy Smith	4	Land Use	The State recommends that the proposed action be consistent to the fullest extent with Washington County Resource Management Plan,2 in particular, Washington County's Irrigation policy: a. County Policy: vi. Washington County supports and encourages the development of dams (diversions and storage), canals, piping and other related water projects to develop and utilize water sources. b. Desired Future Conditions/Objectives: i. The county works cooperatively with partners, including the water conservancy district, irrigation companies, the conservation districts, and municipalities, to plan for future water needs. c. Management Actions: i. The county will seek cooperating agency status on all federal resource management plans within or affecting Washington County.
141	32	11/9/2021	Email	Agency	PLPCO	Sindy Smith	4	Land Use	The state of Utah (State) appreciates the opportunity to provide scoping comments on the Cove-East Fork Virgin River Watershed Project Environmental Impact Statement (EIS). The State provided comments on the project's Environmental Assessment on December 31, 2020, and in collaboration with the Division of Wildlife Resources (DWR), the State restates these comments for the EIS project your consideration. Additionally, the State would like to take this opportunity to highlight that the Kane County Resource Management Plan1 states that one of the purposes for the county land use plan is to "provide for sustainable productive watersheds for a continued supply of waters for Kane County's irrigated agriculture, sector which is dependent on both stream flows and water storage" (page 264).
142	32	11/9/2021	Email	Agency	PLPCO	Sindy Smith	4	Sensitive Species	**Native Species** The Draft EA claims potential benefits for three Threatened and Endangered (T&E) species: the Southwest willow flycatcher, woundfin, and Virgin River chub. Another species of particular concern for this project area is the Virgin spinedace, which is managed under a Conservation Agreement and Strategy and has been petitioned for listing as a T&E species. The U.S. Fish and Wildlife Service is currently determining whether listing is warranted for the Virgin spinedace, and yet impacts to that species are not included in the EA. The State recommends that impacts for this species, in addition to the others listed above, be considered, and included in the draft EIS. Prior to claiming a benefit to the species listed above, DWR recommends the following points be carefully considered: • The term "summer months" should be defined, and the low end of the stream flow delivery range should be included, in relation to the high end of 882 acre-feet. • The claimed benefits these flows could have for T&E species are undemonstrated. There is reference to a water budget for the project which includes evaporative losses (193 acre-feet), but it is unclear how much water will still be in the stream channel 50 miles downstream from the project, at different levels of release. • When water is diverted to Cove Reservoir, spring runoff flows would decrease. T&E fish and Virgin spinedace require higher spring flushing flows to cue spawning and clean necessary spawning habitat. A reduction in spring flows could limit available spawning habitat, thus impacting existing spawning, ultimately reducing population levels. The EA should express what percentage of the total flow in the East Fork Virgin River would be diverted. The extent and effect of decreased spring runoff flows should be analyzed and reported as a potential impact in Table S-4. • The Draft EA does not analyze how much of an increase in flow would be required to reduce temperatures and salinity below Pah Tempe Hot Springs. It is not possible to determine from the document whether the proposed releases from Cove Reservoir would be sufficient to deliver native fish benefits in that reach.

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143	32	11/9/2021	Email	Agency	PLPCO	Sindy Smith	4	Recreation	Sport Fish Cove Reservoir has the potential to become an important recreation offering in a part of the state with limited opportunities for cold water sport fisheries. The State recommends the following points be carefully considered regarding potential recreational benefits associated with the creation of a cold-water sport fishery: • The proposed location of Cove Reservoir is at an elevation where frequent and large drawdowns would occur, which would negatively impact a sport fishery. A conservation pool will be an extremely important component if the fishery and recreation plan is to be successful. Additional analysis is needed to determine the appropriate size for a conservation pool and what the extent and timing of drawdowns should be to produce the desired cold-water fishery. • It is currently unclear if DWR would be interested in contributing financially to a conservation pool at the reservoir. That determination would be made in the future based on the analysis of the necessary conservation pool size and cost and weighed in terms of benefits gained. Additionally, if DWR elected to contribute, DWR would not be able to pay more than the appraised value of the water. It is not clear presently whether the benefits of such a conservation pool would justify the costs. • More detail is needed on the plans for recreational facilities including a boat ramp, such as when would these actions take place, how far into the reservoir the ramp would go, and how many days of the year the boat ramp would be accessible. These details are important for the cost/benefit analysis. • There will also be stocking limitations in this system due to existing agreements. Kane County Water Conservancy District should coordinate with DWR in developing any stocking plans for the reservoir. In summary, the State finds additional analysis is needed to determine impacts to the Virgin spinedace, as well as the claimed benefits to the three T&E species that inhabit the project area. Additional analysis on the requirements needed to establish a conservation pool that would create a sustainable cold water sport fishery would also strengthen the draft EA. For questions regarding these recommendations or any others related to the project, please contact Gary Bezzant, Habitat Program Manager, DWR, via email at .
144	33	4/27/2022	Email	Public		Lauren Nickell	26	Water Resources	I am grateful that the potential decision surrounding Cove Reservoir is open to public comment, as this matter is incredibly dear to me. Years of my life have been spent dedicated to learning about the environment across southwest Utah as a student in hydrology and geology out of nearby SUU. My interest throughout that time has been on the water resources across the four corners region, including the Virgin River. Currently my studies and research are related to understanding how sedimentation impacts downstream reservoir capacity and water quality. It is with this background in mind, in addition to my profound love of this landscape and its various communities, that I ask the National Resources Conservation Service and other project partners to abandon the proposed project as described in both the previous Environmental Assessment and the EIS scoping notice by choosing the No Action Alternative. Further assessment by NRCS is necessary to provide a more robust understanding of the projects downstream impacts. The diminished capacity of the rivers flow for any period of time, in addition to the lack of sedementation, could significantly impact ecological and recreational values downstream of the reservoir. This should include a complete review of different annual hydrograph scenarios, and consider the rivers rate of sedementation in regards to the proposed lifespan of the reservoir. It must also consider what this lack of sedimentation will mean for downstream morphology and the impact on both aquatic populations and vegetation. The project must also consider the long-term feasability of such a costly project. Utah relies heavily on the 130+ reservoirs already established across the state, and the threat that these water bodies face have become increasingly apparent over the prior two decades. Trends towards rainfall over snowfall and a longer window for transitional seasons have resulted in diminished snowpack in many years, and ultimately undermine waterlevels at many reservoirs. Considering another reservoir in the midst of Utah's State of Emergency and record lows at nearby reservoirs, such as the Glen Canyon Dam, blatantly disregards the current trends that have resulted in the southwest's water crisis.
145	33	4/27/2022	Email	Public		Lauren Nickell	26	Health and Safety	In addition to this, an understanding of the proposed threat of upstream disturbance, such as wildfire, must be studied. Fire suppression efforts made throughout the area have resulted in high amounts of fuel in the area, increasing the threat of large, high severity fires occurring. The Stout Creek Fire, which occurred in a watershed nearby the East Fork Virgin River's headwaters, is an example of the threat that fire will continue to present to any reservoir made in this region. In Stout Canyon, the loss of bank stability in a highly erosive canyon primarily composed of sediments from the Claron Formation resulted in rapid channel incision. Any fire that may ignite within, or cross into, the watershed upstream of the proposed Cove Reservoir will likely result in similar rates of sedimentation that can rapidly decrease the carrying capacity of the reservoir. It may also degrade its water quality through nurtrient loading and algal outbreaks, rendering the water inaccessible for many.
146	33	4/27/2022	Email	Public		Lauren Nickell	26	Recreation	In addition to the potential ecological consequences, the varying river flows support the robust recreation of the region that has cemented Utah as an international vacation destination. On the East Fork of the Virgin River’s spring peak flows provide the only possible time of year to go boating. Downstream reaches on the mainstem of the Virgin are very well-known amongst recreators and flows are dependent upon high spring streamflows in the East Fork Virgin River. The project as proposed would have severe environmental and recreational impacts, carries an extreme risk of disturbance, is not economically feasible, and is a misuse of taxpayer money. Thank you for considering my comments on this project.

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147	34	10/31/2021	Email	Public		Craig Wallentine	11	Economics	EIS PROJECT COMMENT #1 - NEPA SCOPING COMMENT FORM – The DEIS should include a provision for the KCWCD and WCWCD project sponsors to absorb at least 50% of all expected cost increases for project construction. The Cove reservoir project has been steadily increasing in cost at each project evaluation. In 2017, the Cove project sponsors were requesting approximately $14MM. Three years later, KCWCD and WCWCD increased their request by 50% to $21MM+ in NRCS Federal taxpayer funds. The DEIS should show a range of future project construction cost scenarios in light of the return of general inflation in the US economy and especially in the material and labor costs in the construction industry. Clearly the Cove project cost is going to increase yet again. The DEIS should include a cost sharing agreement with the project sponsors to be fair to both (a) NRCS Federal taxpayers and (b) to other national NRCS project stakeholders who are seeing over 15%+ of the national NRCS budget consumed by this one Southern Utah proposal. The situation is only going to get worse as the project costs escalate and the project sponsors should share in the burden in order to treat other NRCS stakeholders fairly.
148	34	10/31/2021	Email	Public		Craig Wallentine	11	NEPA Process	EIS PROJECT COMMENT #2 - NEPA SCOPING COMMENT FORM – The DEIS should address why the proposed Cove Reservoir project is so large in comparison to normal NRCS projects and why it should be allocated over 15% of the national budget for the PL 83-566 Watershed Protection and Flood Protection projects. The average size of an NRCS project is approximately $5MM. The DEIS should explain why this project is 4X larger than average NRCS especially since it creates major flood risks where none existed before. The DEIS should also include a listing of the national NRCS projects displaced by funding the proposed Cove project which would absorb more than 15% of the entire national budget for Watershed Protection and Flood Protection. This is critical since the original Cove Environmental Assessment did not achieve breakeven financial return since half of the claimed agricultural land in Washington County had already been converted from agricultural to municipal and commercial use. With less Washington County agricultural land available in the future and with the expected cost escalation, the future Cove project cost benefit ratio will likely be even more negative making alternative and less expensive NRCS projects more attractive to NRCS and federal taxpayers. The DEIS listing should include the respective cost benefit ratios for the displaced NRCS projects around the United States. A simple calculation will likely show that more value is created for American farmers and taxpayers if the NRCS funds smaller, high return agricultural projects versus oversized projects with low or negative returns. The DEIS should also include comments from any Congressional representatives whose constituent's higher return NRCS projects were sacrificed for the Cove project.
149	34	10/31/2021	Email	Public		Craig Wallentine	11	Water Resources	EIS PROJECT COMMENT #3 - NEPA SCOPING COMMENT FORM – The Project EIS should include a detailed discussion of how aridification will impact the Wild and Scenic Virgin River that flows through Zion National Park The original Cove proposal contained minimal facts about the protection of threatened and endangered species in the Virgin River and made essentially no mention of the ongoing aridification of Southern Utah. To avoid preventable errors, the DEIS should include up to date and detailed hydrological data showing the range of water flows across a calendar year in the Wild & Scenic portions of the Virgin River with and without the Cove Project. The DEIS should also discuss the impact of the projected water flows on natural habitat and endangered species and demonstrate that the proposed project will not harm the Virgin River or Zion National Park. Given the increasingly severe impact of aridification, it does not seem likely that there is enough water to meet current water allocations in the first place nor that new water diversions can be done without serious damage to the Virgin River ecosystem.

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150	34	10/31/2021	Email	Public		Craig Wallentine	11	Water Resources	EIS PROJECT COMMENT #4 - NEPA SCOPING COMMENT FORM – The DEIS should include a discussion of the current and future water resources available to meet the 1996 Zion National Park Water Rights Agreement. The entire Colorado River Basin is currently suffering a water crisis because prior water rights agreements either intentionally or inadvertently overstated the amount of water actually available given climatic conditions. The DEIS should address the probability that aridification since 1990 has already reduced the amount of water available in the East Fork Virgin River such that the 1996 Zion National Park Water Rights commitments cannot be met consistently. The DEIS should also assess how aridification of East Fork Virgin River watershed will impact water availability over the 100-year life span of the proposed project. Most scientific estimates of aridification anticipate at least a 5% long term reduction of average water runoff which will reduce supply for current water right holders while eliminating the prospect of diversions for any new projects. If future water flows are only sufficient for current senior water users then water negotiations should be restarted with regards to the actual sustainable diversions in the EFVR watershed in an era of aridification rather than pretending that climatic conditions from 30 years ago will hold 100 years into the future.
151	34	10/31/2021	Email	Public		Craig Wallentine	11	Water Resources	EIS PROJECT COMMENT #5 - NEPA SCOPING COMMENT FORM – The DEIS should include responses from all Colorado River Compact member State Water Engineers with respect to the Cove project diversion of water in the Lower Basin of the Colorado River Compact. The EIS should include comments from State Water engineers in the Colorado River Compact especially Nevada, Arizona and California as the Virgin River is part of the Lower River Basin. The DEIS should also include written input from the other Upper State Water Engineers with respect to this project. It would be useful to outline how many Congressional approvals will be required for this project.
152	34	10/31/2021	Email	Public		Craig Wallentine	11	Tribal and Cultural Resources	EIS PROJECT COMMENT #6 - NEPA SCOPING COMMENT FORM – DEIS should include written input from the sovereign tribes in the Lower Basin of the Colorado River and the State of Utah who have not been receiving their senior water allotments from the Colorado River and who are not receiving the state funds necessary to allow delivery of their senior water rights. The DEIS should include comments from sovereign tribes in the Lower Basin and in the State of Utah as to how the Cove project impacts their senior water rights. The DEIS should also include an official explanation of why federal taxpayer dollars are being used to develop private water rights in the Lower Basin while senior water rights held by the sovereign tribes are not being honored nor serviced by the same Utah state agencies supporting the Cove project.
153	34	10/31/2021	Email	Public		Craig Wallentine	11	Environmental Justice	EIS PROJECT COMMENT #7 - NEPA SCOPING COMMENT FORM – The DEIS should include an Environmental Justice analysis per the National Environmental Policy Act – specifically for the non-privileged and minority residents of Kane County and Washington County, Utah The DEIS should include a comparative financial analysis of who benefits from the Cove project per the White House Council on Environmental Justice principles for environmental justice. Based on information available to date, the Cove project proposes spending $20MM+ of NRCS Federal taxpayer funds almost exclusively for the benefit of wealthy special interests in Kane County and Washington County. The increased asset values for the existing land and water rights owners benefiting from the project will not be shared with the non-privileged/minority/lower income communities. The Cove project appears to provide essentially no new benefits to non-privileged/minority/lower income communities in the project service area. This would not be an equitable or acceptable use of NRCS Federal taxpayer funds The DEIS should include a detailed long-term study of the direct beneficiaries of the NRCS Federal tax- payer subsidy to see how Cove project benefits are actually going to be distributed across all member groups within the greater Kane County and Washington County community. The DEIS should also include a socio-economic analysis of the contractors used during the project construction and how many are owned by non-privileged/minority/lower income principals. Based on the data, the DEIS should include a discussion of how the Cove project could be better designed to deliver the benefits of Environmental Justice to all Kane County and Washington County community members.

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154	34	10/31/2021	Email	Public		Craig Wallentine	11	Economics	EIS PROJECT COMMENT #8 - NEPA SCOPING COMMENT FORM – The DEIS should contain project details on the proposed Garkane Energy hydropower relocation/modernization project as claimed by project sponsors. Such data would allow an accurate public assessment of the feasibility of an EFVR hydropower project to determine if it should actually be part of the NRCS Cove project in the first place. The original Cove proposal contained minimal facts about a proposed hydropower expansion on the EFVR. The DEIS should include the actual project economics, the amount of project funding and sources, the power line routing plans and approvals, outline of the FERC approval process and the project timing commitments directly from Garkane Energy Co-op (named by KCWCD as the project sponsor). In particular, DEIS discussion should include the actual financial benefits of the claimed hydropower generated net of project financing costs with a detailed explanation of how the Garkane Energy hydropower project is connected with NCRS Federal taxpayer spending for agricultural users. This DEIS data is critical because the de-minimis value of the electrical power generation claimed in the original Cove Environmental Assessment could never justify the proposed hydropower project and inclusion in the Cove Project appears to add nothing of value to the NRCS assessment of this project.
155	34	10/31/2021	Email	Public		Craig Wallentine	11	Economics	EIS PROJECT COMMENT #9 - NEPA SCOPING COMMENT FORM – If the Garkane Energy hydropower is to be included in the DEIS, then the DEIS should include an independent study of the most economic power generation options available to Garkane Energy ratepayers over the 100 year life span of the project. NRCS Federal taxpayer funds should not be used to subsidize incidental projects that are not economically feasible in the first place. The original Cove proposal contained minimal facts about the economic competitiveness of a proposed hydropower project on the EFVR. Due to the rapid learning curve as cumulative sustainable energy production increases, there is a steady decrease in the cost of sustainable energy from wind power (available year round not just seasonally); from solar power (also available year round not just seasonally); and potentially, even regional geothermal power from the Milford Utah FORGE project (Frontier Observatory for Research in Geothermal Energy) which would not have diurnal or seasonal time constraints. Over the 100-year Cove project life span, it is almost certain that the incremental cost of energy from these renewable sources will be lower than the proposed, remotely located Garkane Energy hydropower project if they are not already. The value of the DEIS would be greatly increased by comparing the independent long term power cost outlook with that of the strategic energy supply planners at Touchstone Energy, the parent energy co-op for Garkane Energy and discussing any differences of interpretation. If remote hydropower is not cost competitive with alternative sustainable energy sources in the region today or in the future, then there is no value to include a hydropower project as part of the NRCS assessment of the Cove project.

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156	35	4/28/2022	Email	NGO	American Rivers	Michael Fiebig	27	General	American Rivers appreciates the decision that was made to analyze this project through a full EIS. In the letter below, we reiterate and elaborate on the concerns that we conveyed to both Transcon Environmental and NRCS in our previous comments. We respectfully submit the following set of concerns and concerns regarding the proposed Cove Reservoir Project, which could adversely affect the Wild and Scenic East Fork Virgin River, Zion National Park, and the fish and wildlife species that rely on the river. We oppose the proposed reservoir based upon a perceived mischaracterization of the purpose and need of the project as an "agricultural" water supply project, as well as the likely future impacts to flow regime, water quality and quantity, sediment transport, and invasive species proliferation that would result from the project. Such impacts would negatively impact fish and bird species protected under the Endangered Species Act (ESA), and adversely impact the values of two important and iconic protected areas: The Wild and Scenic Virgin River and Zion National Park. We outline these objections below. All of these likely and foreseeable impacts must be analyzed in the EIS. **Introduction** American Rivers is a leading conservation organization working to protect and restore the nation's rivers and streams. Our mission is to protect wild rivers, restore damaged rivers, and conserve clean water for people and nature. Since 1973, we have conserved more than 150,000 miles of rivers through Wild and Scenic River (WSR) designations, dam removals, on-the-ground projects, and advocacy efforts. Our Southwest Regional Program is headquartered in Denver, CO, while our Southwest River Protection Program is located in Durango, CO, Flagstaff, AZ, and Moab, UT. American Rivers' mission is integrally tied to ecosystem health and the protection of Wild and Scenic rivers such as the East Fork of the Virgin River where the Cove Reservoir project is proposed. **Project Overview** The proposed Cove Reservoir Project aims to build a 6,055-acre reservoir on the East Fork of the Virgin River in Kane County, UT, upstream of Zion National Park and the Wild and Scenic Virgin River system. The project proposal claims that it would irrigate an additional 6,068 acres in Kane and Washington counties, using nearly $30 million of taxpayer funds, $22 million (75%) of which would come from the USDA Natural Resources Conservation Service (NRCS). In addition, the project proposes providing reservoir-based fishing, camping and boating recreation, a small hydropower project, and an augmentation of flows for endangered fish and bird species downstream. Concerns with the Proposed Project Which Must be Analyzed in the EIS This proposed project raises a number of concerns for us, enumerated below.
157	35	4/28/2022	Email	NGO	American Rivers	Michael Fiebig	27	General	**1. The proposed project may violate the law, as most of the identified project lands are not agricultural properties, but instead new residential and commercial properties.** Under the proposal, NRCS would provide $22 million of the $29,982,000.00 cost of the project, or approximately 75% of the required funding. The project identifies 6,068 acres of "agricultural" land in Washington and Kane Counties. Closer research of the project area on Google Earth, and then through on-the-ground site visits by a local partner, shows that only 1600 acres of the project area are in fact still agricultural lands. The other 4,468 acres (64% of the project area) are composed of new residential and commercial developments, making this a municipal water project. The Watershed Protection and Flood Prevention Act of 1954 directs the NRCS to not pay more than 30% of project costs for municipal projects,1 yet the NRCS is proposing to pay 75% of the Cove Reservoir project. This must be analyzed in detail and reviewed by NRCS. A municipal project would presumably require a flattened annual hydrograph in order to provide consistent water for homes and businesses, which is contraindicated for native ecosystem health. In addition to the agency taking a close look at the project area, we ask that it undertake a robust flow analysis for the East Fork Virgin River, accounting for both pre-project flows and post-project flows on a month-by-month, annual basis. Since municipal water is in question, we request that subsequent analysis in an EIS also consider conservation measures to meet municipal demands analyzing potential environmental harms and likely economic costs in a least-cost methodology. The fact that the Cove Reservoir Project area has been so drastically raises significant doubts and concerns with the rest of the unsubstantiated ecosystem benefit claims for which the project is purportedly proposed, warranting a hard in the EIS or abandonment of the project altogether.

CID	Doc ID	Received	Type	Group	Entity	Commenter	Commenter ID	Category	Comment
158	35	4/28/2022	Email	NGO	American Rivers	Michael Fiebig	27	Sensitive Species	**2. The proposed project would likely adversely impact two federally listed fish species, the woundfin and Virgin River chub, and one federally listed bird species, the Southwest willow flycatcher.** In 2000, the U.S. Fish and Wildlife Service (USFWS) designated 87.5 miles of the Virgin River, including the East Fork Virgin River confluence, as critical habitat for the woundfin and Virgin River chub, protected under the Endangered Species Act (ESA) in 1970 and 1989, respectively.2 *"Both species have declined in numbers because of loss or degradation of habitat, including channelization, impoundments, loss of water due to diversion projects, and alterations to natural stream flow, temperature, and sediment processes. The introduction and proliferation of nonnative fishes, such as the red shiner, have also contributed to the species' decline."3* Reservoirs have been proven to exacerbate all of the direct causes of native fish species decline listed by USFWS, and Transcom Environmental and the Natural Resources conservation Service (NRCS) must address these issues in the EIS. The claim that the reservoir would "benefit" listed species4 is unsupported and contrary to the proven negative impacts that dams have on the native fish in the Colorado River system. Furthermore, the project proposes the addition of "boating, fishing and camping" facilities at the reservoir,5 but fails to note whether or not the reservoir will be stocked with non-native game-fish species (as is typical), which would be detrimental to the woundfin and Virgin River chub. The project proposal also fails to address the detrimental impacts of severing of fish and wildlife habitat that the physical dam and reservoir themselves would cause in the river system. Drastically altered flows, invasive species and habitat modifications at reservoir sites and along impacted river corridors are precisely the factors that led to the listing of the southwestern willow flycatcher in 1995. A riparian nesting species, the southwestern willow flycatcher, "has declined because of removing, thinning, or destroying riparian vegetation; water diversions and groundwater pumping which alter riparian vegetation; overstocking or other mismanagement of livestock; and recreational development," according the USFWS.6 The EA fails to address how the more managed, altered flow regime from the proposed Cove Reservoir, also directly associated with habitat loss due to non-native species encroachment in riparian areas, could possibly improve the habitat of the southwest willow flycatcher. By all estimation, such a project would further impair its habitat. Due to the potential, adverse impacts to ESA-listed species, we request that the NRCS address the issues above in a full EIS, find that none of the potential harms listed above would occur, or cancel the project.
159	35	4/28/2022	Email	NGO	American Rivers	Michael Fiebig	27	Wild and Scenic Rivers	**3. The proposed project would adversely impact the Wild and Scenic East Fork Virgin River and Zion National Park.** American Rivers is highly concerned about the potential impacts that the proposed Cove Reservoir would have on the Wild and Scenic East Fork Virgin River, the mainstem of the Virgin River, and Zion National Park – all downstream of the proposed project, and not adequately addressed thus far. The East Fork Virgin River was protected under the Wild and Scenic Rivers Act as a "Wild" classified river for its "Cultural, Fish, Geologic, Wildlife and Ecologic" outstandingly remarkable values (ORVs) in 2009.7 The East Fork is an essential part of the 165-mile Virgin River system protected within Zion National Park and an adjacent Bureau of Land Management (BLM) Wilderness Area. The canyons of the Virgin were carved and shaped by the river over the course of 13 million years, essentially tying the habitat and cultural values of these protected areas to the natural flows of rivers such as the East Fork Virgin River. Under Section 7 of the Wild and Scenic Rivers Act (WSRA), projects proposed outside of the Wild and Scenic corridor must not "invade or unreasonably diminish" the outstandingly remarkable values (ORVs), free-flowing character, or water quality of the designated reach, in this case downstream. Considering that 145 miles of the Virgin River system downstream of the proposed project was designated as a National Wild and Scenic River in 2009, NRCS must require a detailed analysis of the proposed Cove Reservoir project under Section 7 of the WSRA. The Virgin River and its tributaries also provide a unique and intact habitat for a number of native fish and wildlife species, including the woundfin, Virgin River chub, Virgin spinedace, flannelmouth sucker, desert sucker, speckled dace, southwestern willow flycatcher, desert bighorn sheep, Mexican spotted owl and the endemic Zion snail. The geologic setting, high flows, large sediment loads, unique water quality and frequent disturbance are effective deterrents to exotic species. Other factors contributing to the productivity of native fish are connectivity to tributary systems and habitat diversity for spawning, rearing and supporting adult fish. Additionally, the Zion stonefly, an important component of the food web and directly linked to both flow regimes and water quality, is found along the Virgin River and its tributaries.8 Potential adverse impacts to these species and values must be addressed in the EIS. The proposed project fails to address the likely negative impacts that Cove Reservoir could have on the ORVs of the Wild and Scenic Virgin River system, Zion National Park, and the fish and wildlife species important to such protected areas. Due to the serious, potential adverse impacts of the project, we request that the NRCS require analyses under the Wild and Scenic Rivers Act and the Endangered Species Act in coordination with the National Park Service and the U.S. Fish and Wildlife Service in the Environmental Impact Statement (EIS) or cancel the project altogether.

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160	35	4/28/2022	Email	NGO	American Rivers	Michael Fiebig	27	NEPA Process	**4. A full Environmental Impact Statement (EIS) is required by the scope and magnitude of the potential impacts of the proposed project.** This controversial project with substantial potential impacts to currently protected landscapes and ESA-listed species on federal public lands, requires the preparation of a full Environmental Impact Statement, including robust coordination and consultation with indigenous Tribes, the National Park Service, and U.S. Fish and Wildlife Service. The National Environmental Policy Act (NEPA) requires federal agencies to prepare a full Environmental Impact Statement before undertaking "major Federal actions significantly affecting the quality of the human environment." CEQ regulations provide direction about evaluating the context and intensity of significant aspects of the project.9 One measure is whether there are "unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas."10 In this case, the proposed dam and reservoir project envisions trading impacts to three ESA-listed species, a Congressionally designated Wild and Scenic River, and Zion National Park for an increase in irrigated agriculture, municipal water with unproven need, and reservoirbased recreation, costing nearly $30 million. The project fails to provide evidence of the need for more irrigated agriculture, more municipal water, or increased reservoir-based recreation in the region, and fails to address potential impacts to the three ESA-listed species and two protected areas. The Cove Reservoir Project clearly requires analyses of these issues under the criteria provided by NEPA. We thank the NRCS for requiring this analysis, and the hard look into the issues that we list here that it requires.
161	35	4/28/2022	Email	NGO	American Rivers	Michael Fiebig	27	Climate Change	**5. Aquatic resources and climate adaptation.** The protection of aquatic resources, including wetlands, riparian areas, and water quality and quantity, rank among the most critical issues to be addressed in any NEPA analysis for potential development, particularly in the Colorado River Basin, where so few free-flowing rivers remain and climate change is expected to decrease river flows 20-30% by 2050.11 Activities resulting from the proposed Cove Reservoir Project have the potential to adversely impact aquatic resources, including wetlands, streams, riparian areas, and their supporting hydrology. Since the proposed project may ultimately result in adverse impacts to aquatic resources, the NRCS must pay particular attention to ensuring a robust treatment of the issues in the EIS, including an assessment of cumulative impacts. Our rapidly warming climate is causing dramatic changes in the landscapes, habitats, and hydrology of the Colorado River Basin. Retaining intact river corridors and unfragmented habitat is crucial to any adaptation strategy in the face of climate change. The EIS must analyze potential impacts to the ability of species that use the public lands and rivers upstream and downstream of the proposed project to adapt to future shifts in hydrology and habitat owing to climate change if the construction of Cove Reservoir is allowed to go forward. Likewise, The EIS must take into consideration the 100-year projected hydrology of the East Fork Virgin River under climate change, how much water is projected to occur in the river, and what potential future depletions could do to the values and natural resources of the Virgin River downstream, many of which are protected under federal law.
162	35	4/28/2022	Email	NGO	American Rivers	Michael Fiebig	27	General	**6. Documentation of FERC hydropower exemption needed.** Finally, the original project briefly mentioned an off-site hydropower project, which may be exempt from permitting and regulation under the Federal Energy Regulatory Commission (FERC) due to its size, though details of the project were slim. If such an exemption has been received from FERC, the analysis should both cite it and provide the documentation in an appendix. If this hydropower component is still a part of the project proposal, it must also be analyzed for potential impacts in the EIS.
163	35	4/28/2022	Email	NGO	American Rivers	Michael Fiebig	27	General	**Conclusion** Reiterating many of the points from our previous letter and due to the reasons articulated above, American Rivers supports the "no action" alternative for the proposed Cove Reservoir Project in the EIS, requiring the project to be abandoned altogether. The proposed project would have myriad adverse effects on fish, wildlife, cultural sites, and federally protected areas. In addition to analyzing the issues we have discussed here, we expect the NRCS to require documentation of robust consultation and coordination with potentially effected indigenous Tribes, the National Park Service, and the U.S. Fish and Wildlife Service.
164	36	4/23/2022	Email	Public		Barry Sochat	7	General	As a long time resident of Rockville, Utah, I am reliant on waters from the Virgin River for both culinary and agricultural usage. I am particularly alarmed by the frequent outbreaks of deadly bacterial algae during the low river flows and how any upstream diminution of flow will further worsen the water quality of the North fork of the Virgin River. Please enter all concerns into the official record for the Cove Reservoir Project DEIS, to wit:
165	36	4/23/2022	Email	Public		Barry Sochat	7	Climate Change	1. Study existing megadrought conditions and the current modeling for the future of water supplies in the region driven by climate change and determine if this project is sustainable.
166	36	4/23/2022	Email	Public		Barry Sochat	7	Alternatives	2. Suggest that federal agricultural funding might best be used to help farmers in Kane and Washington counties transition to climate and sustainable smart agriculture. There are a variety of new agricultural technologies including remote sensing technology that can result in using less water and increasing yield. These are practices that are beginning to be used world-wide. A cost-effective study should be completed comparing the cost of arming farmers with new technologies vs. the cost and environmental impact of constructing and maintaining the Cove Reservoir.

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167	36	4/23/2022	Email	Public		Barry Sochat	7	Cumulative Effects	3. Analyze the direct, indirect, and cumulative impacts of eliminating high flows on both the East Fork and the Main Virgin as it relates to the hydrologic connection of both ground and surface water. Changing river flow levels forever could hinder how the aquifer is recharged along with permanently decreasing the flow of surface water downstream of the project area.
168	36	4/23/2022	Email	Public		Barry Sochat	7	Sensitive Species	4. Study the history of what caused the endangered fish in the Virgin to become imperiled in the first place and evaluate how further reducing perennial flows will further complicate the effort to save these species. Changing the historical flows are likely to have an impact as well on the entire riparian zone along the river. This must be carefully evaluated.
169	36	4/23/2022	Email	Public		Barry Sochat	7	Water Resources	5. Complete an analysis of ecosystem health of the Virgin River watershed with attention to how using more fertilizer for agriculture affects downstream water quality.
170	36	4/23/2022	Email	Public		Barry Sochat	7	Water Resources	6. Complete an analysis of the complete Virgin River watershed and how water supplies and quality may be affected in Arizona and Nevada as the Virgin River watershed is technically in the Lower Basin drainage.
171	36	4/23/2022	Email	Public		Barry Sochat	7	Water Resources	7. Analyze and evaluate the water rights that the irrigation companies are using to build the project. Current records show these water rights are being protested by other water users.
172	36	4/23/2022	Email	Public		Barry Sochat	7	Economics	8. Calculate the cost/benefit ratios for the 100-year life of the project.
173	37	2/4/2022	Email	Public		Martha Ham	28	General	I am following the Cove-East Fork Virgin Watershed Project-Kane County, Utah. I received the public scoping notice in the Fall of 2021 and was notified of several meetings. I never saw the scoping comment period open. What can you tell me about the status of this project?
174	38	10/14/2022	Email	Public		Jane Whalen	3	NEPA Process	Is the Cove reservoir project the same as the design in the EA? Will the new description of the project be available for the up coming meetings? Thus far, there is little information on the new project plan so that will make it hard to write any constructive scoping comments. Thanks so much for taking the time to respond.
175	39	4/13/2022	Email	Public	The Spectrum	Sean Hemmersmeier	29	NEPA Process	My name is Sean Hemmersmeier, I'm a reporter for The Spectrum in St. George. I'm following any updates that happen with the Cove Reservoir project. I recently got sent an email about the public scooping period for the project is closing soon and I've visited the NRCS project website and am a little confused by the timeline for the project so I'm one of you can answer some questions I have. On the NRCS website it says the scoping public comment period opens on Apr. 28 and will close 30 days after a NOI is published but the email I got today says the Apr. 28 is the deadline for comments. So I just wanted to clarify when the comment period for the scoping portion of the project would end, is it Apr. 28? When this comment period ends what are the next steps for the Environmental Impact Statement for the Cove Reservoir project to be completed? How long will it take finish the EIS and when would you expect the EIS to be made public?
176	40	4/26/2022	Email	NGO	Conserve Southwest Utah	Jane Whalen	3	General	Please accept and fully consider these comments from Conserve Southwest Utah (CSU). CSU is a nonprofit 501(c)(3) organization based in St. George, Utah, advocating for the conservation of Southwest Utah's natural resources and was established in 2006. CSU worked hard to help pass the Omnibus Public Lands Management Act of 2009 (P.L. 111-11). It designated the Red Cliff and Beaver Dam Wash National Conservation Areas and Wilderness Areas in Washington County. It also designated approximately 165.5 miles of the Virgin River and its tributaries across federal land within Zion National Park (28 segments) and adjacent Bureau of Land Management Wilderness (11 segments) as part of the National Wild and Scenic Rivers System. Many CSU members and supporters live near, recreate in, and value Zion National Park. CSU's supporters include more than 2,500 individuals. These lands provide critical habitat and unique opportunities for sightseeing, hiking, camping, trail running, mountain biking, appreciation of archaeological resources, natural quiet, journaling, birdwatching, ecosystem research, photography, and more. These lands are the traditional homelands of Native Americans, including the Paiute Tribe. Our vision is that Southwest Utah grows in a manner that enables the conservation and restoration of its natural and cultural resources. Our mission is to advocate for conservation and stewardship of our area's natural and cultural resources and implement the Smart Growth policies that enable conservation for the benefit of present and future generations.

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177	40	4/26/2022	Email	NGO	Conserve Southwest Utah	Jane Whalen	3	General	I. Introduction The East Fork Virgin River is a small stream of critical significance. Conserve Southwest Utah (CSU) is concerned that the Cove Reservoir Project (Project) will permanently change the river's natural flow and disrupt this already fragile riparian ecosystem. In the face of rapid climate change, and in megadrought conditions, the Project would cause and greatly exacerbate changes in the timing, amount, and natural flow of the East Fork that would, in turn, negatively impact the plants, fish, wildlife, and interconnected ecosystems they all depend on to survive. There are only two rivers designated as Wild and Scenic in Utah: Sections of the Green River and the Virgin River that runs through Zion National Park. The East Fork of the Virgin River is designated as Wild under the Wild and Scenic Rivers Act, where it flows through Zion National Park. Protecting and preserving this Wild designation has both practical and legal significance. The Project would likely alter water flows in this area, and changes in flow rates will adversely affect the values that underlie the Wild qualities of this delicate river. Changes in the natural flow patterns, particularly during the summer months, may negatively impact the visitor use in the famous slot canyons of the Bureau of Land Management's Parunuweap Canyon Wilderness Area (WSA) of 30,800 acres. The WSA boundary is located near the project area, and downstream of the gravel pits needed to build the 90-foot-high earthen dam. The East Fork Virgin River runs through the proposed Wilderness Study Area—an area that should remain wild. Unfortunately, the NOI lacked detailed and essential information regarding the proposed Cove Reservoir Project. We contacted the applicable agencies to verify whether the Project design was the same as in the 2020 Plan-EA, because some water would be diverted to agricultural fields in Hurricane. We received no clear answer and concluded that the scoping period should have been postponed until the details of the Project were determined. Therefore, we relied on the Project's description in the 2020 Plan-EA to make scoping comments on this Project. CSU will include sections from our previous comments on the 2020 Cove Reservoir Plan-EA for our scoping comments. Where applicable, the section from the Plan-EA receiving a comment is identified by the section number and title. The quoted text is italicized and indented. CSU's comments follow.
178	40	4/26/2022	Email	NGO	Conserve Southwest Utah	Jane Whalen	3	Purpose and Need	II. Purpose and Need The Draft Environmental Impact Statement (DEIS) must include an evaluation of the validity of water rights for the 100-year life of the Project in the purpose and need. The water availability for the reservoir would undermine the Project's ability to supply water to agricultural uses and generate power. Therefore, the availability of water supply is directly related to the Project's purpose and must be disclosed. The ability of the Kane County Water Conservancy District (KCWCD) to capture the water from the eleven subbasins above the dam to fill the reservoir must be verified. Due to increasing temperatures and less precipitation, it is unclear whether there would be enough physical water in East Fork Virgin River to sustain the reservoir over the 100-year life span of the Project. A study needs to be conducted regarding how much physical water there is flowing in the East Fork and from the drainage up-gradient to the dam. As water supplies decline as expected, the DEIS must determine who has the priority water right to use it over the Project's 100-year life span. The DEIS must also calculate how much water would remain in the Virgin River between the diversions and withdrawals for the Project and where the critical aquatic species need it. These species include macroinvertebrates, which are the basis of the aquatic food chain. This is a critical analysis to include in the DEIS. From: 40 CFR 1500.1 Purpose and Policy (b): NEPA procedures are intended… "…to ensure that relevant environmental information is identified and considered early in the process in order to ensure informed decision making by Federal agencies. The regulations in this subchapter are also intended to ensure that Federal agencies conduct environmental reviews in a coordinated, consistent, predictable and timely manner, and to reduce unnecessary burdens and delays." The DEIS must provide the public and decision makers with adequate, clear, and high-quality scientific analysis of the impacts of the Project on the environment.

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179	40	4/26/2022	Email	NGO	Conserve Southwest Utah	Jane Whalen	3	Wild and Scenic Rivers	III. East Fork Virgin River Designated Under Wild and Scenic Act The East Fork of the Virgin River corridor shelters one of only two designated Wild and Scenic Rivers in the state. It is not only congressionally designated as a Wild and Scenic River but is also designated as a Research Natural Area. The DEIS must analyze the direct, indirect, and cumulative impacts of the Project's water diversions and withdrawals on the ecosystem health and hydrologically connected flows applicable to this designated wild segment of the East Fork of the Virgin River. CSU is concerned that flows will be altered and adversely affect the wild character of the river, in violation of the Wild and Scenic Rivers Act (WSRA). Plan-EA, 2.6 Wild and Scenic Rivers, page 17: *"The East Fork Virgin River enters Zion National Park approximately 20 river miles downstream and southwest of the proposed project area. The river flows through the Park from the east boundary to the west boundary. This portion of the river has been designated as wild under the Wild and Scenic Rivers Act (National Wild and Scenic Rivers System 2018). This designation means that the river is free of impoundments and generally inaccessible, except by trail, and includes watersheds or shorelines that are essentially primitive with waters unpolluted, representing vestiges of primitive America. Outstandingly remarkable values (ORV) associated with this stretch of the river include cultural, geologic, ecological processes, wildlife, and fish. Additionally, the East Fork Virgin River was designated as a Research Natural Area in 2001. The area has been set aside for research purposes and is closed to recreation (NPS and BLM 2013)." (Emphasis added)* The DEIS must include the East Fork Virgin River's Outstandingly Remarkable Values (ORV). Federal agencies' are obliged to protect these values in a designated Wild and Scenic River.
180	40	4/26/2022	Email	NGO	Conserve Southwest Utah	Jane Whalen	3	Wild and Scenic Rivers	IV. FERC Restrictions on Hydropower Plants above a Wild and Scenic River *"In addition to using reserved water rights to protect the flows of designated rivers, the WSRA provides protection for a designated river by limiting the licensing of dams, reservoirs, and other water project works on, or adversely affecting, protected segments. The WSRA prohibits the Federal Energy Regulatory Commission (FERC) from licensing "the construction of any dam, water conduit, reservoir, powerhouse, transmission line, or other project works under the Federal Power Act ... on or directly affecting any river" designated as part of the national wild and scenic rivers system. Likewise, no other federal agency may "assist by loan, grant, license, or otherwise in the construction of any water resources project that would have a direct and adverse effect on the values for which [a designated] river was established." The prohibitions on water and power projects are very broad in the WSRA. The prohibitions generally limit federal agencies from recommending authorization of such projects, or appropriations to begin construction on such projects, that would have an adverse effect [sic] on the purpose of the designation". (Emphasis added)*
181	40	4/26/2022	Email	NGO	Conserve Southwest Utah	Jane Whalen	3	ACEC	V. East Fork Virgin River Designation as Parunuweap Canyon Wilderness Study Area The Bureau of Land Management has designated 30,800 acres of the East Fork Virgin River watershed as part of the Parunuweap Canyon Wilderness Study Area.1 This designation holds both historic and legal significance. The historic significance includes honoring the explorations of the East Fork Virgin River by John Wesley Powell, Stephen Jones, and Joseph Young in 1872. The DEIS must take a hard look at the direct, indirect, and cumulative impacts of the proposed projects altering hydrologically connected flows through this designated area. With that, the DEIS must determine the impact of the proposed Project on this designation. This includes, among other things, analyzing the impact of the Project's release of more water in the summer for downstream irrigation on visitor use in the slot canyons.
182	40	4/26/2022	Email	NGO	Conserve Southwest Utah	Jane Whalen	3	Water Resources	VI. Analyze Water Rights for Proposed 100-year Project In the DEIS, the agencies must holistically evaluate the water rights in the Virgin River Watershed. It must disclose all water rights to the East Fork Virgin River and identify those which can depend on those rights over the long term as water supplies decline. The KCWCD claimed in the 2020 Plan-EA that the only water being stored in the reservoir would be from the irrigation water rights of Orderville, Mount Carmel, and Glendale irrigation companies. However, the proposed reservoir has a 6,055 acre-feet capacity, much more water than the canal companies have water rights to. Table 1 shows water rights held by the three irrigation companies that would receive water from the reservoir. Table 1 also shows that each of these irrigation companies' water rights is being protested. An analysis of the potential impact of possible results of the protests on the amount of that water for or from the reservoir needs to be addressed and disclosed in the DEIS. Further, the 2020 Plan-EA didn't describe how much water would be counted as depletion and how much water would be counted as a return flow. These issues must be analyzed and disclosed in the DEIS. SEE TABLE OF RIGHTS CSU notes that the river's average flow between November and March is 17 CFS at the Glendale USGS gage # 9404450. Table 1 points to the problem of the over-allocation of diminishing resource water; new binding agreements would be needed to protect the ecosystem health for the imperiled Virgin River fishes of the East Fork of the Virgin River and still provide water to the irrigation companies. The planned reservoir requires too much water from a small stream; it would diminish the river's natural flow and negatively affect the fragile natural ecosystem of the East Fork.

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183	40	4/26/2022	Email	NGO	Conserve Southwest Utah	Jane Whalen	3	Water Resources	The KCWCD also wants to capture runoff from the 4.7 square miles of watershed behind the dam. However, Utah's water law does not allow the enlargement of the existing water rights of the canal companies. The Plan-EA failed to determine the amount of surface flows that the reservoir and dam would block. The amount of water use allowed in this region is limited. Based on how many water use depletions are accruing in the region, none of this critical information on depletions and return flows was in the 2020 Plan-EA; therefore, it should be in the DEIS. CSU is concerned that the project diverts water from the East Fork in two ways; building a dam to contain runoff from 4.7 square miles in eleven subbasins that would normally flow to the East Fork plus the diversion of mainstem East Fork flows into the reservoir. Both of these withdrawals from the East Fork watershed disrupt the river's natural flow, and neither is adequately analyzed in the Plan-EA and must be evaluated in the DEIS. The DEIS should complete a water rights assessment mentioned in a Washington County Water Conservancy District (WCWCD) letter of June 20, 2018, requesting a study to determine whether the Project would harm WCWCD's water rights. They wrote: "the Project must evaluate the proposed reservoir and its function on the district's ability to capture and store water within its existing rights. Any negative impacts to existing rights and uses in the basin must be addressed to the satisfaction of the district." The DEIS should disclose what WCWCD's water rights would be used for the Project and how much water from the Project they will receive. The DEIS must analyze: 1. whether the irrigation companies have a right to store the water up-gradient from the proposed dam at a different diversion point; and 2. whose water rights will be used to fill the reservoir; and 3. what will be the amount of runoff water expected per year; and 4. who has rights to this water (if anyone)
184	40	4/26/2022	Email	NGO	Conserve Southwest Utah	Jane Whalen	3	Water Resources	VII. Analyze Whether Utah has Adequate Water for the Project Utah's Colorado River water right is not fixed; it is a percentage. Under the Colorado Compact, it is 23% of 15-million-acre feet a year (MAFY) after other senior water rights are met, including abiding by the compact agreements with the Lower Basin States and the treaty with Mexico. But due to a warming climate, water supplies are declining, and Utah no longer has as much water left to use. The DEIS must analyze how many water use depletions remain undeveloped in this region that the Project can use. The problem is the state estimates it could still develop 1.4 MAFY of depletions in its compact allocation, but they are basing this on a higher flow of 15 MAFY, whereas the annual flow has been much less at about 12.5 MAFY or less. Consequently, the state will have to use less water and there may not be water left for this Project. The DEIS must comprehensively analyze this issue to determine whether this proposed diversion complies with the Colorado River Compact. The States of Arizona and Nevada also hold water rights in the Virgin River watershed downstream of the Project that needs to be included in the DEIS's water availability analysis for the Project.
185	40	4/26/2022	Email	NGO	Conserve Southwest Utah	Jane Whalen	3	Climate Change	VIII. Evaluate Critically the Impact of Climate Change on the Project CSU has mentioned in these comments that the Project may not be viable in a few years. The DEIS must use the best available science to assess the East Fork Virgin River's existing and future conditions after climate change impacts on the Project. The DEIS should determine what the flows in the East Fork of the Virgin River need to be to keep it functioning for the 100-year life span of the Project. One study on climate impacts on reducing Colorado River flows concluded a significant risk of permanent flow reduction in the Colorado River Basin of 30% by midcentury.2 Similarly, another study explains the impact of "unprecedented basin-wide warming" températures on increased precipitation and plant water use, decreasing runoff, reduced snowpack, and the overall reduction of Colorado River flows.3 In that context, CSU is concerned with the prudence, viability, and sustainability of this Project and requests that the DEIS research and disclose all pertinent evidence. Further, the DEIS must consider other studies that forecast lower flows in the East Fork of the Virgin River predicted by 2050, ranging from -7 percent to -27 percent4 and -14 percent to -31 percent.5 Courts characterize NEPA's procedural requirement as obliging agencies to take a "hard look" at the environmental consequences and alternatives.6 This information must be rational and disclosed to the public before final decisions are made. NEPA emphasizes informed decision-making based on the best science available. Thus, the DEIS must provide a thorough climate change impact analysis that "presents the environmental impacts of the proposal and the alternatives in the comparative form [and] sharply define the issues and provide a clear basis for choice among options by the decision-maker and the public."7 Moreover, the DEIS must follow NEPA regulations 40 CFR § 1500.1(b).

CID	Doc ID	Received	Type	Group	Entity	Commenter	Commenter ID	Category	Comment
186	40	4/26/2022	Email	NGO	Conserve Southwest Utah	Jane Whalen	3	Sensitive Species	IX. Analyze Impacts Regarding Imperiled Virgin River Fishes The DEIS must include an analysis of the proposed Project on native fishes, including the Virgin spinedace, desert sucker, and speckled dace. The Virgin spinedace Conservation Agreement was not considered in the 2020 Plan-EA, though it is part of the Virgin River Resource Management and Recovery Program (Program). The Virgin River Resource Management and Recovery Program (Program) establishes a multi-agency cooperative program of the United States Fish and Wildlife Service (USFWS), Bureau of Land Management (BLM), National Park Service (NPS), Utah Department of Natural Resources (UDNR), and the Washington County Water Conservancy District (WCWCD). Two goals have been defined for the Program. These goals have been developed from the objectives, actions, and tasks outlined in the Virgin River Fishes Recovery Plan (VRFRP), the Virgin Spinedace Conservation Agreement and Strategy (VSCAS), and the Virgin River Management Plan (VRMP). These goals include Goal 1: Implement actions to recover, conserve, enhance, and protect native species; and Goal 2: Enhance the ability to provide adequate water supplies for sustaining human needs. The Virgin spinedace, desert sucker, and speckled dace, were considered imperiled aquatic species and are in the river reach of East Fork Virgin River. The Spinedace Conservation Agreement was developed to expedite measures that have been identified by the USFWS and the Utah Division of Wildlife Resources for the continued existence and conservation of Virgin spinedace (Lepidomeda mollispinis mollispinis), flannelmouth sucker (Catostomus latipinnis), desert sucker (Catostomus clarki), speckled dace (Rhinichthys osculus), and the southwestern toad (Bufo microscaphus). Implementation of the Program will also reduce threats to these species that might otherwise warrant listing as a sensitive, threatened, or endangered species. NRCS must consider the Virgin Spinedace Agreement in the DEIS. The 2020 Plan-EA included a reference to the "East Fork Virgin River Instream Flow Memorandum of Understanding (MOU)" between Kane County Water Conservancy District, Orderville Irrigation Company, UDWR, and USFWS. This MOU discusses an agreement between the parties regulating water flows on the East Fork Virgin River (KCWCD 2001; Appendix E). The DEIS must analyze and update this MOU. It should be updated as an agreement of the proposed operation of the Project and include protection to flows for the Virgin spinedace, desert sucker, and speckled dace, the imperiled Virgin River fishes. CSU requests a copy of "The East Fork Virgin River Instream Flow Study March 2001" by Watershed Systems Group of Logan, Utah, which was the basis of the study. The DEIS must include: 1. Hydrological analyses of the water for the fishes needs to be based on the best available science; and 2. A direct assessment of the reliability of the Project to protect the flows for the benefit of imperiled Virgin River fishes for the life of the project; and 3. An analysis detailing how the lower flows will directly affect the natural resources of ecosystems that the fish rely on to survive; and 4. Incorporate the cumulative effect of the Quail Lake Diversion withdrawals from the Virgin River on the imperiled Virgin River fishes.
187	40	4/26/2022	Email	NGO	Conserve Southwest Utah	Jane Whalen	3	Effects Analysis	X. Analyze Impacts Regarding Highly Erodible Soils in Project Sites The DEIS must assess the direct, indirect, and cumulative impacts of discharge on water quality and the impact to fish and water quality from sediment. The dry drainages above the proposed Cove Reservoir dam are very deep and show evidence of substantial erosion, presumably because of the geology and the topography. Further, it mush analyze how much water could be lost to seepage beneath the reservoir. The DEIS must include essential information on how the Waters of the United States will be protected and managed and who holds the water rights from these drainages. Given the highly erodible soils above the reservoir, the DEIS must include an analysis of how fast the reservoir's storage will be diminished by silt. Further, the DEIS must contemplate the risks of, since these soils are highly erodible, making an earthen dam out of these soils and the associated risk of failure in a heavy rainstorm. Additionally, the DEIS must analyze whether the proposed secondary spillway will survive an overflow event, as it is an earthen structure (trapezoidal earthen channel 1,070 feet long and 30 feet wide).
188	40	4/26/2022	Email	NGO	Conserve Southwest Utah	Jane Whalen	3	Water Resources	XI. Analyze Impacts Regarding Riparian Water Resources The DEIS must analyze the degree in which the Project will reduce high water flows away from the current riparian zone, significantly changing the existing ecosystem. The DEIS must document the existing conditions of the baseline health of the watershed's ecosystem and determine whether its current state is deemed healthy or distressed. The North Fork Virgin River fails to meet healthy water quality standards because of over-grazing. More agriculture, coupled with increased use of fertilizers, will likely worsen the East Fork watershed exacerbating water quality problems. The Virgin River watershed is shared by two other states, Arizona and Nevada, and each state depends on return flows and values water quality. This watershed analysis must also consider the direct, indirect, and cumulative impacts on downstream water rights holders. Further, the DEIS must include floodplain models and analyze how they would be affected by reduced winter flows.

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189	40	4/26/2022	Email	NGO	Conserve Southwest Utah	Jane Whalen	3	Water Resources	XII. Analyze Impacts Regarding the Hydrologic Connection of Ground and Surface Water Groundwater is the foundation on which all surface water rests, including the East Fork Virgin River. Water flow toward the discharge area can take days, weeks, months, years, decades, centuries, or millenia depending on the distance of flow from recharge to discharge area. Understanding how, when, and where discharge and recharge occurs is essential information to ensure that all hydrologically connected withdrawal and diversion are conducted in a sustainable manner to maintain this precious resource over time. The DEIS must include the exploration, monitoring, and analysis of the East Fork Virgin River groundwater resources to understand the hydrologic connection of ground and surface water and, in that context, detail and disclose the direct, indirect, and cumulative impacts of the proposed Cove Reservoir Project. The DEIS must include information essential to make a reasoned choice among alternatives—including, but not limited to, hydrologic connection models. A conceptual model must reflect the physical system and the operational or management features. With that, the information must disclose existing data for the system, including how many years data was available. The modeling experts must reduce the conceptual model into a numerical and computer model by either using 1) field data; and 2) the establishment of dimensions of time and space units. The information must consider whether the model adequately describes the system and disclose the levels of uncertainty related to predictions quantified and attributed to various sources beyond simply the error rate of calibration data.8
190	40	4/26/2022	Email	NGO	Conserve Southwest Utah	Jane Whalen	3	Effects Analysis	XIII. Analyze Impacts Regarding Borrow Pits The Plan-EA, Table S-4, provides context for this section under; Summary of Resource Concerns and Potential Environmental Impacts, page S-5, et seq. Water Resources, Water Resources (surface water quality and quantity: *"Construction activities would occur in drainages and near water sources. Two potential borrow pit sites would be accessed by crossing the East Fork Virgin River on existing dirt roads. Use of the third borrow site would not affect any water resources. Storage of surface water would provide additional water for summer irrigation and recreation. Interception of ephemeral floodwater could occur. Construction activities near water areas could result in short-term water quality reduction…"* It will take three years to build the proposed Project, and the Plan-EA described reductions in reservoir volume resulting from sedimentation. Still, the Plan-EA did not consider the impacts of the heavy equipment that will have to cross the East Fork Virgin River and gather material on the other side of the river from two existing borrow sites to provide gravel and riprap for the proposed project 90-foot high earthen dam. The sentiment load in the East Fork will likely be significantly increased. The amount of material to build the dam and reservoir is estimated to be 4,360,000 cubic yards—which is about the same as the volume of concrete used to build the Hoover Dam and power plant.9 The roads and materials are also located in an area with highly erodible soils that could degrade water quality downstream. The DEIS must analyze how this Project affects the wilderness values of the Bureau of Land Management's Parunuweap Canyon Wilderness Study Area (WSA) (30,800 acres) downstream of the Project. The Plan-EA revealed that the trucks must drive through the East Fork of the Virgin River to access Lamb's Pit and Tait Pit, two of the gravel pits it relies on, but it fails to assess the sedimentation associated with that disturbance. Consequently, if it takes three years to build the Project, the impact on the river's water quality will likely be significant. The DEIS must analyze Borrow pit impacts by: 1. estimating the amount of material from each pit. Table 11 in the Plan EA only gives amounts of types of material; and 2. describing how to minimize dust when accessing borrow pits, p. 32 et seq. (total disturbance ~75 ac, total 4,319,000 cu yd removed), and over 7 miles of dirt road along Glendale Bench Road; and 3. analyzing the impact of sedimentation from extracting material from the borrow pits on the values of the Bureau of Land Management's Parunuweap Canyon
191	40	4/26/2022	Email	NGO	Conserve Southwest Utah	Jane Whalen	3	Economics	XIV. Analyze KCWCD and WCWCD Potentially Misleading for Better Funding The DEIS must analyze whether the proponents are misleading the public and whether the Districts' misuse of these funds is allowed under the NRCS Watershed Flood Prevention and Protection Program (PL83-566). According to an article in the Spectrum newspaper,10 the project proponents admit they do not have to continue to use the water for agriculture if they just declare that they are using it now for agriculture. It seems the proponents want to get the better terms for funding an agricultural project, all the while intending to use the water for municipal purposes. For example, the DEIS must include the information that KCWCD anticipates rezoning along the access roads around the reservoir to allow property sales and homes to be constructed along the access road to help finance the Project. The Plan-EA said, "The pipeline would be an 8-inch line with fire hydrants located every 500 feet." This is a requirement under the fire code for building homes. Thus, NRCS funding would be used for municipal development, not agricultural development. Further, KCWCD claims they have already spent $2 million building the Project piecemeal without environmental review of being a part of a larger project. The property for the reservoir was purchased, a pipeline was built double its original size from the proposed reservoir to the Orderville diversion, and they participated in the Orderville diversion. They applied for the NRCS grant in 2017, and three years later, in 2020, the Project completed a watershed plan and an environmental assessment omitting this key information. They left these vital components out of the environmental review of the 2020 Plan-EA, and they must be evaluated in the DEIS.

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192	40	4/26/2022	Email	NGO	Conserve Southwest Utah	Jane Whalen	3	Alternatives	XV. CSU Proposes Another Alternative to be Studied in the DEIS The other alternatives proposed to be studied in the DEIS were only about different dam sites and not the proposed purpose of the Project being the need for water for growing more alfalfa on the farmers' existing fields. As mentioned in our comments, CSU is concerned that the proposed Project is not viable over the long term due to the foreseeable reduction of future water supplies because of a warming climate. This Project was envisioned many years ago, and since then, circumstances have changed significantly due to the ongoing and projected diminishing water supplies. CSU proposes another alternative that should be studied in the DEIS that could focus precious funds on better agricultural practices to conserve water in preparation for expected changes in precipitation patterns, such as, but not limited to, using smart technologies such as metering all agricultural water use and using satellite technologies. For instance, Alfalfa and Forage Specialist at UC Davis Dan Putman concluded that: *"While alfalfa holds some important advantages in terms of water use efficiency and water management, there is no question that the alfalfa industry needs to envision improvements in irrigation management and WUE [water use efficiency] for a water-scarce future. These long-term strategies include 1) improving yields through genetic and crop management methodologies, 2) Changing irrigation technology where appropriate and optimizing system performance in all systems, and 3) Improving water management monitoring systems to more closely estimate and match crop water demand with applied water."* He continued, "[e]nvisioning more water-use efficient systems is critical to meeting future needs for forage crops in a more water-limited future."11 CSU shares Dan Putnam's vision for improvements in irrigation management for water conservation in the face of a water-scarce future. The proposed Project draws serious concerns. The DEIS must take a hard look at this feasible and reasonable conservation alternative—using the best available science to assess the East Fork Virgin River's existing and future conditions and closely consider climate change impacts. In considering this and other alternatives, all essential information must be rational and disclosed to the public before final decisions are made. Additionally, the No Action alternative should describe existing conditions in detail and how they will be improved or impacted by the proposed alternative.
193	40	4/26/2022	Email	NGO	Conserve Southwest Utah	Jane Whalen	3	Effects Analysis	XVI. Conclusion The DEIS must complete the analyses begun in the prior Plan-EA to address the in-depth and long-term impacts of this project on the environment. That analysis must include additional reasonable alternatives such as that suggested above.
194	41	4/20/2022	Email	Public		Brian Behle	30	General	As an outdoor enthusiast and native Utahn I ask you support the no action alternative regarding the Cove Reservoir proposal. Farming is important, however, this planned reservoir for irrigation is deeply flawed. It risks degrading the amazing attraction of the Virgin River, so important to local tourist dollars and all Americans' enjoyment of our national treasures. We have thousands of better alternatives to grow more crops in the U.S. Thank You, Brian Behle
195	42	4/22/2022	Email	Public		Jason Costa	31	General	I grew up in Utah, fishing and paddling the rivers across the state. This project threatens delicate ecology and ecosystems, and puts natural resources at risk. It is also a tremendous waste of taxpayer money. Please keep the Virgin River wild and scenic, and select the NO ACTION option on Cove Reservior.
196	43	3/4/2022	Email	Public		Richard Spotts	1	NEPA Process	I would appreciate answers to the following questions related to the above-referenced proposed NRCS project. 1) Will or may this proposed project receive any of the recently approved USDA infrastructure funding for new flood control projects? Please see the related article at this web link: https://www.eenews.net/articles/usda-emphasizes-flood-control-in-face-of-climate-disasters/ 2) Why has the required Notice of Intent (NOI) for this forthcoming Environmental Impact Statement (EIS) not yet been published in the Federal Register (it was announced last October), and what is the NOI's current status or expected date of publication? 3) When it is published, will the NRCS NOI include a description of the draft agency purpose and need statement that would be subsequently used to determine which alternatives should be carried forward for detailed EIS analysis? If so, would this statement be consistent with and help advance the Biden administration's executive orders and policies relating to responding to the climate and extinction crises, and encouraging more sustainable and efficient uses of water? I look forward to your answers.
197	44	4/15/2022	Email	Public		Dave and Jolene Clark	15	Watershed Protection	*Norm Evenstad had a phone conversation with Jolene Clark regarding flood protection improvements at their property as part of the project proposal. She sent over a photo during a flood last year.* Response: I have forwarded to the Cove Reservoir-East Fork Virgin EIS Planning team to capture your concern. Per our phone conversation March 31, 2022, I am not sure our specific proposed project can do much for your particular scenario, but the team will consider your comment/concern.

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198	45	4/28/2022	Email	Public		Mike Crane	32	General	I appreciate the hard work the NRCS does every day. The agency does much to help protect America's rivers. However, in the case of the Cove Reservoir on the East Fork Virgin, based on your Environmental Impact Statement, the agency is making a grave mistake that can damage the environmental integrity of the Virgin River ecosystem. The current EIS is remiss on several important considerations and therefore I respectfully request the National Resources Conservation Service and other project partners to abandon the proposed project as described in both the previous Environmental Assessment and the EIS scoping notice by choosing the No Action Alternative. The EIS did not fully assess all downstream impacts of the project, including impacts to recreational, ecological, and other values. This should include a complete review of different annual hydrograph scenarios. Naturally varying river flows support a myriad of important ecological attributes, including sediment transport and vegetation management., On the East Fork of the Virgin River's spring peak flows provide the only possible time of year to go boating. Downstream reaches on the mainstem of the Virgin are very well-known amongst recreators and flows are dependent upon high spring streamflows in the East Fork Virgin River. The project as proposed would have severe environmental and recreational impacts, is not economically feasible, and is a misuse of taxpayer money. Thank you for considering my comments on this project.
199	46	4/19/2022	Email	Public		Doug Tally	33	General	RE: Cove Reservoir (rhetorical) What is the project lifetime expense to taxpayers v proposed water diversion uses? What are reasonable unintended consequences and their costs? I kayak and raft rivers in the Northern Rockies to Michigan and Florida and I cherish wild and free-flowing rivers. No Action Alternative is the reasonable decisiin based on prior publications. Detractors: - Environmental - Recreation use - Financial... especially in current harsh realities and uncertain future taxpayer overload.
200	47	4/19/2022	Email	Public		Daniel Cottam	34	General	Thank you for the opportunity to provide comments on the Cove Reservoir - East Fork Virgin Environmental Impact Statement. As a river enthusiast who cherishes wild and free-flowing rivers, I hope the National Resources Conservation Service and other project partners abandon the proposed project as described in both the previous Environmental Assessment and the EIS scoping notice by choosing the No Action Alternative. If the project proceeds, the NRCS needs to fully assess all downstream impacts of the project, including impacts to recreational, ecological, and other values. This should include a complete review of different annual hydrograph scenarios. Naturally varying river flows support a myriad of important ecological attributes, including sediment transport and vegetation management., On the East Fork of the Virgin River's spring peak flows provide the only possible time of year to go kayaking and rafting. Downstream reaches on the mainstem of the Virgin are very well-known amongst recreators and flows are dependent upon high spring streamflows in the East Fork Virgin River. Having personally kayaked the much of the virgins entire length it amazes me that they want to take away this opportunity from me. I have valued these runs and they are truly some of the most unique in the entire world from the narrows in the NP to the hurricane gorge and the virgin gorge. Timpoweap canyon is not to be missed. And all these runs happened without any government help. Imagine how many boaters there would be if the was an approved put in and take out and they held releases of known amounts and times in timpoweap canyon. Instead there is nothing and we are left guessing as to what is going to happen. I would certainly donate time and money for put and take out places for boaters. The project as proposed would have severe environmental and recreational impacts, is not economically feasible and is a misuse of taxpayer money. This is especially gauling as SE Utah has more water use per person than any other place in the whole country. I have a house in St George and the amount of grass they have down there in a desert is awful. At least Las Vegas pays you to pull up your turf. St George does nothing then wants to steal water without considering recreation. There is at least one commercial company with a permit on the virgin river and they can't run it because so many people are taking water out. We need viable river flows and reliable river flows. We already have two reservoirs that don't consider kayakers/rafters we don't need a third. These runs could be as famous as the Grand Canyon but we take so much water out we depend on high flow in spring as our only chance to run them.

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201	48	4/20/2022	Email	Public		Sam Carter	35	General	I am writing you today about the proposed water storage project of Cove Reservoir on the East Fork of the Virgin River. My request is that you cancel this project. Why? Damning rivers in the southwest USA does not work well for the downstream river environment. I live at the Dolores Project where McPhee dammed the Dolores River. McPhee is at historic lows and there have not been adequate downstream releases as "advertised" when the storage project was proposed. And now that downstream environment is struggling. Cottonwoods are not repopulating the riparian reach. Willows are encroaching on the river bed more and more. And the native fish are in steep decline. Come for a visit. I'll take on a dry river tour. And then just southwest of here is Lake Powell and its mess of a project. There is not enough water in the SW to store in a reservoir and to sustain flows out of said reservoir. The Cove Reservoir will crush the riparian habitat of the EF Virgin River. While you may believe otherwise, you are being duped. It doesn't work. Thank you for your time.
202	49	4/27/2022	Email	Public		Stanford Pitcher	36	General	The East Fork of the Virgin is such a small river which rarely flows except for a short time in the spring. It is ridiculous to consider to put a dam on it. The water is needed downstream to give the Virgin enough water to allow floating between Springdale and the Virgin Gorge. I'm sure the fish on the river appreciate it too! The Virigin River is a magnificent part of the Zion area and Utah - please don't change its wilderness character to grow alfalpha!
203	50	4/20/2022	FR	Public		Robert Figgins	37	General	As a resident of orderville it is my opinion that the reservoir will only improve our beautiful town. This project will provide much needed recreational options for all of Kane county. The new reservoir will also benefit the agricultural community. More water better crops. For the residents of orderville mt caramel and glendale this reservoir will improve the ability to have good old fashioned family fun without breaking the bank. Please move forward on this project
204	51	4/20/2022	FR	Public		Kurt Brinkerhoff	38	General	We in Glendale (irrigation company) are in dyer need of water that could be used if/when the Cove Reservoir project is completed.
205	52	3/30/2022	FR	Public		Richard Spotts	1	General	Dear NRCS officials: Please accept, carefully review, respond to in the forthcoming DEIS, and include in the NEPA project file my following scoping comments in response to this NOI. At the outset, I live near the Virgin River in Washington County Utah. As a twenty-year Utah resident, I am continually disappointed by the unsustainable, regressive decisions and actions by most Utah officials. For example, they constantly support risky and expensive boondoggle water projects instead of much more reliable and less costly water conservation and reclamation methods. They refuse to implement already-proven-effective water conservation and reclamation measures in a county with an obscenely excessive per capita water use rate. This NRCS NOI is another example of this pattern of moving backward when we desperately need to be moving forward. Former Utah Republican legislative leader Mike Noel's controversial proposed Cove Reservoir project, actively promoted during the Trump era, unfortunately remains alive under this NOI's misrepresented Trojan horse "watershed plan" title under the Biden administration.
206	52	3/30/2022	FR	Public		Richard Spotts	1	Purpose and Need	In reviewing this NOI, it is appallingly clear that the NRCS office in Utah ignored virtually all of the previous public comments on their earlier defective and biased Cove Reservoir Environmental Assessment (EA). For example, the two action alternatives described in today's NOI are substantially similar to what was originally proposed in the EA. Both would improperly divert Virgin River water that would otherwise flow downriver to Lake Mead. Both would facilitate more water-wasting alfalfa farming during the hot summers, and likely provide for potential future water sales and transfer to expand sprawl developments in Washington County. Both ignore cheaper and more reliable watershed health measures proposed during the previous round of EA comments. In a nutshell, if approved and implemented, this project would use federal funds to facilitate further unsustainable private water use and development instead of advancing feasible and bona fide methods to actually improve watershed health during this mega drought. In addition, the NRCS continues to refuse to answer basic questions such as how or whether this proposed Virgin River diversion would comply with the Colorado River Compact (Law of the River). Lake Mead is already dangerously low, but the NRCS and other Utah promoters of this Cove Reservoir seek this harmful Virgin River diversion without regard for the added negative impacts on other Lower Colorado River Basin water users. This NOI is supposed to start a broad scoping process under the National Environmental Policy Act (NEPA) where the public may provide comments on the proper purpose and need for action, feasible alternatives to the proposed action, and resources/issues of concern. Sadly, based on the arbitrary narrowness of this NOI, NRCS appears to remain highly biased toward what Mike Noel and other development interests want. The Cove Reservoir could apparently not be built unless the Bureau of Land Management (BLM) approves needed borrow pits. So NRCS and BLM are each responsible for this NEPA compliance prior to any final decisions.

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207	52	3/30/2022	FR	Public		Richard Spotts	1	General	Given the Cove Reservoir's high level of public controversy and conflicts with the Biden administration's executive orders and professed environmental policies, it is shameful that NRCS was allowed to publish such a misleading and truncated NOI. Just like with their ridiculous proposed Lake Powell Pipeline, Utah's regressive officials continue to arrogantly ignore the two-decade-long mega drought and foolishly believe that they can create water by building more storage structures. It is tragic that NRCS officials who should know better are nevertheless willing to partner with these Utah officials. As President Biden has noted, the climate and extinction crises are real, connected, getting worse, and require bold and innovative solutions. The proposed Cove Reservoir would add to these problems and take precious funds away from implementing positive solutions. NRCS should not waste its limited resources to subsidize Utah's unsustainable insanity. For scoping purposes, I hereby wish to fully incorporate by reference as part of my scoping comments the relevant attachments provided (including my previous Cove Reservoir EA comments) and the information at the web link below. This information provides pertinent input on the DEIS purpose and need statement, a reasonable range of feasible alternatives that should be carried forward for detailed analysis, and many resources, uses, and issues that should be addressed. I may supplement my comments by the April 28th deadline.
208	52	3/30/2022	FR	Public		Richard Spotts	1	General	SEE ATTACHED COMMENTS to FR
209	53	3/30/2022	FR	Public		Robert Lacey	6	General	As a resident of Orderville, shareholder in the Orderville Irrigation Company, and member of the Orderville Town Council, I am excited to see this project moving forward. Many residents, and particularly farmers and ranchers in our area, have been anticipating the construction of this reservoir for many years. It will be a major benefit to our small community as water availability is stabilized throughout the summer. With climate change affecting our weather patterns, storage capacity like this is invaluable for an agricultural community like ours. Additionally, the increased recreational opportunities will benefit residents directly, along with the potential growth in tourism. The improvement in clean hydropower capacity will also be welcome. In my view, this project is a win for all involved. The reservoir is off-river, using a diversion and pipeline that is already in place, so the impact to the river ecosystem should be minimal. Having increased river flow later in the summer should return the river to a more historic state, since water that is currently diverted may not need to be to the same extent. I recognize that there are others who don't share these same views, including a few who live downstream from the proposed Cove location. I anticipate that the floodplain permit will account for any of their concerns as it moves forward. I, for one, have spent a fair amount of time exploring and utilizing the area that will be inundated. While it is a quiet area with some dirt roads and brush, there is nothing particularly interesting there, and I feel that the benefits of the water storage project outweigh the loss of the area for ground-level recreation. I look forward to seeing the EIS move forward and for the project to advance into construction and completion.
210	54	4/4/2022	FR	Public		Anonymous	N/A	General	I recommend this project be ended. The area is desert and we are in a mega drought. There is no water resources available for development and we must stop and begin reversing growth in the counties. The only good option is to live within our means and retreat if necessary. We must downsize our families and consumption.
211	55	4/10/2022	FR	Public		Carolyn Borg	39	General	As a long-time Utah and Washington County resident, I vigorously oppose this misleadingly titled "watershed plan" because it is a ridiculous contrivance for the controversial proposed Cove Reservoir. NRCS did a previous Environmental Assessment (EA) for the Cove Reservoir that was clearly biased and defective. Strong public comments and questions were submitted to NRCS in response to this EA. To the best of my knowledge, NRCS has never responded to these comments nor answered these questions. Instead, NRCS has simply fraudulently re-packaged this proposed reservoir as a watershed plan. Diverting Virgin River water for wasteful summer alfalfa growing and for speculative future sales to developers are not legitimate watershed plan purposes. This is a shameful attempt to fool the public and to cloak a boondoggle as a plan. Mike Noel and the other Cove Reservoir proponents tend to hate the federal government except when they can obtain public federal subsidies to increase their private profits. It is like they figuratively slap Uncle Sam in the face with one hand while trying to steal his wallet with the other hand. I am appalled that something as unnecessary and wasteful as the proposed Cove Reservoir would even be allowed to proceed under the Biden administration. There are much more important and legitimate projects that should be the focus for using limited federal funds and staff. We are in the midst of the worst drought in apparently 1,200 years and Lakes Mead and Powell are already dangerously low. The Colorado River Compact states are struggling to develop an updated drought contingency plan and painful reductions in water deliveries are already occurring. In this context, diverting Virgin River water into the Cove Reservoir would exacerbate these worsening problems and reduce the flows into Lake Mead. The water in Lake Mead is far more valuable for existing human uses, whereas the Cove Reservoir water would be largely wasted for summer alfalfa irrigation and to stimulate further sprawl developments. There may be a need for some legitimate watershed health projects in this area to slow erosive runoff, reduce soil loss, increase soil water infiltration, recharge depleted groundwater aquifers, and restore degraded riparian habitats. These are the types of projects that should constitute a reasonable range of feasible alternatives for objective analysis in a Draft Environmental Impact Statement (DEIS). Unfortunately, NRCS is clearly not interested in pursuing these types of bona fide watershed projects in the public interest, nor fairly considering alternatives to the Cove Reservoir. NRCS is merely going through the NEPA motions with this required scoping process.
212	56	4/13/2022	FR	Public		Edward Bolander	40	General	Given the difficulties of maintaining sufficient water in the area, this project should proceed ASAP

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213	57	4/20/2022	FR	Public		Chris Gorzalski	41	General	Please accept my comments on the proposed Cove-East Fork Virgin River Watershed Plan NRCS-2022-0002. I am a resident of St George, Utah and have been a frequent recreational user of the Parunuweap Canyon WSA and the Zion National Park Wilderness area including the East Fork of the Virgin River. I am concerned that the development of the proposed reservoir will effect the flow of the East Fork Virgin River to the extent that irreparable damage will occur to the Wilderness characteristics of the WSA and Wilderness Area. I am aware that seeps do feed into the river but the initial water flow will be reduced during the summer months when we have already been seeing low flows occurring due to the drought. Has a full study of the effect this flow reduction will have on the species in the canyon? Parunuweap canyon is a wild and beautiful area which has not been overrun due to its relative inaccessibility. Petroglyphs show that this area has been important to mankind for a long time. It is an area worth saving.
214	58	4/20/2022	FR	Public		M. Honer-Orton	42	General	At a time when we are in Extraordinary drought, this proposal ignores all cautionary concepts with regard to conserving water and instead creates an additional reservoir to store water for growing alfalfa, a water intensive crop. Utah officials arrogantly ignore the two-decade-long mega drought and foolishly believe that they can create water by building more storage structures. In addition there do not seem to be any specifics as to who or what will determine when and how much water will be released to downstream water users including water that should rightfully be going to Lake Mead. Also, the ultimate plan for this water seems to be a residential development and not agricultural/recreational uses. We oppose this water grab project that can only reduce supply to down river users and right-holders.
215	59	4/20/2022	FR	Public		John Horel	43	General	As an Orderville home owner, there seems to be little justifiable need for this project to have moved to the point of requiring an EIS. Having participated in the earliler EA, there seemed to be little recognition of the limited value of this project and overstatements of its benefits. I hope Option #1 becomes the preferred outcome.
216	60	4/20/2022	FR	Public		Merlin Esplin	44	General	Thank you for receiving comments on the proposed Cove Reservoir. I am a resident of Orderville and own property near the proposed reservoir site. I am not excited about some aspects of having a reservoir adjacent to my property, but I understand the great benefits that such a project would create for Orderville, and Kane County. First - there is a diversion already in place and a pipeline already delivers East Fork Virgin River water to the reservoir site. Farm land is currently irrigated right to the proposed reservoir site. This will not entail a new diversion. Water will be stored beyond currently irrigated property on dry range land. Second - the reservoir would allow water users in this part of Kane County to better use the water they have rights to buy providing storage and releasing water during times when the river does not provide the full right granted. A reservoir would also allow farmers to choose to cultivate various types of crops. Most farms now grow alfalfa as feed for livestock. Alfalfa is deep rooted and produces well when it receives enough water, but has the ability to go dormant when the soil dries out. It can then green up again when water is available. This makes alfalfa a great crop that does not have to be replanted after every dry spell. Water storage in a reservoir would allow farmers to grow other types of crops, including vegetables, because there would be a more reliable expectation of water delivery at more dependable intervals. Also, greater production of alfalfa and forage could be expected with water storage on the system. Third - a reservoir would bring business opportunities, especially in the form of recreation, to our area. Fourth - Washington County's involvement in the Cove Reservoir makes sense because they could store water at higher elevations and reduce evaporation. Whether they used the water for culinary or irrigation - it could help meet their water needs. This is not an attempt to capture a complete list of opportunities and benefits, but a quick glimpse showing there is good reason to proceed.
217	61	4/21/2022	FR	Public		Tina Esplin	45	General	Because of the continuing drought, we are learning and seeing the importance of storage reservoirs to secure water and water rights for the residents of southern Utah. This reservoir is critical for water storage, farming, recreation, the local economies and the beauty and overall enhancement of this area, and Action 1 Alternative is the only alternative that provides for all of these important matters, and the building of the reservoir should proceed as soon as possible. Thank you.
218	62	4/23/2022	FR	Public		Shauna Archer	46	Climate Change	We live in an arid state and adding a reservoir does not seem to be an appropriate action to counteract water demands. There are so many other alternatives to pursue that are more sustainable including types of crops being planted, how water is used including watering times, and how to best manage water without creating reservoirs which cause damage to ecosystems and of which much of the water is evaporated in our arid climate. In a day and age in which we are beginning to understand how important it is to humans to have intact ecosystems and sustainable practices this solution does not seem to be viable long term. Other options have been proposed and a formal in-depth study has been suggested. Bottom line we have too many people living in an arid climate and making demands on the land that are not appropriate for this climate and ecosystem. Solutions should be long term and sustainable. If not for this generation we owe it to be considered for future generations. Please consider the following steps that were submitted by Utah Water Conservation Organizations. 1. Study existing megadrought conditions and the current modeling for the future of water supplies in the region driven by climate change and determine if this project is sustainable.
219	62	4/23/2022	FR	Public		Shauna Archer	46	Economics	2. Suggest that federal agricultural funding might best be used to help farmers in Kane and Washington counties transition to climate and sustainable smart agriculture. There are a variety of new agricultural technologies including remote sensing technology that can result in using less water and increasing yield. These are practices that are beginning to be used world-wide. A cost-effective study should be completed comparing the cost of arming farmers with new technologies vs. the cost and environmental impact of constructing and maintaining the Cove Reservoir.
220	62	4/23/2022	FR	Public		Shauna Archer	46	Water Resources	3. Analyze the direct, indirect, and cumulative impacts of eliminating high flows on both the East Fork and the Main Virgin as it relates to the hydrologic connection of both ground and surface water. Changing river flow levels forever could hinder how the aquifer is recharged along with permanently decreasing the flow of surface water downstream of the project area.

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221	62	4/23/2022	FR	Public		Shauna Archer	46	Sensitive Species	4. Study the history of what caused the endangered fish in the Virgin to become imperiled in the first place and evaluate how further reducing perennial flows will further complicate the effort to save these species. Changing the historical flows are likely to have an impact as well on the entire riparian zone along the river. This must be carefully evaluated.
222	62	4/23/2022	FR	Public		Shauna Archer	46	Water Resources	5. Complete an analysis of ecosystem health of the Virgin River watershed with attention to how using more fertilizer for agriculture affects downstream water quality.
223	62	4/23/2022	FR	Public		Shauna Archer	46	Water Resources	6. Complete an analysis of the complete Virgin River watershed and how water supplies and quality may be affected in Arizona and Nevada as the Virgin River watershed is technically in the Lower Basin drainage.
224	62	4/23/2022	FR	Public		Shauna Archer	46	Water Resources	7. Analyze and evaluate the water rights that the irrigation companies are using to build the project. Current records show these water rights are being protested by other water users.
225	62	4/23/2022	FR	Public		Shauna Archer	46	Economics	8. Calculate the cost/benefit ratios for the 100-year life of the project.
226	63	4/25/2022	FR	Public		Arthur Haines	47	Climate Change	I have two comments on the scope of the EIS for the Cove-East Fork Virgin Riven Watershed Plan. First the, impact on this fragile water shed of the current mega drought and the impact of climate change must be assessed. This assess must be thorough and objective.
227	63	4/25/2022	FR	Public		Arthur Haines	47	Purpose and Need	Secondly, the project is built on the assumption that Kane and Washington County farmers need additional water to support their (alfalfa) fields. This assumption must fully evaluated. The assessment must determine the beneficial impact of new water saving project. Moreover, in Washington count these fields are likely to transition to residential develpment early in the life cycle of the Cover Reservoir. This implications of this highly probable future on the rationale for the Cover Reservoir must be evaluated.
228	64	4/26/2022	FR	Public		Ingrid Akerblom	48	Purpose and Need	I am providing this comment in opposition to the proposed Cove-East Fork Virgin River Watershed Plan Project. I have provided a comment on this project during the EA phase. I appreciate that a full environmental analysis will be performed before proceeding with this project. My concerns remain relevant. From the NOI: “ The primary purpose for watershed planning…is to increase and maintain a reliable supply of water for local agricultural use….agricultural users routinely experience water shortages in the late summer months…” This project is a government hand-out to specifically benefit the alfalfa farmers in the local area who are refusing to face up to climate change and the increasing drought conditions that will spell the end of their businesses in the coming years. This reality is harsh and I understand that no one wants to give up on their history and their livelihood. However, building a new reservoir for water that likely will not be there in even the near-term future is irresponsible and a waste of taxpayer money. It is pertinent to note here almost all of UTAH and particularly Southern Utah is in exceptional drought status currently with no relief in sight. The drought emergency has now become even more extreme since the conception of the project in 2020 or earlier – the megadrought we are facing now is unprecedented and there is no relief in sight. •The EIS must include studying existing megadrought conditions and the current modeling for the future of water supplies in this region due to climate change. Whether or not this project is sustainable in light of what will be considerable expense must be determined In addition, the initial projections showed the net economic cost/ benefit in the best of circumstance was barely above break even annually with nearly all the benefit going to a select few farmers through increased agricultural production. It was not clear if the cost/ benefit included the investment needed to do the project or just operating expenses. As for the ongoing operating expenses, I was not able to determine who would be paying for those; I am assuming not the primary beneficiaries. As a Utah and federal taxpayer, I see no justification for using my money to support this project in order to subsidize this small group.
229	64	4/26/2022	FR	Public		Ingrid Akerblom	48	Alternatives	•The EIS under the NO ACTION Alternative must include reviewing the impact on water use of adopting new agricultural technologies such as remote sensing technologies that can reduce water use and increase yield. A cost benefit study should be included that compares the use of the newer agriculture sustainable and water-saving technologies with that of the total cost of this project including operating expense. •The EIS under the NO ACTION alternative must consider buy out costs for farmers and developing alternative revenue sources vs moving forward with this project. NO matter what is done it is likely that there won’t be enough water to sustain agriculture and hydroelectric power generation due to the increasing desertification of Southwest UTAH.
230	64	4/26/2022	FR	Public		Ingrid Akerblom	48	Sensitive Species	As an avid hiker and outdoor enthusiast, I have great concern on the impact of this diversion to ecological habitats downstream both within and outside Zion National Park. The park belongs to all Americans and the health of its extended ecosystem should not be endangered for the benefit of a very few. The NRCS should leave the existing river and the wildlife and human recreation downstream intact by maintaining the natural flow of the river. It is critical that the Wild and Scenic values of the Virgin River and Zion National Park designations remain intact. •The EIS must include analyses of how the diversions from the East Fork of the Virgin River will affect the downstream ecosystem directly, indirectly, or cumulatively by eliminating high flows on both the East Fork and the Main Virgin. How will the changing river flows affect recharging the aquifer in the watershed? How will further reducing perennial flows complicate the efforts to save endangered species that are already struggling for low water due to drought?

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231	64	4/26/2022	FR	Public		Ingrid Akerblom	48	Water Resources	•The EIS must also include an analysis of the complete Virgin River Watershed and how water supplies and quality may be affected in Arizona and Nevada as the Virgin River Basin is in the Lower Basin drainage. The EIS must address water rights for the watershed - what are the rights of the irrigation companies involved in this project? Finally, having driven Route 89 many times to view the scenic beauty there, I would be heartbroken to see this wild river become yet another casualty of a short-sighted effort to retain a way of life that has no future – the folly of continuing to grow crops not suited for the desert environment.
232	65	4/27/2022	FR	Public		Stephanie Kilcher	49	Climate Change	1. Study existing megadrought conditions and the current modeling for the future of water supplies in the region driven by climate change and determine if this project is sustainable.
233	65	4/27/2022	FR	Public		Stephanie Kilcher	49	Economics	2. Suggest that federal agricultural funding might best be used to help farmers in Kane and Washington counties transition to climate and sustainable smart agriculture. There are a variety of new agricultural technologies including remote sensing technology that can result in using less water and increasing yield. These are practices that are beginning to be used world-wide. A cost-effective study should be completed comparing the cost of arming farmers with new technologies vs. the cost and environmental impact of constructing and maintaining the Cove Reservoir.
234	65	4/27/2022	FR	Public		Stephanie Kilcher	49	Water Resources	3. Analyze the direct, indirect, and cumulative impacts of eliminating high flows on both the East Fork and the Main Virgin as it relates to the hydrologic connection of both ground and surface water. Changing river flow levels forever could hinder how the aquifer is recharged along with permanently decreasing the flow of surface water downstream of the project area.
235	65	4/27/2022	FR	Public		Stephanie Kilcher	49	Sensitive Species	4. Study the history of what caused the endangered fish in the Virgin to become imperiled in the first place and evaluate how further reducing perennial flows will further complicate the effort to save these species. Changing the historical flows are likely to have an impact as well on the entire riparian zone along the river. This must be carefully evaluated.
236	65	4/27/2022	FR	Public		Stephanie Kilcher	49	Water Resources	5. Complete an analysis of ecosystem health of the Virgin River watershed with attention to how using more fertilizer for agriculture affects downstream water quality.
237	65	4/27/2022	FR	Public		Stephanie Kilcher	49	Water Resources	6. Complete an analysis of the complete Virgin River watershed and how water supplies and quality may be affected in Arizona and Nevada as the Virgin River watershed is technically in the Lower Basin drainage.
238	65	4/27/2022	FR	Public		Stephanie Kilcher	49	Water Resources	7. Analyze and evaluate the water rights that the irrigation companies are using to build the project. Current records show these water rights are being protested by other water users.
239	65	4/27/2022	FR	Public		Stephanie Kilcher	49	Economics	8. Calculate the cost/benefit ratios for the 100-year life of the project.
240	66	4/27/2022	FR	Public		McKay Williams	50	General	The virgin river is one of our last untouched natural recourses here in Utah and we need to protect it as such. Please consider the recreational and environmental opportunities we will loose out on forever if we do not consider protecting this waterway for generations to come.
241	67	4/28/2022	FR	Public		Christian Felger	51	Wild and Scenic Rivers	Much of the E. Fork of the Virgin River is protected wilderness study area. This change could heavily impact the ecosystem in this area.
242	68	4/28/2022	FR	Public		Helene Jorgensen	2	Water Resources	Please accept and include in the relevant public record my scoping comments on the Cove-East Fork Virgin River Watershed Plan, Kane County, Utah in preparation of the Draft Environmental Impact Statement (DEIS). I am a Kane County UT resident. I deeply care about reliable water supply and the future management of our water resources. I strongly believe that water resources should be managed in the long-term public interest. I am concerned that there is insufficient water, both water rights and wet water, to fill and operate a reservoir at the East Fork Virgin River in Kane County. The U.S. Bureau of Reclamation needs to analyze and evaluate the water rights used for this project. The Bureau of Reclamation also needs to study and develop projections for future precipitation and water flows in the East Fork Virgin River.
243	68	4/28/2022	FR	Public		Helene Jorgensen	2	Purpose and Need	The Notice of Intent (NOI) for the project, published on 3/29/2022, provided limited information about the project itself, the location of the reservoir, the beneficiaries, and potential environmental impacts. This makes it challenging to provide specific public scoping comments. The fact that the public information meeting was held in October 2021, almost 6 months before the NOI was published, also has contributed to the scarcity of information provided to the public. The NOI states that the primary purpose of the project is “to increase and maintain a reliable supply of water for local agricultural use and existing storage needs, increase water conservation, and improve water delivery efficiency in the Upper Virgin Watershed in Kane County, Utah, and for existing and future water demands in Washington County, Utah.” Due to rapid development in Kane County and Washington County, alfalfa fields and other agricultural activities are disappearing. It is not clear which future agricultural uses the U.S. Bureau of Reclamation envisions that Cove reservoir would benefit.
244	68	4/28/2022	FR	Public		Helene Jorgensen	2	Economics	The NOI states that “the project proposes a new Glendale [power generating] facility and would make water available during the summer months at the Orderville site that could help meet energy needs.” The Glendale facility was not mentioned in the scoping notice published in October 2021 or at the public meeting in October 2021. This component of the project needs to described and cost estimates for building the power plant should be included in the DEIS.

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245	69	4/28/2022	FR	Public		Carolyn Borg	39	Wild and Scenic Rivers	As a Washington County Utah resident, I concur with the scoping comments submitted by Conserve Southwest Utah. The East Fork of the Virgin River is a small stream of critical significance. The proposed Cove Reservoir would permanently change the river's natural flow and disrupt this already fragile riparian ecosystem. In the face of rapid climate change, in megadrought conditions, the project would cause and greatly exacerbate changes in the timing, amount, and natural flow of the river that would negatively impact the plants, fish, wildlife, and interconnected ecosystems they depend on to survive. The East Fork of the Virgin River is designated as Wild under the Wild and Scenic Rivers Act, where it flows through Zion National Park. The project will likely alter water flows in this area, and changes in flow rates will likely affect the wild qualities of the river. The change in the natural flow patterns in the summer may also negatively impact the famous slot canyons of the Bureau of Land Management's Parunuweap Canyon Wilderness Area (WSA) of 30,800 acres. The WSA boundary is near the project area along the East Fork and downstream of the gravel pits needed to build the 90-foot-high earthen dam. The East Fork runs through the proposed wilderness area—an area that should remain wild. There are many important issues, resources, and concerns that should be fully analyzed in the NRCS DEIS, including the following:
246	69	4/28/2022	FR	Public		Carolyn Borg	39	Climate Change	1. Study existing megadrought conditions and the current modeling for the future of water supplies in the region driven by climate change and determine if this project is sustainable.
247	69	4/28/2022	FR	Public		Carolyn Borg	39	Water Resources	2. Federal agricultural funding might best be used to help farmers in Kane and Washington counties transition to climate and sustainable smart agriculture. There are a variety of new agricultural technologies including remote sensing technology that can result in using less water and increasing yield. These are practices that are beginning to be used world-wide. A cost-effective study should be completed comparing the cost of arming farmers with new technologies vs. the cost and environmental impact of constructing and maintaining the Cove Reservoir.
248	69	4/28/2022	FR	Public		Carolyn Borg	39	Economics	3. Analyze the direct, indirect, and cumulative impacts of eliminating high flows on both the East Fork and the Main Virgin as it relates to the hydrologic connection of both ground and surface water. Changing river flow levels forever could hinder how the aquifer is recharged along with permanently decreasing the flow of surface water downstream of the project area.
249	69	4/28/2022	FR	Public		Carolyn Borg	39	Sensitive Species	4. Study the history of what caused the endangered fish in the Virgin to become imperiled in the first place and evaluate how further reducing perennial flows will further complicate the effort to save these species. Changing the historical flows are likely to have an impact as well on the entire riparian zone along the river. This must be carefully evaluated.
250	69	4/28/2022	FR	Public		Carolyn Borg	39	Water Resources	5. Complete an analysis of ecosystem health of the Virgin River watershed with attention to how using more fertilizer for agriculture affects downstream water quality.
251	69	4/28/2022	FR	Public		Carolyn Borg	39	Water Resources	6. Complete an analysis of the complete Virgin River watershed and how water supplies and quality may be affected in Arizona and Nevada as the Virgin River watershed is technically in the Lower Basin drainage. Determine how this proposed diversion of Virgin River water may affect compliance with the Colorado River Compact (Law of the River) and future water availability for the Lower Basin Compact states.
252	69	4/28/2022	FR	Public		Carolyn Borg	39	Water Resources	7. Analyze and evaluate the water rights that the irrigation companies are using to build the project. Current records show these water rights are being protested by other water users.
253	69	4/28/2022	FR	Public		Carolyn Borg	39	Economics	8. Calculate the cost/benefit ratios for the 100-year life of the project. Analyze whether other watershed health and storm water retention projects would provide cheaper and more reliable benefits than the proposed Cove Reservoir.
254	69	4/28/2022	FR	Public		Carolyn Borg	39	Economics	9. Confirm whether this proposed watershed project would ultimately lead to water transfers to benefit additional sprawl developments.
255	70	4/29/2022	FR	Public		Kyle Roerink	52	NEPA Process	RE: COVE RESERVOIR SCOPING COMMENTS, NRCS-2022-0002 The Great Basin Water Network, the Center for Biological Diversity, and Living Rivers submit scoping comments on the Natural Resource Conservation Service (NRCS) proposal on Cove-East Fork Virgin River Watershed, Docket No. NRCS-2022-0002. COUNCIL ON ENVIRONMENTAL QUALITY (CEQ) REGULATIONS NRCS must specify under what authority it will be issuing the EIS as it relates to the National Environmental Policy Act guidance from CEQ. At the least, we believe that the project must be reviewed in accordance with the Council on Environmental Quality's proposed rule via docket CEQ-2021-0002. It would not be a hardship to put forth an EIS under this CEQ guidance, considering that this "Phase 1" approach from CEQ had been in effect since 1978 prior to the Trump Administration. If NRCS is not issuing this NEPA under the 1978 standard, we would need a significant explanation. On the scoping call, NRCS said that it would "follow what is current, which is basically the reinstated." Therefore, we believe that what officials during scoping actually meant were that NRCS will follow CEQ guidance and requirements as outlined in CEQ-2021-0002. But due to the uncertainty, we would like to confirm.
256	70	4/29/2022	FR	Public		Kyle Roerink	52	General	VALIDITY OF CONDUIT PERMIT NRCS must detail the additional permits and applications that the project proponent will need in order to generate power. In the public scoping meeting presentation in October 2021, Mike Noell mentioned that no permit would be required from FERC. He also mentioned one or two other necessary permits for electricity generation and exemptions from FERC. The public needs a complete listing of all applications/exemptions related to the project.
257	70	4/29/2022	FR	Public		Kyle Roerink	52	Air Quality	METHANE: NRCS must provide a detailed analysis for how it will account for methane emissions from the reservoir.

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258	70	4/29/2022	FR	Public		Kyle Roerink	52	Water Resources	WATER RIGHTS, DELIVERY AND CAPTURE • The applicant must demonstrate how the project will affect groundwater and surface water rights in the East Fork of the Virgin River and the associated hydrographic areas upstream and downstream. • The applicant must analyze how this project will affect flows on the main stem of the Virgin River and the Colorado River. • The applicant must provide legal justification for how this project complies with the Drought Contingency Plan, the 2007 Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Mead, and other reservoir management practices on the Colorado River. • NRCS must list the associated water rights numbers as issued by the Utah Division of Water Rights associated with the project. • NRCS must outline delivery schedules. • NRCS must outline what happens if water rights owners file for change applications that would change the place of use of the water rights associated with this proposal.
259	70	4/29/2022	FR	Public		Kyle Roerink	52	Legal	PROJECT FUNDING If the preceding Environmental Assessment for the Cove Reservoir project is any indicator, this is a municipal effort masquerading as an agricultural project. Taxpayer dollars from the Watershed Protection and Flood Prevention Act, PL 83-566, are slated to fund this effort. The mandate associated with those funds require that the project be predominantly for agriculture. In 2020, the signatories of this letter and other NGOs expressed concerns about the funding source during the project's previous NEPA review.1 During the pre-scoping comments for this iteration of Cove Reservoir, the project proponent and federal officials did not provide any meaningful details about the legal justification for the project while knowing that the intent is for urban development. The EIS must include solicitor analysis relating to the legality of the project. Mike Noell described the project as being almost "100 percent" for agricultural water in the pre-scoping meeting on October 20, 2021. NRCS must list what would happen if water were used for non-ag uses.
260	70	4/29/2022	FR	Public		Kyle Roerink	52	Sensitive Species	ENDANGERED SPECIES The Virgin River, its forks, and its tributaries are important ecosystems that have been highly altered by human activities, resulting in a loss of native biodiversity. Two species of fish in the Virgin River are listed as endangered under the Endangered Species Act: the Virgin River chub (Gila robusta seminuda) and the woundfin (Plagopterus argentissimus). There is a third fish, the Virgin River spinedace (Lepidomeda mollispinis mollispinis) which was petitioned for listing in 2012 and was found not warranted for listing by the US Fish and Wildlife Service in 2021. These species are perilously close to extinction, and one of the main drivers of their endangered status is the precarious nature of the water supply in the Virgin River. [E]ndangered species," such as the Virgin River chub and the woundfin, are "any species which is in danger of extinction throughout all or a significant portion of its range."2 The Endangered Species Act ("the Act") prohibits the "take" of listed species.3 Section 9 of the ESA prohibits all "persons" from "taking" any endangered fish or wildlife species.4 "Take" encompasses a broad spectrum of conduct; it is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct."5 "Harm" has further been defined in regulation to mean "an act which actually kills or injures wildlife [including] significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering."6 The term "person," is broadly defined to include: [A]n individual, corporation, partnership, trust, association, or any other private entity; or any officer, employee, agent, department, or instrumentality of the Federal Government, of any State, municipality, or political subdivision of a State, or of any foreign government; any State, municipality, or political subdivision of a State; or any entity subject to the jurisdiction of the United States.7
261	70	4/29/2022	FR	Public		Kyle Roerink	52	Sensitive Species	Courts have repeatedly held that government regulations authorizing third parties to engage in harmful actions can constitute an illegal taking under Section 9 of the ESA.8 Courts have found that habitat modification conducted or carried out by a State agency, which injures or kills listed species, may amount to an unlawful taking.9 And at least one court has expressly held that State water rights do not prevail over the restrictions on habitat codification set forth in the ESA.10 This holding, combined with the "proximate cause" view of causation expressed in cases such as Cascadia Wildlands v. Kitzhaber, 911 F. Supp. 2d 1075 (D. Or. 2012), and Strahan v. Coxe, 127 F.3d 155 (1st Cir. 1997), indicates that States may incur liability under the ESA based on the issuance of water rights. An entity, such as NRCS, permitting the damming of surface water resources to the point where habitat for a listed species is degraded (i.e. permitting pumping which affects flows in the Virgin River) would be responsible for an unlawful taking under Section 9 of the Act, and vulnerable to litigation by the US Fish and Wildlife Service, or private parties, seeking to enforce the Act. Additionally, permitting a dam sufficient to diminish Virgin River flows poses a new, previously unanticipated risk of extinction to the Virgin River spinedace, and as such may precipitate a new listing petition for the fish. The US Fish and Wildlife Service would then be required to reexamine their assessment that listing for the spinedace was not warranted, and should NRCS permit these water rights applications, it may trigger a new Endangered Species Act listing.
262	70	4/29/2022	FR	Public		Kyle Roerink	52	Health and Safety	WE'RE NOT PLANNING FOR A DAM FAILURE Mike Noell said multiple times that his agency is "not planning" for a dam failure. Depending on the context of his words, that statement could be of great concern to downstream residents.
263	70	4/29/2022	FR	Public		Kyle Roerink	52	Alternatives	ALTERNATIVES Considering the well known intent of this project, federal officials and the project applicant must develop proposed alternatives that include municipal conservation independent of damming and diverting new sources.

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264	71	4/29/2022	FR	Public		John Hiscock	53	General	I hereby re-submit my previous comments (December 30, 2020) on the Cove Reservoir Environmental Assessment for consideration during the current EIS scoping. My previous comments should be considered and addressed as the EIS is developed. Thank you for your consideration. The following comments are submitted in regard to the Draft Watershed Plan and Environmental Assessment for the Proposed Cove Reservoir Project – Kane County, Utah (EA). My basis for submitting comments is as follows: - I am a United States citizen and taxpayer, and this project is proposed to be funded primarily by federal funds. - I am a resident and property owner of Kane County, Utah, subject to taxes and fees paid to the Kane County Water Conservancy District (KCWCD) – the primary sponsor of this project. - I am an avid and regular user of federal public lands that will arguably be affected by this project, such as Bureau of Land Management lands in the Kanab Field Office Area, and Zion National Park.
265	71	4/29/2022	FR	Public		John Hiscock	53	Legal	Legal Basis for Federal – Natural Resource Conservation Service – Project Funding The EA states that the total project cost is estimated at $29,982,000.00 and that $21,426,000.00 will be federally funded from Natural Resource Conservation Service (NRCS), PL 83-566, allocations. See EA, §6.9, p. 79. PL 83-566, 16 USC §1001, et. seq., authorizes the Department of Agriculture (DOA) and NRCS to: *cooperate with States and their political subdivisions, soil or water conservation districts, flood prevention or control districts, and other local public agencies for the purpose of preventing such damages, of furthering the conservation, development, utilization, and disposal of water, and the conservation and utilization of land and thereby of preserving, protecting, and improving the Nation's land and water resources and the quality of the environment.* 16 USC §1001. The law continues to state: *In order to assist local organizations in preparing and carrying out plans for works of improvement, the Secretary [of DOA] is authorized . . .to enter into agreements with landowners, operators, and occupiers, individually or collectively, based on conservation plans of such landowners, operators, and occupiers which are developed in cooperation with and approved by the soil and water conservation district in which the land described in the agreement is situated, to be carried out on such land during a period of not to exceed ten years . . .* and that, *In return for such agreements by landowners, operators, and occupiers the Secretary shall agree to share the costs of carrying out those practices and measures set forth in the agreement for which he determines that cost sharing is appropriate and in the public interest. The portion of such costs, including labor, to be shared shall be that part which the Secretary determines is appropriate and in the public interest for the carrying out of the practices and measures set forth in the agreement, except that the Federal assistance shall not exceed the rate of assistance for similar practices and measures under existing national programs.* 16 USC §1003(a). Certain limitations on the DOA's cost sharing apply, including most pertinent, a limitation on funding applicability based on the size of the watershed within which the project is located. The statute states "works of improvement" that may be funded only include those "in watershed or subwatershed area not exceeding two hundred and fifty thousand acres . . .." 16 USC §1002.
266	71	4/29/2022	FR	Public		John Hiscock	53	Legal	The watershed relevant to this project is the watershed of the East Fork Virgin River. The EA states that the size of said watershed is 152.2 square miles, equivalent to 97,408 acres. EA, §S-6.0, p. S-3. However, at least one other federal agency is on record as measuring the watershed acreage as substantially larger. The National Park Service has recorded the East Fork Virgin River watershed at 1,051.2 square kilometers, or 405.87 square miles, equivalent to 259,757.177 acres. See https://www.researchgate.net/figure/1-Watershed-area-East-Fork-Virgin-River_fig1_283516483 , from Riparian Monitoring of Wadeable Streams, East Fork Virgin River, Zion National Park, Summary Report, 2008–2012, Northern Colorado Plateau Inventory and Monitoring Network, NPS (September 2015). This acreage exceeds the maximum which the NRCS, the DOA, and the federal government are authorized to provide project funds for pursuant to 16 USC §1002. This discrepancy in federally measured watershed size, and allowable federal, DOA/NRCS funding, must be explained. If the watershed is in excess of the statutorily mandated watershed acreage limitation, the project cannot be funded by DOA and NRCS.

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267	71	4/29/2022	FR	Public		John Hiscock	53	Effects Analysis	The EA Analysis of Potential Impacts to Downstream Watershed Values and Resources of Public Lands, Zion National Park, and the East Fork Virgin River Wild and Scenic River Is Inadequate The Cove Reservoir project is upstream of Zion National Park, and the East Fork Virgin River Wild and Scenic River on NPS lands, and Bureau of Land Management, Kanab Field Office area public lands, including specifically, the Parunuweap Wilderness Study Area. The analysis of potential impacts of the proposed project on these public lands, resources, and values, and congressionally designated protected lands is woefully inadequate. Although the EA touches on the Zion National Park Water Rights Settlement Agreement entered into by the NPS, the State of Utah, the KCWCD, and others, the NRCS fails to recognize that this agreement is not comprehensive in assuring the federally mandated protection of NPS resources and values. While the agreement does assure quantifiable flows to and through the Park, it does not override federally mandated protection of park resources and values which may be affected by other considerations than water rights quantities. Most importantly, and as readily asserted by the project proponents, the construction and operation of Cove Reservoir will purposely alter seasonal and high and low flows of the East Fork of the Virgin River. Many natural resources and values of Zion National Park are dependent upon continuation of varying seasonal and high and low flows of the river. These include geologic riverine deposition and erosion processes, maintenance of aquatic and riparian flora and fauna of all types and adjacent plant and wildlife species, unacceptable establishment and spread of exotic species, etc. Many examples of protected park resources and values should be considered. One example, and only an example, that comes to mind is the continued establishment and maintenance of cottonwood seedlings and trees along the river corridor. Will the natural processes that contribute to the protection of this natural species be assured with further alteration of seasonal and high and low flows of the East Fork as envisioned by the Cove Reservoir project? A multitude of these kind of consequences must be thoroughly analyzed and assessed in a truly comprehensive EA, or arguably a complete EIS given the potential impact of the project on Zion National Park.
268	71	4/29/2022	FR	Public		John Hiscock	53	Wild and Scenic Rivers	The EA contains little or no reference to, or consideration of, the guidance of important NPS documents related to general and specific park purposes, resources, values, plans, and research. Examples of such guiding documents include: Foundation Document – Zion National Park – Utah, National Park Service / U.S. Department of the Interior (October, 2013). This planning document sets forth the significance of the park and its fundamental resources and values. The document explains that park "Significance statements express why a park's resources and values are important enough to merit designation as a unit of the national park system. These statements are linked to the purpose of Zion National Park, and are supported by data, research, and consensus." (p.5). The Foundation Document includes the following park significance statements: Geologic processes continue today as the free-flowing Virgin River rapidly cuts into the margin of the Colorado Plateau, incising a multitude of deep, narrow canyons. An abundance of canyon springs, fed by groundwater, create hanging gardens and grottos that support endemic varieties of flora and fauna. These exceptional features and processes contribute to the outstanding scenery and scientific value of the park. (p.5, emphasis added) Utah's first designated wild and scenic rivers flow through the park carving a colorful labyrinth of canyons across layers of time. These rivers, fed by natural undiminished spring flows from the Navajo sandstone aquifers and sculpted by unimpeded torrents of flood waters, have an ecological value that far exceeds their spatial extent in the park. (p.5, emphasis added).
269	71	4/29/2022	FR	Public		John Hiscock	53	Wild and Scenic Rivers	The document also identifies the park's fundamental resources and values (FRVs) which "are those features, systems, processes, experiences, stories, scenes, sounds, smells, or other attributes determined to warrant primary consideration during planning and management processes because they are essential to achieving the purpose of the park and maintaining its significance. Fundamental resources and values are closely related to a park's legislative purpose and are more specific than significance statements." (p.6) In regard to those FRVs the document explains: "One of the most important responsibilities of NPS managers is to ensure the conservation and public enjoyment of those qualities that are essential (fundamental) to achieving the purpose of the park and maintaining its significance. If fundamental resources and values are allowed to deteriorate, the park purpose and/or significance could be jeopardized." (p.6). The Foundation Document includes the following FRVs: Water Shapes the Landscape. The park's many free-flowing rivers carry powerful flash floods and tremendous sediment loads, which act together as the primary agents of erosion. These rivers continue to carve into the edge of the Colorado Plateau, shaping Zion's dramatic scenery. By virtue of rivers cutting through the water-bearing Navajo sandstone, numerous canyon springs, fed by groundwater, create hanging gardens and seeping alcoves that form moist oases in a desert environment and sustain perennial river flows. Natural Resource Quality and Function. The quality of air, water, vegetation, and wildlife resources in Zion National Park are generally preserved, in some cases by allowing natural processes and natural disturbance regimes (such as fires, floods, and rockfalls) to exist, thereby promoting an environment predominated by natural processes. Wild and Scenic Rivers. Zion's wild and scenic rivers provide for a wide range of river values and are composed of more than 140 miles of free-flowing, largely undeveloped water courses that provide habitat for six native fish species. In recent geologic time, the rivers have sliced though rock layers thousands of feet thick. The carved canyons provide habitat for the threatened Mexican spotted owl and cool canyon microclimates are home to hanging gardens where the endemic Zion snail resides. (pp. 6-7)

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270	71	4/29/2022	FR	Public		John Hiscock	53	Effects Analysis	The EA or EIS must consider the project's potential impact on the maintenance of the significant and fundamental natural processes of unimpeded and unaltered river flow through Zion National Park. The NPS has long recognized the importance of monitoring and research related to the significance, resources, and values of the natural flow regimes of the East Fork of the Virgin River. This is evidenced by its research and monitoring studies such as: Riparian monitoring of wadeable streams, East Fork Virgin River, Zion National Park: Summary report, 2008–2012. Natural Resource Report - Witwicki, D. L., and R. Weissinger - NPS/Northern Colorado Plateau Network/NRR—2015/1021. National Park Service, Fort Collins, Colorado. The purpose of such studies, and this one in particular is stated as: "The goal of Northern Colorado Plateau Network (NCPN) riparian monitoring of wadeable streams is to provide park managers with status and trend information about integrated attributes of hydrology, vegetation, and geomorphology on those streams. This information is intended to provide early warning of resource degradation and determine natural variability of wadeable streams." Valuable information which should be critical to the NRCS NEPA process, but heretofore ignored, is contained in such studies.
271	71	4/29/2022	FR	Public		John Hiscock	53	Land Use	The Bureau of Land Management is also mandated to protect special natural resources and values in the Parunaweap Wilderness Study Area (PWSA), downstream of the Cove Reservoir project and potentially affected by river flow changes related to that project. BLM and the federal government are mandated to manage said WSA to protect wilderness values identified in the Wilderness Act and "administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness and so as to provide for the protection of these areas, the preservation of their wilderness character." 16 USC §1131(a). The Wilderness Act guides federal management of said wilderness and defines wilderness as: A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this chapter an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value. Id. at §1131(c) (emphasis added). The NRCS EA has failed to evaluate any impacts on the PWSA, and its resources and values protected under the Wilderness Act.
272	71	4/29/2022	FR	Public		John Hiscock	53	Effects Analysis	In fact, overall, in the section "1.5.1 Resources/Issues Studied in Detail or Eliminated from Further Study" the NRCS EA categorizes many evaluation categories critical to the protection of special areas, such as Zion National Park and the Parunaweap WSA, as non-existent or irrelevant to its NEPA analysis, including: - "Hydrology" – irrelevant to analysis, stating that lower, yet natural flood flows downstream will be lowered in direct contradiction to value of maintaining natural flow regimes; - "Ecological Critical Areas" – listed as irrelevant and, therefore, not analyzed; - "Essential Fish Habitat" – listed as irrelevant and, therefore, not analyzed; - "Natural Resources" - listed as irrelevant and, therefore, not analyzed; - "Scenic Beauty and Parklands" - listed as irrelevant and, therefore, not analyzed; - "National Parks, Monuments, and Historical Areas" - listed as irrelevant and, therefore, not analyzed. Again, as previously noted the NRCS EA is woefully inadequate in evaluating the consequences of the Cove Reservoir project on the qualities, resources, and values of Zion National Park, and the Parunaweap WSA. The assessment of potential impacts on these congressionally designated, and/or protected areas should be comprehensively included in a revised draft EA, or arguably an EIS, given the importance of such considerations.
273	72	4/29/2022	FR	Public	National Parks Conservation Assosciation	Cory McNulty	54	General	On behalf of the National Parks Conservation Association (NPCA), thank you for the opportunity to submit the attached scoping comments for the Environmental Impact Statement (EIS) for the proposed Cove-East Fork Virgin River Watershed Project in Kane County, Utah. Since our founding in 1919, NPCA has been the independent, nonpartisan voice working to strengthen and protect America's national parks. Our 1.6 million members and supporters, including thousands in Utah, care deeply about the national parks and their surrounding landscapes including decisions made on the broader landscape that affect park resources and quality visitor experiences. See attached file(s)

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274	72	4/29/2022	FR	Public	National Parks Conservation Assosciation	Cory McNulty	54	General	On behalf of the National Parks Conservation Association (NPCA), thank you for the opportunity to submit scoping comments for the Environmental Impact Statement (EIS) for the proposed Cove-East Fork Virgin River Watershed Project in Kane County, Utah. Since our founding in 1919, NPCA has been the independent, nonpartisan voice working to strengthen and protect America's national parks. Our 1.6 million members and supporters, including thousands in Utah, care deeply about the national parks and their surrounding landscapes including decisions made on the broader landscape that affect park resources and quality visitor experiences. NPCA submitted comments on the 2020 Cove Reservoir Plan Environmental Assessment (EA), and in the absence of more detailed and updated information in the Notice of Intent for the Cove-East Fork Virgin River Watershed Plan EIS Project, we have based the following scoping comments on the project's previous description in the 2020 Plan-EA. NPCA remains extremely concerned about potential impacts from proposed construction of the Cove (or alternate) Reservoir, Black Knoll borrow pit and expansion of the Bald Knoll borrow pit upstream from Zion National Park on the park's resources, particularly the Outstandingly Remarkable Values (ORV) associated with the Wild and Scenic River Designation for the East Fork of the Virgin River through the park. NPCA strongly encourages open communication and a close working relationship between the United States Department of Agriculture Natural Resources Conservation Service (NRCS) and the National Park Service (NPS) to ensure park resources are not adversely impacted by the reservoir proposal. We request that the EIS carefully identify and address potential impacts to the park resources listed below as well as other concerns raised by NPS during the planning process
275	72	4/29/2022	FR	Public	National Parks Conservation Assosciation	Cory McNulty	54	Effects Analysis	The NPS has strong authority to protect its resources from harmful impacts on nearby lands. The significance of park resources at our national parks and the responsibility of NPS to protect them was clearly articulated in the Organic Act of 1916, "… to the fundamental purpose of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." Further, because national parks are not islands of protection, and their scenery and fundamental resources are more often at risk from adverse impacts originating outside national park boundaries, the NPS Management Policies 2006 (§ 4.1.4) outline the responsibility of NPS to engage with other agencies and decision-makers. "... the Service will seek the cooperation of others in minimizing the impacts of influences originating outside parks by controlling noise and artificial lighting, maintaining water quality and quantity, eliminating toxic substances, preserving scenic views, improving air quality, preserving wetlands, protecting threatened or endangered species, eliminating exotic species, managing the use of pesticides, protecting shoreline processes, managing fires, managing boundary influences, and using other means of preserving and protecting natural resources." National Park Resources of Concern The National Environmental Policy Act requires the NRCS to analyze and disclose any direct, indirect and cumulative impacts of the proposed Cove Reservoir project on park resources. The EIS must supply sufficient information and key analyses, particularly regarding flow rates, flow regimes and approved water rights, to assess potential impacts to park resources and nationally significant river segments and fish species.
276	72	4/29/2022	FR	Public	National Parks Conservation Assosciation	Cory McNulty	54	Wild and Scenic Rivers	Virgin River Wild and Scenic River Designation More than 140 miles of free flowing, largely undeveloped wild and scenic rivers flow through Zion National Park and are at the heart of its national significance, Wilderness Character of the park's designated Wilderness and contribute to its merit for designation as a unit of the national park system. The Zion National Park Foundation Document1 provides basic guidance for planning and management decisions and includes the following: "In 2009, the Omnibus Public Land Management Act (PL 111-11, 123 Stat. 1081) designated 144 miles (35,146 acres) of the Virgin River and its tributaries as a wild and scenic river. The Wild and Scenic Rivers Act (PL 90-542) requires the National Park Service to protect and enhance the water quality, free-flowing condition, and outstandingly remarkable values of the Virgin River and its tributaries. The river is to be managed with the goal of nondegradation and the enhancement of the values for which it was established. Section 4.3.4 of NPS Management Policies 2006 states that no management actions may be taken that could adversely affect the values that qualify a river for inclusion in the national wild and scenic rivers system." (Foundation Document, pg 10) The Foundation document identifies fundamental resources and values determined to warrant primary consideration during planning and management processes because they are essential to achieving the purpose of the park and maintaining its significance. The list of fundamental resources includes: "Wild and Scenic Rivers. Zion's wild and scenic rivers provide for a wide range of river values and are composed of more than 140 miles of free-flowing, largely undeveloped water courses that provide habitat for six native fish species. In recent geologic time, the rivers have sliced though rock layers thousands of feet thick. The carved canyons provide habitat for the threatened Mexican spotted owl and cool canyon microclimates are home to hanging gardens where the endemic Zion snail resides." (Foundation Document, pg 7)

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277	72	4/29/2022	FR	Public	National Parks Conservation Association	Cory McNulty	54	Wild and Scenic Rivers	Action Alternative 1, the proposed action, would construct Cove Reservoir within the East Fork Virgin River Watershed approximately 20 river miles upstream of the park's east boundary. Action Alternative 2 would construct a reservoir at an alternate location within the East Fork Virgin River Watershed. The stretch of the East Fork of the Virgin River that runs through Zion National Park is designated "Wild" under the Wild and Scenic Rivers Act. "Wild" rivers are "Those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. These represent vestiges of primitive America." (Foundation Document, pg 59) The foundation for wild and scenic river management is a clearly defined set of outstandingly remarkable values, free-flowing condition, and water quality. The outstandingly remarkable values for the East Fork of the Virgin River through Zion National Park include cultural, geologic, ecological processes, wildlife and fish. (Foundation Document, pg 62). In 2001, this same section of the river was designated by the park as a Research Natural Area, set aside for research purposes and closed to recreation. Zion manages the river corridor with an emphasis on resource protection. (Plan-EA, pg S-6)
278	72	4/29/2022	FR	Public	National Parks Conservation Association	Cory McNulty	54	Sensitive Species	Virgin Spinedace and other Species of Concern The East Fork of the Virgin River is important habitat for the Virgin spinedace (Lepidomeda mollispinis), managed under a Conservation Agreement (CA)2 among US Fish and Wildlife Service, Utah Division of Wildlife Resources, NPS, and several other local, state, and federal organizations. The objectives stated in the CA purpose are to 1) eliminate threats where possible and reduce threats to the greatest extent possible that cannot be eliminated entirely and 2) enhance and/or stabilize instream flows in specific reaches of occupied and unoccupied habitat. The East Fork of the Virgin River also provides habitat for: • Four native fish species: In addition to the Virgin spinedace (Lepidomeda mollispinis), desert sucker (Catostomus clarkia), flannelmouth sucker (Catostomus latipinnis), and speckled dace (Rhinichthys osculus). The desert sucker, flannelmouth sucker and Virgin spinedace are each listed as a Utah Species of Greatest Conservation Need by the Utah Department of Natural Resources. • Mexican Spotted Owl, which inhabit the East Fork of the Virgin River, part of designated critical habitat • Southwestern Willow Flycatcher and Yellow-Billed Cuckoo • State-listed Arizona Toad
279	72	4/29/2022	FR	Public	National Parks Conservation Association	Cory McNulty	54	Water Resources	Zion National Park Water Rights Settlement Agreement (1996) "The Department of the Interior entered into the Zion National Park Water Rights Settlement Agreement in 1996 with the State of Utah and water conservancy districts from Washington and Kane counties. This negotiated agreement resolved uncertainties in the water rights held by the United States under the 1909 proclamation designating Zion as a national monument. The 1996 agreement determined that "the United States has a reserved right to all water underlying, originating within or flowing through Zion National Park, including perennial, intermittent and ephemeral, streams, springs, seeps, lakes, ponds, ground water, and other natural sources of water" that was unappropriated when the park was established. It also asserts that these "waters are to remain in a free flowing condition." While very inclusive, this protection is not absolute because…(4) the agreement allows for some additional appropriation of water upstream of the park. These new appropriations are not to exceed a total of 6,000 acre-feet per year with no more than 2,500 of that coming from diversion of surface waters. The magnitude of this last provision is minimized by the fact that the state engineer manages the Virgin River Basin as fully appropriated, so no new water rights are permitted." (Foundation Document, pg 11)
280	72	4/29/2022	FR	Public	National Parks Conservation Association	Cory McNulty	54	Water Resources	NPCA concerns include but are not limited to: • The EIS must articulate how requirements of the Zion National Park Water Rights Settlement Agreement (1996) will be met and analyze anticipated impacts to the agreement, including the locations, timing and rate of actual diversions associated with the reservoir in each of the proposed action alternatives and how the flow will be sustained below any new surface water diversions. It must also include the location, flow rate and timing of releases and any return flow to the East Fork of the Virgin River. • The EIS must identify acre-feet of downstream water that will be available annually during the summer months for endangered fish species and Southwest Willow Flycatcher, and include a detailed flow schedule to back up any claims or an updated memorandum of understanding or other commitment that ecological flows will be met. • The approved water right(s) used to fill a reservoir of the sizes proposed must be disclosed in the EIS, particularly because the state engineer manages the Virgin River Basin as fully appropriated, so no new water rights are permitted. The over allocation of water in the Virgin River Basin is exacerbated by warming temperatures and shorter winters and must be fully addressed in the EIS. A study is needed to determine baseline flow in the East Fork of the Virgin River, and as water supplies decline as expected, who has the right to use it over the next 100 years, the life of the project.
281	72	4/29/2022	FR	Public	National Parks Conservation Association	Cory McNulty	54	Wild and Scenic Rivers	• The EIS must provide adequate information and analysis to determine how the proposed action alternatives will change the flow rates and timing, and downstream temperature, and how those factors might affect the Virgin spinedace, desert sucker, and speckled dace's habitat as well as the outstandingly remarkable values (ORVs) and "Wild" designation of the East Fork of the Virgin River. NRCS must determine the impact of the proposed project on the ORVs, freeflowing condition and water quality that underpin the "Wild" designation for the East Fork of the Virgin River through Zion National Park.

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282	72	4/29/2022	FR	Public	National Parks Conservation Assosciation	Cory McNulty	54	Sensitive Species	• To fulfill the Spinedace Conservation Agreement, the EIS must provide an analysis on how changes in the flow (timing, rate) downstream of the proposed reservoir and its diversion points may impact Virgin spinedace or their habitat and identify mitigation measures, where appropriate. • If stocking non-native salmonids or other game fish species is still proposed under the action alternatives, the EIS must include analyses to address whether the reservoir conservation pool could support a sport fishery, and if that sport fishery would result in introductions of nonnative species that could threaten the Virgin spinedace in Zion National Park or the threatened fish species downstream. The Virgin spinedace CA states, “Stocking of salmonids is to be restricted to areas in association with existing salmonid populations OR made in new areas only where they will not conflict with native species of special concern.” (CA, pg 13)
283	72	4/29/2022	FR	Public	National Parks Conservation Assosciation	Cory McNulty	54	Health and Safety	• The EIS must fully analyze the consequences of dam failure on stream flows, including flows through the protected portion of the river and its ORVs in Zion National Park, downstream infrastructure, or park visitors. The geologic seismic hazard classification for the Cove Reservoir dam in the Plan-EA was “high hazard” due to potential loss of life and serious damage to homes, public utilities and highway 89. (Plan-EA, Appendix D pg 6) If the dam fails, an extraordinary surge of water would flow across highway 89, the major road connecting Bryce Canyon and Zion National Parks and the primary access route to the east entrance of Zion National Park. Visitors accessing Zion National Park from Kane County will likely increase if the East Zion Initiative is successful in creating an East Zion visitor contact station and trail network as anticipated, thereby increasing the number of visitors who would be negatively impacted by a dam breach. Nearly all of the water from a dam failure would likely flow down the East Fork of the Virgin River and through the “Wild” section in Zion National Park where there could be catastrophic damage to the river ecosystem and ORVs.
284	72	4/29/2022	FR	Public	National Parks Conservation Assosciation	Cory McNulty	54	Recreation	• While we recognize the potential for outdoor recreation and national park tourism to contribute to economic sustainability of small rural communities such as Orderville, Mt. Carmel and Glendale, methods used previously to calculate potential recreation benefits of the Cove Reservoir in Appendix E-46 of the 2020 Plan-EA were flawed. Given the importance of calculating accurate economic benefits to justify the high cost of constructing a reservoir under the action alternatives, the EIS should use accepted social science techniques for estimating outdoor recreation visitation.
285	72	4/29/2022	FR	Public	National Parks Conservation Assosciation	Cory McNulty	54	General	Thank you for the opportunity to provide scoping comments for the Cove-East Fork Virgin River Watershed Project EIS to fully assess the impacts of the proposed action alternatives on the resources of Zion National Park, the Virgin River system and the surrounding landscape. Please include me in future correspondence or public engagement opportunities regarding this project: We look forward to participating in the process as the plan evolves.
286	73	4/29/2022	FR	Public		April Johnson	55	General	Locals don't want this and don't trust Mike Noel. Jackson Flat Reservoir is already gross and low most of the year. We live in a desert - if tourists need water recreation, they can migrate to northern latitudes. This project doesn't make sense and in my opinion, is wasting NRCS's valuable expertise and money. I imagine a fair amount of our tax money is also being wasted on this project. Why does the burden of proof that this project is unwanted, unmerited, and unnecessary require the entire NEPA process? Shouldn't it suffice that only about a dozen people want this? The system is broken. You should've turned down this application long ago. But because I have no power to change anything, I will simply say.....
287	73	4/29/2022	FR	Public		April Johnson	55	Climate Change	This EIS needs to include: 1. Study existing megadrought conditions and the current modeling for the future of water supplies in the region driven by climate change and determine if this project is sustainable.
288	73	4/29/2022	FR	Public		April Johnson	55	Economics	2. Suggest that federal agricultural funding might best be used to help farmers in Kane and Washington counties transition to climate and sustainable smart agriculture. There are a variety of new agricultural technologies including remote sensing technology that can result in using less water and increasing yield. These are practices that are beginning to be used world-wide. A cost-effective study should be completed comparing the cost of arming farmers with new technologies vs. the cost and environmental impact of constructing and maintaining the Cove Reservoir.
289	73	4/29/2022	FR	Public		April Johnson	55	Water Resources	3. Analyze the direct, indirect, and cumulative impacts of eliminating high flows on both the East Fork and the Main Virgin as it relates to the hydrologic connection of both ground and surface water. Changing river flow levels forever could hinder how the aquifer is recharged along with permanently decreasing the flow of surface water downstream of the project area.
290	73	4/29/2022	FR	Public		April Johnson	55	Sensitive Species	4. Study the history of what caused the endangered fish in the Virgin to become imperiled in the first place and evaluate how further reducing perennial flows will further complicate the effort to save these species. Changing the historical flows are likely to have an impact as well on the entire riparian zone along the river. This must be carefully evaluated.
291	73	4/29/2022	FR	Public		April Johnson	55	Water Resources	5. Complete an analysis of ecosystem health of the Virgin River watershed with attention to how using more fertilizer for agriculture affects downstream water quality.
292	73	4/29/2022	FR	Public		April Johnson	55	Water Resources	6. Complete an analysis of the complete Virgin River watershed and how water supplies and quality may be affected in Arizona and Nevada as the Virgin River watershed is technically in the Lower Basin drainage.
293	73	4/29/2022	FR	Public		April Johnson	55	Water Resources	7. Analyze and evaluate the water rights that the irrigation companies are using to build the project. Current records show these water rights are being protested by other water users.
294	73	4/29/2022	FR	Public		April Johnson	55	Economics	8. Calculate the cost/benefit ratios for the 100-year life of the project.
295	74	4/29/202	FR	Public		Michael Lerner	56	Alternatives	I urge the EIS to consider an alternative of no reservoir but only improved irrigation with federal assistance. Rather than building an expensive dam and continue the county’s relatively quite high average per capita water usage, how about the federal government providing some of the cost for installing vastly more efficient drip irrigation systems? The net cost would be far less, and if alfalfa proves too water-intensive, then other, climate-smart crops should be grown in this arid region. The government could provide assistance or incentives to switch to less water-intensive crops there. Water conservation would be the best outcome, and it could be done to every party’s satisfaction. So please make that an option besides the no action alternative or building a reservoir in several possible locations. Thank you.

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296	75	4/29/2022	FR	Public		Richard Spotts	1	Purpose and Need	Please carefully consider, respond to in the DEIS, and include in the NEPA project file my following supplemental scoping comments. The Council on Environmental Quality (CEQ) is responsible for NEPA oversight and effective implementation. CEQ recently adopted their "Phase 1" NEPA regulations which go into legal effect very soon. Because there would be no hardship or substantial delay in doing so, NRCS should prepare the DEIS under these "Phase 1" regulations. Prior to the corrupt, weakening Trump CEQ regulations (which remain under pending litigation), these "new" CEQ regulations are actually reinstating the previous regulations that were in effect for decades. These regulations are well-settled and have had significant judicial interpretations over many years. It would be foolish for NRCS to attempt to use the Trump era CEQ regulations because of the pending litigation and the high potential for public and agency confusion. In applying these "Phase 1" CEQ regulations, it is especially important that NRCS use a balanced purpose and need statement that is broad enough to capture what the applicant wants as well as what NRCS should evaluate as bona fide watershed restoration projects. It will be an enormous travesty if NRCS uses an arbitrarily narrow purpose and need statement so that it can improperly limit the alternatives carried forward for detailed DEIS comparison and analysis.
297	75	4/29/2022	FR	Public		Richard Spotts	1	Alternatives	The DEIS alternatives should include proposed projects that would increase the capture of storm water, slow runoff, reduce gully downcutting, prevent further soil erosion, restore riparian habitats, and increase water infiltration for groundwater recharge. These are legitimate watershed health and restoration projects that would benefit the public interest. I strongly oppose the proposed Cove Reservoir because it would improperly divert Virgin River water for wasteful purposes: growing summer alfalfa and stimulating unsustainable urban sprawl. I support the previous request for an objective investigation into whether this proposed "watershed plan" is a fraudulent Trojan horse for the Cove Reservoir, and whether the purported agricultural benefits are a smokescreen for likely future lucrative water transfers to add to urban sprawl. In the midst of the worst reported drought in 1,200 years, and with the Colorado and Virgin River waters fully appropriated with cutbacks and conflicts already underway, it is crazy for NRCS to be moving forward with such a wasteful, controversial, and potentially illegal venture. Ideally, NRCS should publish a Federal Register notice to withdraw this NOI and terminate this senseless NEPA process. Otherwise, if NRCS proceeds with this DEIS, it should be fair, honest, and comprehensive. Thank you very much for your consideration.
298	76	4/29/2022	FR	Public		Latimer Smith	57	General	Thank you for providing this opportunity for concerned citizens like myself to comment on this scoping process. I'll be brief and add more to what I've written here once the DRAFT EIS becomes available. My name is Latimer Smith and I live in Kane County in the town of Kanab. Over the past few years, I have spent a significant amount of time exploring the East Fork of the Virgin River with my two children. Any time we have a chance during the spring, summer, and fall months we use the river as a place of refuge; a place to swim, a place to catch frogs and snakes, and a place to relax in the shade near running water. It seems all for this would be threatened with the construction of the Cove Reservoir. It has been said by members of the NRCS and other supporters that the reservoir and the "steady" downstream flows it would bring would benefit the fish and other aquatic life that inhabit the river. This notion seems completely nonsensical to me. Free-flowing rivers tend to be much more beneficial to fish and other life. The river is currently irrigated and, in some cases, diverted from its natural course and flow. These factors have caused stress to the river and these realities are evident during the late summer when some flows have dwindled and algae colonies -undoubtedly enhanced by upstream agricultural runoff- abound. The health and future of a wild and beautiful East Fork of the Virgin is important to me, but the larger picture is the Megadrought we are currently in, intensified by global climate change. Peer reviewed analysis of our climate has shown that the decreased overall snow and rainfall, hotter than normal temperatures, and long periods without any precipitation whatsoever, are happening because of climate change. The scientific information we have is telling us that these conditions will continue to worsen, especially as humans continue to put fossil fuel emissions into the atmosphere. In light of the realities we are facing, and that will continue to intensify, it seems completely reckless to me that this proposed reservoir is on the table for consideration. Because of the reasons I have listed above, I do not support the diversion of the East Fork of the Virgin River or the construction of Cove Reservoir. Instead, I would like all of us to tread lighter on the earth and find ways to conserve the water and the natural beauty that we are so fortunate to have. I am a big supporter of Conserve Southwest Utah. They have come up with 8 points that I would like to share here with my comments. I look forward to remaining engaged and submitting more comments in the future.
299	76	4/29/2022	FR	Public		Latimer Smith	57	Climate Change	Conserve Southwest Comments (below) 1. Study existing megadrought conditions and the current modeling for the future of water supplies in the region driven by climate change and determine if this project is sustainable.
300	76	4/29/2022	FR	Public		Latimer Smith	57	Economics	2. Suggest that federal agricultural funding might best be used to help farmers in Kane and Washington counties transition to climate and sustainable smart agriculture. There are a variety of new agricultural technologies including remote sensing technology that can result in using less water and increasing yield. These are practices that are beginning to be used world-wide. A cost-effective study should be completed comparing the cost of arming farmers with new technologies vs. the cost and environmental impact of constructing and maintaining the Cove Reservoir.

CID	Doc ID	Received	Type	Group	Entity	Commenter	Commenter ID	Category	Comment
301	76	4/29/2022	FR	Public		Latimer Smith	57	Water Resources	3. Analyze the direct, indirect, and cumulative impacts of eliminating high flows on both the East Fork and the Main Virgin as it relates to the hydrologic connection of both ground and surface water. Changing river flow levels forever could hinder how the aquifer is recharged along with permanently decreasing the flow of surface water downstream of the project area.
302	76	4/29/2022	FR	Public		Latimer Smith	57	Sensitive Species	4. Study the history of what caused the endangered fish in the Virgin to become imperiled in the first place and evaluate how further reducing perennial flows will further complicate the effort to save these species. Changing the historical flows are likely to have an impact as well on the entire riparian zone along the river. This must be carefully evaluated.
303	76	4/29/2022	FR	Public		Latimer Smith	57	Water Resources	5. Complete an analysis of ecosystem health of the Virgin River watershed with attention to how using more fertilizer for agriculture affects downstream water quality.
304	76	4/29/2022	FR	Public		Latimer Smith	57	Water Resources	6. Complete an analysis of the complete Virgin River watershed and how water supplies and quality may be affected in Arizona and Nevada as the Virgin River watershed is technically in the Lower Basin drainage.
305	76	4/29/2022	FR	Public		Latimer Smith	57	Water Resources	7. Analyze and evaluate the water rights that the irrigation companies are using to build the project. Current records show these water rights are being protested by other water users.
306	76	4/29/2022	FR	Public		Latimer Smith	57	Economics	8. Calculate the cost/benefit ratios for the 100-year life of the project.

Section 106 Consultation

First Cultural Resource Inventory Report

SHPO Consultation

January 9, 2020

Dr. Christopher Merritt, PhD
State Historic Preservation Officer
Utah Division of State History
300 Rio Grande Avenue
Salt Lake City, Utah 84101-1182

Reference: Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah (UDSH Project No. U18TN0544)

Dear Dr. Merritt:

Included in this submission are a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah,* and accompanying data. The Natural Resources Conservation Service (NRCS) is providing technical and financial assistance through the Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566 Stat. 666 as amended [16 U.S.C. Section 1001 et. Seq.]) 1954, as amended, to the Kane County Water Conservancy District (KCWCD), as the project sponsor, to construct a new dam and improve water management infrastructure within the East Fork Virgin River Watershed, located north of Orderville, Utah. Specific improvements include the construction of a 6,055-acre foot reservoir (Cove Reservoir) that would provide enhanced conservation and a reliable water source for local agricultural users and maintain pressure through the local irrigation system. In addition, the existing Glendale hydroelectric power plant would be relocated and upgraded, which would double the amount of green energy created. Furthermore, the water from Cove Reservoir would be released during the summer months, providing additional water flow and reducing high water temperatures for the endangered Virging River chub and woundfin. To assess the environmental impacts of the project, a Watershed Plan and Environmental Assessment is being prepared by Transcon Environmental, on behalf of the NRCS, in cooperation with the Washington County Water Conservancy District, the Bureau of Land Management (BLM), and the National Park Service.

The Area of Potential Effects (APE) for the project encompasses a total of 791.68 acres, which includes the proposed reservoir area, the hyrdroelectric plant locations, four borrow pits, a linear survey of a new water pipeline, powerline, and utility corridor locations, and a spot check/survey of two borrow pit locations. Of the total acreage, 152.18 acres are on BLM Kanab Field-Office-managed land, 70.33 acres are on State of Utah, School and Institutional Trust Lands Administration (SITLA)-managed lands, and 569.17 are on privately-owned lands. The NRCS is acting as the lead Federal agency for the purposes of Section 106 consultation, which will also cover SITLA's responsibilities under Utah Code Annotated Section 9-8-404. The BLM and the U.S. Army Corps of Engineers are cooperating agencies.

A pedestrian cultural resource inventory of the undertaking was completed by Transcon Environmental on October 1 through 8 and October 10 through 13, 2018; supplemental surveys of the project occurred between June 12 through 14. A total of 9 new cultural resource sites (42KA8785, 42KA8900, 42KA8901, 42KA8902, 42KA8903, 42KA8904, 42KA8972, 42KA8973, and 42KA8974), 1 previous cultural resource site (42KA6331), and 15 isolated occurrences (IOs) were identified and recorded within the Project APE. Five archaeological sites and two historic structures were identified as a result of the inventory. Table 1 summarizes the sites identified and the NRCS' National Register of Historic Places (NRHP) eligibility determinations.

Table 1. Summary of sites and structures in the survey area

Site Number/ Land Status	Site Type	NRHP Eligibility	Effects
42KA6331/ BLM	Prehistoric lithic scatter	Eligible—D (previously determined)	*No Adverse Effect to Historic Properties.* Site will be avoided by at least 50 feet by all project activities. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.
42KA8785/ Private	Prehistoric artifact scatter	Eligible – D	*No Adverse Effect to Historic Properties*. Site will be avoided by at least 50 feet by all project activities. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.
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42KA8901/ Private	Multicomponent: prehistoric lithic scatter, historic artifact scatters	Not Eligible	No Effects
42KA8902/ Private	Historic artifact scatter	Not Eligible	No Effects
42KA8903/ Private	Historic artifact scatter	Not Eligible	No Effects
42KA8904/ Private	Prehistoric ceramic, lithic, and FCR scatter	Eligible—D	*No Adverse Effect to Historic Properties.* Site will be avoided by at least 50 feet by all project activities. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.
42KA8972/ BLM	Prehistoric lithic scatter	Not Eligible	No Effects
42KA8973/ BLM	Prehistoric artifact scatter	Not Eligible	No Effects
42KA8974/ Private	Prehistoric artifact scatter	Eligible—D	*No Adverse Effect to Historic Properties* if the site is avoided. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.

Based on the results of the cultural resources survey and adherence to the avoidance stipulations described above, the NRCS recommends that the project proceed as planned with a determination of ***no adverse effect to historic properties***. The NRCS requests concurrence for the determination of project effects and site eligibility. If you have any questions, comments, or concerns, please contact Tara S. Hoffmann, State Cultural Resources Specialist, at 801-524-4556 at your convenience.

Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)
Norm Evenstad, Water Resources Coordinator, NRCS, Salt Lake City, Utah
Derek Hamilton, Biologist, NRCS, Salt Lake City, Utah
Kristine Curry, Archaeologist, SITLA, Salt Lake City, Utah
Tara S. Hoffmann, State Cultural Resources Specialist, NRCS, Salt Lake City, Utah

January 17, 2020

Emily Fife
Natural Resources Conservation Service USDA
USDA - NRCS
Wallace F. Bennett Federal Building
125 South State Street, Room 4010
Salt Lake City, Utah 84138-1100

RE: Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah

For future correspondence, please reference Case No. 20-0121

Dear Emily,

The Utah State Historic Preservation Office received your request for our comment on the above-referenced undertaking on January 10, 2020.

We concur with your determinations of eligibility and effect for this undertaking.

This letter serves as our comment on the determinations you have made within the consultation process specified in §36CFR800.4. If you have questions, please contact me at 801-245-7263 or by email at cmerritt@utah.gov.

Sincerely,



Christopher W. Merritt, Ph.D.
State Historic Preservation Officer

Utah Department of Heritage & Arts

Tribal Consultation

January 9, 2020

Mr. Val Panteah Sr.
Governor
Pueblo of Zuni
P.O. Box 339
Zuni, New Mexico 87327

Reference: Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah (UDSH Project No. U18TN0544)

Dear Mr. Panteah:

Enclosed is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah.* The Natural Resources Conservation Service (NRCS) is providing technical and financial assistance through the Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566 Stat. 666 as amended [16 U.S.C. Section 1001 et. Seq.]) 1954, as amended, to the Kane County Water Conservancy District (KCWCD), as the project sponsor, to construct a new dam and improve water management infrastructure within the East Fork Virgin River Watershed, located north of Orderville, Utah. Specific improvements include the construction of a 6,055-acre foot reservoir (Cove Reservoir) that would provide enhanced conservation and a reliable water source for local agricultural users and maintain pressure through the local irrigation system. In addition, the existing Glendale hydroelectric power plant would be relocated and upgraded, which would double the amount of green energy created. Furthermore, the water from Cove Reservoir would be released during the summer months, providing additional water flow and reducing high water temperatures for the endangered Virging River chub and woundfin. To assess the environmental impacts of the project, a Watershed Plan and Environmental Assessment is being prepared by Transcon Environmental, on behalf of the NRCS, in cooperation with the Washington County Water Conservancy District, the Bureau of Land Management (BLM), and the National Park Service.

The Area of Potential Effects (APE) for the project encompasses a total of 791.68 acres, which includes the proposed reservoir area, the hyrdroelectric plant locations, four borrow pits, a linear survey of a new water pipeline, powerline, and utility corridor locations, and a spot check/survey of two borrow pit locations. Of the total acreage, 152.18 acres are on BLM Kanab Field-Office-managed land, 70.33 acres are on State of Utah, School and Institutional Trust Lands Administration (SITLA)-managed lands, and 569.17 are on privately-owned lands. The NRCS is acting as the lead Federal agency for the purposes of Section 106 consultation, which will also cover SITLA's responsibilities under Utah Code Annotated Section 9-8-404. The BLM and the U.S. Army Corps of Engineers are cooperating agencies.

A pedestrian cultural resource inventory of the undertaking was completed by Transcon Environmental on October 1 through 8 and October 10 through 13, 2018; supplemental surveys of the project occurred between June 12 through 14. A total of 9 new cultural resource sites (42KA8785, 42KA8900, 42KA8901, 42KA8902, 42KA8903, 42KA8904, 42KA8972, 42KA8973, and 42KA8974), 1 previous cultural resource site (42KA6331), and 15 isolated occurrences (IOs) were identified and recorded within the Project APE. Five archaeological sites and two historic structures were identified as a result of the inventory. Table 1 summarizes the sites identified and the NRCS' National Register of Historic Places (NRHP) eligibility determinations.

Table 1. Summary of sites and structures in the survey area

Site Number/ Land Status	Site Type	NRHP Eligibility	Effects
42KA6331/ BLM	Prehistoric lithic scatter	Eligible—D (previously determined)	*No Adverse Effect to Historic Properties.* Site will be avoided by at least 50 feet by all project activities. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.
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Based on the results of the cultural resources survey and adherence to the avoidance stipulations described above, the NRCS recommends that the project proceed as planned with a determination

of ***no adverse effect to historic properties***. The NRCS requests concurrence for the determination of project effects and site eligibility. If you have any questions, comments, or concerns, please contact Tara S. Hoffmann, State Cultural Resources Specialist, at 801-524-4556 at your convenience.

Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)
Norm Evenstad, Water Resources Coordinator, NRCS, Salt Lake City, Utah
Derek Hamilton, Biologist, NRCS, Salt Lake City, Utah
Kristine Curry, Archaeologist, SITLA, Salt Lake City, Utah
Tara S. Hoffmann, State Cultural Resources Specialist, NRCS, Salt Lake City, Utah

January 9, 2020

Ms. Ona Segundo
Chairwoman
Kaibab Band of Paiute Indians of the Kaibab Indian Reservation
Tribal Affairs Building
HC65, Box 2
Fredonia, Arizona 86022

Reference: Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah (UDSH Project No. U18TN0544)

Dear Ms. Segundo:

Enclosed is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah.* The Natural Resources Conservation Service (NRCS) is providing technical and financial assistance through the Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566 Stat. 666 as amended [16 U.S.C. Section 1001 et. Seq.]) 1954, as amended, to the Kane County Water Conservancy District (KCWCD), as the project sponsor, to construct a new dam and improve water management infrastructure within the East Fork Virgin River Watershed, located north of Orderville, Utah. Specific improvements include the construction of a 6,055-acre foot reservoir (Cove Reservoir) that would provide enhanced conservation and a reliable water source for local agricultural users and maintain pressure through the local irrigation system. In addition, the existing Glendale hydroelectric power plant would be relocated and upgraded, which would double the amount of green energy created. Furthermore, the water from Cove Reservoir would be released during the summer months, providing additional water flow and reducing high water temperatures for the endangered Virging River chub and woundfin. To assess the environmental impacts of the project, a Watershed Plan and Environmental Assessment is being prepared by Transcon Environmental, on behalf of the NRCS, in cooperation with the Washington County Water Conservancy District, the Bureau of Land Management (BLM), and the National Park Service.

The Area of Potential Effects (APE) for the project encompasses a total of 791.68 acres, which includes the proposed reservoir area, the hyrdroelectric plant locations, four borrow pits, a linear survey of a new water pipeline, powerline, and utility corridor locations, and a spot check/survey of two borrow pit locations. Of the total acreage, 152.18 acres are on BLM Kanab Field-Office-managed land, 70.33 acres are on State of Utah, School and Institutional Trust Lands Administration (SITLA)-managed lands, and 569.17 are on privately-owned lands. The NRCS is acting as the lead Federal agency for the purposes of Section 106 consultation, which will also cover SITLA's responsibilities under Utah Code Annotated Section 9-8-404. The BLM and the U.S. Army Corps of Engineers are cooperating agencies.

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Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)
Norm Evenstad, Water Resources Coordinator, NRCS, Salt Lake City, Utah
Derek Hamilton, Biologist, NRCS, Salt Lake City, Utah
Kristine Curry, Archaeologist, SITLA, Salt Lake City, Utah
Tara S. Hoffmann, State Cultural Resources Specialist, NRCS, Salt Lake City, Utah

January 9, 2020

Mr. Benny Tso
Chairman
Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony
One Paiute Drive
Las Vegas, Nevada 89106

Reference: Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah (UDSH Project No. U18TN0544)

Dear Mr. Tso:

Enclosed is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah.* The Natural Resources Conservation Service (NRCS) is providing technical and financial assistance through the Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566 Stat. 666 as amended [16 U.S.C. Section 1001 et. Seq.]) 1954, as amended, to the Kane County Water Conservancy District (KCWCD), as the project sponsor, to construct a new dam and improve water management infrastructure within the East Fork Virgin River Watershed, located north of Orderville, Utah. Specific improvements include the construction of a 6,055-acre foot reservoir (Cove Reservoir) that would provide enhanced conservation and a reliable water source for local agricultural users and maintain pressure through the local irrigation system. In addition, the existing Glendale hydroelectric power plant would be relocated and upgraded, which would double the amount of green energy created. Furthermore, the water from Cove Reservoir would be released during the summer months, providing additional water flow and reducing high water temperatures for the endangered Virging River chub and woundfin. To assess the environmental impacts of the project, a Watershed Plan and Environmental Assessment is being prepared by Transcon Environmental, on behalf of the NRCS, in cooperation with the Washington County Water Conservancy District, the Bureau of Land Management (BLM), and the National Park Service.

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Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)
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Derek Hamilton, Biologist, NRCS, Salt Lake City, Utah
Kristine Curry, Archaeologist, SITLA, Salt Lake City, Utah
Tara S. Hoffmann, State Cultural Resources Specialist, NRCS, Salt Lake City, Utah

January 9, 2020

Ms. Carlene Yellowhair
President
San Juan Southern Paiute Tribe of Arizona
50 South Main Street, Suite 201
P.O. Box 2950
Tuba City, Arizona 86045

Reference: Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah (UDSH Project No. U18TN0544)

Dear Ms. Yellowhair:

Enclosed is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah.* The Natural Resources Conservation Service (NRCS) is providing technical and financial assistance through the Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566 Stat. 666 as amended [16 U.S.C. Section 1001 et. Seq.]) 1954, as amended, to the Kane County Water Conservancy District (KCWCD), as the project sponsor, to construct a new dam and improve water management infrastructure within the East Fork Virgin River Watershed, located north of Orderville, Utah. Specific improvements include the construction of a 6,055-acre foot reservoir (Cove Reservoir) that would provide enhanced conservation and a reliable water source for local agricultural users and maintain pressure through the local irrigation system. In addition, the existing Glendale hydroelectric power plant would be relocated and upgraded, which would double the amount of green energy created. Furthermore, the water from Cove Reservoir would be released during the summer months, providing additional water flow and reducing high water temperatures for the endangered Virging River chub and woundfin. To assess the environmental impacts of the project, a Watershed Plan and Environmental Assessment is being prepared by Transcon Environmental, on behalf of the NRCS, in cooperation with the Washington County Water Conservancy District, the Bureau of Land Management (BLM), and the National Park Service.

The Area of Potential Effects (APE) for the project encompasses a total of 791.68 acres, which includes the proposed reservoir area, the hyrdroelectric plant locations, four borrow pits, a linear survey of a new water pipeline, powerline, and utility corridor locations, and a spot check/survey of two borrow pit locations. Of the total acreage, 152.18 acres are on BLM Kanab Field-Office-managed land, 70.33 acres are on State of Utah, School and Institutional Trust Lands Administration (SITLA)-managed lands, and 569.17 are on privately-owned lands. The NRCS is acting as the lead Federal agency for the purposes of Section 106 consultation, which will also cover SITLA's responsibilities under Utah Code Annotated Section 9-8-404. The BLM and the U.S. Army Corps of Engineers are cooperating agencies.

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Table 1. Summary of sites and structures in the survey area

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42KA8974/ Private	Prehistoric artifact scatter	Eligible—D	*No Adverse Effect to Historic Properties* if the site is avoided. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.

Based on the results of the cultural resources survey and adherence to the avoidance stipulations described above, the NRCS recommends that the project proceed as planned with a determination of ***no adverse effect to historic properties***. The NRCS requests concurrence for the determination of project effects and site eligibility. If you have any questions, comments, or concerns, please contact Tara S. Hoffmann, State Cultural Resources Specialist, at 801-524-4556 at your convenience.

Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)
Norm Evenstad, Water Resources Coordinator, NRCS, Salt Lake City, Utah
Derek Hamilton, Biologist, NRCS, Salt Lake City, Utah
Kristine Curry, Archaeologist, SITLA, Salt Lake City, Utah
Tara S. Hoffmann, State Cultural Resources Specialist, NRCS, Salt Lake City, Utah

January 9, 2020

Mr. Greg Anderson
Chairman
Moapa Band of Paiute Indians of the Moapa River Indian
Reservation, Nevada
P.O. Box 340
Moapa, Nevada 89025-0340

Reference: Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah (UDSH Project No. U18TN0544)

Dear Mr. Anderson:

Enclosed is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah.* The Natural Resources Conservation Service (NRCS) is providing technical and financial assistance through the Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566 Stat. 666 as amended [16 U.S.C. Section 1001 et. Seq.]) 1954, as amended, to the Kane County Water Conservancy District (KCWCD), as the project sponsor, to construct a new dam and improve water management infrastructure within the East Fork Virgin River Watershed, located north of Orderville, Utah. Specific improvements include the construction of a 6,055-acre foot reservoir (Cove Reservoir) that would provide enhanced conservation and a reliable water source for local agricultural users and maintain pressure through the local irrigation system. In addition, the existing Glendale hydroelectric power plant would be relocated and upgraded, which would double the amount of green energy created. Furthermore, the water from Cove Reservoir would be released during the summer months, providing additional water flow and reducing high water temperatures for the endangered Virging River chub and woundfin. To assess the environmental impacts of the project, a Watershed Plan and Environmental Assessment is being prepared by Transcon Environmental, on behalf of the NRCS, in cooperation with the Washington County Water Conservancy District, the Bureau of Land Management (BLM), and the National Park Service.

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Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)
Darren Deboda, Moapa Band of Paiute Indians of the Moapa River Indian Reservation, Nevada, P.O. Box 340, Moapa, Nevada 89025-0340
Norm Evenstad, Water Resources Coordinator, NRCS, Salt Lake City, Utah
Derek Hamilton, Biologist, NRCS, Salt Lake City, Utah
Kristine Curry, Archaeologist, SITLA, Salt Lake City, Utah
Tara S. Hoffmann, State Cultural Resources Specialist, NRCS, Salt Lake City, Utah

January 9, 2020

Mr. Russell Begaye
President
Navajo Nation Office of the President
100 Parkway
P.O. Box 7440
Window Rock, Arizona 86515

Reference: Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah (UDSH Project No. U18TN0544)

Dear Mr. Begaye:

Enclosed is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah.* The Natural Resources Conservation Service (NRCS) is providing technical and financial assistance through the Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566 Stat. 666 as amended [16 U.S.C. Section 1001 et. Seq.]) 1954, as amended, to the Kane County Water Conservancy District (KCWCD), as the project sponsor, to construct a new dam and improve water management infrastructure within the East Fork Virgin River Watershed, located north of Orderville, Utah. Specific improvements include the construction of a 6,055-acre foot reservoir (Cove Reservoir) that would provide enhanced conservation and a reliable water source for local agricultural users and maintain pressure through the local irrigation system. In addition, the existing Glendale hydroelectric power plant would be relocated and upgraded, which would double the amount of green energy created. Furthermore, the water from Cove Reservoir would be released during the summer months, providing additional water flow and reducing high water temperatures for the endangered Virging River chub and woundfin. To assess the environmental impacts of the project, a Watershed Plan and Environmental Assessment is being prepared by Transcon Environmental, on behalf of the NRCS, in cooperation with the Washington County Water Conservancy District, the Bureau of Land Management (BLM), and the National Park Service.

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Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)
Richard M. Begaye, THPO and Department Manager, Navajo Nation Historic Preservation Department, P.O. Box 4950, Window Rock, Arizona 86515
Norm Evenstad, Water Resources Coordinator, NRCS, Salt Lake City, Utah
Derek Hamilton, Biologist, NRCS, Salt Lake City, Utah
Kristine Curry, Archaeologist, SITLA, Salt Lake City, Utah
Tara S. Hoffmann, State Cultural Resources Specialist, NRCS, Salt Lake City, Utah

January 9, 2020

Mr. Charley Bullets
Southern Paiute Consortium
Kaibab Band of Paiute Indians of the Kaibab Indian Reservation
Cultural Preservation Office
HC65, Box 2
Fredonia, Arizona 86022

Reference: Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah (UDSH Project No. U18TN0544)

Dear Mr. Bullets:

Enclosed is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah.* The Natural Resources Conservation Service (NRCS) is providing technical and financial assistance through the Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566 Stat. 666 as amended [16 U.S.C. Section 1001 et. Seq.]) 1954, as amended, to the Kane County Water Conservancy District (KCWCD), as the project sponsor, to construct a new dam and improve water management infrastructure within the East Fork Virgin River Watershed, located north of Orderville, Utah. Specific improvements include the construction of a 6,055-acre foot reservoir (Cove Reservoir) that would provide enhanced conservation and a reliable water source for local agricultural users and maintain pressure through the local irrigation system. In addition, the existing Glendale hydroelectric power plant would be relocated and upgraded, which would double the amount of green energy created. Furthermore, the water from Cove Reservoir would be released during the summer months, providing additional water flow and reducing high water temperatures for the endangered Virging River chub and woundfin. To assess the environmental impacts of the project, a Watershed Plan and Environmental Assessment is being prepared by Transcon Environmental, on behalf of the NRCS, in cooperation with the Washington County Water Conservancy District, the Bureau of Land Management (BLM), and the National Park Service.

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Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)
Norm Evenstad, Water Resources Coordinator, NRCS, Salt Lake City, Utah
Derek Hamilton, Biologist, NRCS, Salt Lake City, Utah
Kristine Curry, Archaeologist, SITLA, Salt Lake City, Utah
Tara S. Hoffmann, State Cultural Resources Specialist, NRCS, Salt Lake City, Utah

January 9, 2020

Ms. Elaine Cantsee
Councilwoman
White Mesa, Ute Council
P.O. Box 7096
White Mesa, Utah 84511

Reference: Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah (UDSH Project No. U18TN0544)

Dear Ms. Cantsee:

Enclosed is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah.* The Natural Resources Conservation Service (NRCS) is providing technical and financial assistance through the Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566 Stat. 666 as amended [16 U.S.C. Section 1001 et. Seq.]) 1954, as amended, to the Kane County Water Conservancy District (KCWCD), as the project sponsor, to construct a new dam and improve water management infrastructure within the East Fork Virgin River Watershed, located north of Orderville, Utah. Specific improvements include the construction of a 6,055-acre foot reservoir (Cove Reservoir) that would provide enhanced conservation and a reliable water source for local agricultural users and maintain pressure through the local irrigation system. In addition, the existing Glendale hydroelectric power plant would be relocated and upgraded, which would double the amount of green energy created. Furthermore, the water from Cove Reservoir would be released during the summer months, providing additional water flow and reducing high water temperatures for the endangered Virging River chub and woundfin. To assess the environmental impacts of the project, a Watershed Plan and Environmental Assessment is being prepared by Transcon Environmental, on behalf of the NRCS, in cooperation with the Washington County Water Conservancy District, the Bureau of Land Management (BLM), and the National Park Service.

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Emily Fife

EMILY FIFE
State Conservationist

Enclosure

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Norm Evenstad, Water Resources Coordinator, NRCS, Salt Lake City, Utah
Derek Hamilton, Biologist, NRCS, Salt Lake City, Utah
Kristine Curry, Archaeologist, SITLA, Salt Lake City, Utah
Tara S. Hoffmann, State Cultural Resources Specialist, NRCS, Salt Lake City, Utah

January 9, 2020

Ms. Betsy Chapoose
Director
Cultural Rights Protection Department
Ute Indian Tribe of the Uintah & Ouray Reservation, Utah
P.O. Box 190
Fort Duchesne, Utah 84026

Reference: Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah (UDSH Project No. U18TN0544)

Dear Ms. Chapoose:

Enclosed is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah.* The Natural Resources Conservation Service (NRCS) is providing technical and financial assistance through the Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566 Stat. 666 as amended [16 U.S.C. Section 1001 et. Seq.]) 1954, as amended, to the Kane County Water Conservancy District (KCWCD), as the project sponsor, to construct a new dam and improve water management infrastructure within the East Fork Virgin River Watershed, located north of Orderville, Utah. Specific improvements include the construction of a 6,055-acre foot reservoir (Cove Reservoir) that would provide enhanced conservation and a reliable water source for local agricultural users and maintain pressure through the local irrigation system. In addition, the existing Glendale hydroelectric power plant would be relocated and upgraded, which would double the amount of green energy created. Furthermore, the water from Cove Reservoir would be released during the summer months, providing additional water flow and reducing high water temperatures for the endangered Virging River chub and woundfin. To assess the environmental impacts of the project, a Watershed Plan and Environmental Assessment is being prepared by Transcon Environmental, on behalf of the NRCS, in cooperation with the Washington County Water Conservancy District, the Bureau of Land Management (BLM), and the National Park Service.

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42KA8904/ Private	Prehistoric ceramic, lithic, and FCR scatter	Eligible—D	*No Adverse Effect to Historic Properties.* Site will be avoided by at least 50 feet by all project activities. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.
42KA8972/ BLM	Prehistoric lithic scatter	Not Eligible	No Effects
42KA8973/ BLM	Prehistoric artifact scatter	Not Eligible	No Effects
42KA8974/ Private	Prehistoric artifact scatter	Eligible—D	*No Adverse Effect to Historic Properties* if the site is avoided. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.

Based on the results of the cultural resources survey and adherence to the avoidance stipulations described above, the NRCS recommends that the project proceed as planned with a determination of ***no adverse effect to historic properties***. The NRCS requests concurrence for the determination of project effects and site eligibility. If you have any questions, comments, or concerns, please contact Tara S. Hoffmann, State Cultural Resources Specialist, at 801-524-4556 at your convenience.

Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)
Norm Evenstad, Water Resources Coordinator, NRCS, Salt Lake City, Utah
Derek Hamilton, Biologist, NRCS, Salt Lake City, Utah
Kristine Curry, Archaeologist, SITLA, Salt Lake City, Utah
Tara S. Hoffmann, State Cultural Resources Specialist, NRCS, Salt Lake City, Utah

January 9, 2020

Dr. Damon R. Clarke
Chairman
Hualapai Tribe
P.O. Box 179
941 Hualapai Way
Peach Springs Arizona 86434

Reference: Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah (UDSH Project No. U18TN0544)

Dear Dr. Clarke:

Enclosed is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah.* The Natural Resources Conservation Service (NRCS) is providing technical and financial assistance through the Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566 Stat. 666 as amended [16 U.S.C. Section 1001 et. Seq.]) 1954, as amended, to the Kane County Water Conservancy District (KCWCD), as the project sponsor, to construct a new dam and improve water management infrastructure within the East Fork Virgin River Watershed, located north of Orderville, Utah. Specific improvements include the construction of a 6,055-acre foot reservoir (Cove Reservoir) that would provide enhanced conservation and a reliable water source for local agricultural users and maintain pressure through the local irrigation system. In addition, the existing Glendale hydroelectric power plant would be relocated and upgraded, which would double the amount of green energy created. Furthermore, the water from Cove Reservoir would be released during the summer months, providing additional water flow and reducing high water temperatures for the endangered Virging River chub and woundfin. To assess the environmental impacts of the project, a Watershed Plan and Environmental Assessment is being prepared by Transcon Environmental, on behalf of the NRCS, in cooperation with the Washington County Water Conservancy District, the Bureau of Land Management (BLM), and the National Park Service.

The Area of Potential Effects (APE) for the project encompasses a total of 791.68 acres, which includes the proposed reservoir area, the hyrdroelectric plant locations, four borrow pits, a linear survey of a new water pipeline, powerline, and utility corridor locations, and a spot check/survey of two borrow pit locations. Of the total acreage, 152.18 acres are on BLM Kanab Field-Office-managed land, 70.33 acres are on State of Utah, School and Institutional Trust Lands Administration (SITLA)-managed lands, and 569.17 are on privately-owned lands. The NRCS is acting as the lead Federal agency for the purposes of Section 106 consultation, which will also cover SITLA's responsibilities under Utah Code Annotated Section 9-8-404. The BLM and the U.S. Army Corps of Engineers are cooperating agencies.

A pedestrian cultural resource inventory of the undertaking was completed by Transcon Environmental on October 1 through 8 and October 10 through 13, 2018; supplemental surveys of the project occurred between June 12 through 14. A total of 9 new cultural resource sites (42KA8785, 42KA8900, 42KA8901, 42KA8902, 42KA8903, 42KA8904, 42KA8972, 42KA8973, and 42KA8974), 1 previous cultural resource site (42KA6331), and 15 isolated occurrences (IOs) were identified and recorded within the Project APE. Five archaeological sites and two historic structures were identified as a result of the inventory. Table 1 summarizes the sites identified and the NRCS' National Register of Historic Places (NRHP) eligibility determinations.

Table 1. Summary of sites and structures in the survey area

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42KA8974/ Private	Prehistoric artifact scatter	Eligible—D	*No Adverse Effect to Historic Properties* if the site is avoided. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.

Based on the results of the cultural resources survey and adherence to the avoidance stipulations described above, the NRCS recommends that the project proceed as planned with a determination of ***no adverse effect to historic properties***. The NRCS requests concurrence for the determination of project effects and site eligibility. If you have any questions, comments, or concerns, please contact Tara S. Hoffmann, State Cultural Resources Specialist, at 801-524-4556 at your convenience.

Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)
Norm Evenstad, Water Resources Coordinator, NRCS, Salt Lake City, Utah
Derek Hamilton, Biologist, NRCS, Salt Lake City, Utah
Kristine Curry, Archaeologist, SITLA, Salt Lake City, Utah
Tara S. Hoffmann, State Cultural Resources Specialist, NRCS, Salt Lake City, Utah

January 9, 2020

Mr. Harold Cuthair
Chairman
Ute Mountain Ute Tribe
P.O. Box JJ
125 Mikewash Road
Towaoc, Colorado 81334

Reference: Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah (UDSH Project No. U18TN0544)

Dear Mr. Cuthair:

Enclosed is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah.* The Natural Resources Conservation Service (NRCS) is providing technical and financial assistance through the Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566 Stat. 666 as amended [16 U.S.C. Section 1001 et. Seq.]) 1954, as amended, to the Kane County Water Conservancy District (KCWCD), as the project sponsor, to construct a new dam and improve water management infrastructure within the East Fork Virgin River Watershed, located north of Orderville, Utah. Specific improvements include the construction of a 6,055-acre foot reservoir (Cove Reservoir) that would provide enhanced conservation and a reliable water source for local agricultural users and maintain pressure through the local irrigation system. In addition, the existing Glendale hydroelectric power plant would be relocated and upgraded, which would double the amount of green energy created. Furthermore, the water from Cove Reservoir would be released during the summer months, providing additional water flow and reducing high water temperatures for the endangered Virging River chub and woundfin. To assess the environmental impacts of the project, a Watershed Plan and Environmental Assessment is being prepared by Transcon Environmental, on behalf of the NRCS, in cooperation with the Washington County Water Conservancy District, the Bureau of Land Management (BLM), and the National Park Service.

The Area of Potential Effects (APE) for the project encompasses a total of 791.68 acres, which includes the proposed reservoir area, the hyrdroelectric plant locations, four borrow pits, a linear survey of a new water pipeline, powerline, and utility corridor locations, and a spot check/survey of two borrow pit locations. Of the total acreage, 152.18 acres are on BLM Kanab Field-Office-managed land, 70.33 acres are on State of Utah, School and Institutional Trust Lands Administration (SITLA)-managed lands, and 569.17 are on privately-owned lands. The NRCS is acting as the lead Federal agency for the purposes of Section 106 consultation, which will also cover SITLA's responsibilities under Utah Code Annotated Section 9-8-404. The BLM and the U.S. Army Corps of Engineers are cooperating agencies.

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Table 1. Summary of sites and structures in the survey area

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Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)
Norm Evenstad, Water Resources Coordinator, NRCS, Salt Lake City, Utah
Derek Hamilton, Biologist, NRCS, Salt Lake City, Utah
Kristine Curry, Archaeologist, SITLA, Salt Lake City, Utah
Tara S. Hoffmann, State Cultural Resources Specialist, NRCS, Salt Lake City, Utah

January 9, 2020

Dr. Kurt Dongoske
Director and Tribal Historic Preservation Officer
Pueblo of Zuni
P.O. Box 1149
Zuni, New Mexico 87327

Reference: Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah (UDSH Project No. U18TN0544)

Dear Dr. Dongoske:

Enclosed is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah.* The Natural Resources Conservation Service (NRCS) is providing technical and financial assistance through the Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566 Stat. 666 as amended [16 U.S.C. Section 1001 et. Seq.]) 1954, as amended, to the Kane County Water Conservancy District (KCWCD), as the project sponsor, to construct a new dam and improve water management infrastructure within the East Fork Virgin River Watershed, located north of Orderville, Utah. Specific improvements include the construction of a 6,055-acre foot reservoir (Cove Reservoir) that would provide enhanced conservation and a reliable water source for local agricultural users and maintain pressure through the local irrigation system. In addition, the existing Glendale hydroelectric power plant would be relocated and upgraded, which would double the amount of green energy created. Furthermore, the water from Cove Reservoir would be released during the summer months, providing additional water flow and reducing high water temperatures for the endangered Virging River chub and woundfin. To assess the environmental impacts of the project, a Watershed Plan and Environmental Assessment is being prepared by Transcon Environmental, on behalf of the NRCS, in cooperation with the Washington County Water Conservancy District, the Bureau of Land Management (BLM), and the National Park Service.

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of ***no adverse effect to historic properties***. The NRCS requests concurrence for the determination of project effects and site eligibility. If you have any questions, comments, or concerns, please contact Tara S. Hoffmann, State Cultural Resources Specialist, at 801-524-4556 at your convenience.

Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)
Norm Evenstad, Water Resources Coordinator, NRCS, Salt Lake City, Utah
Derek Hamilton, Biologist, NRCS, Salt Lake City, Utah
Kristine Curry, Archaeologist, SITLA, Salt Lake City, Utah
Tara S. Hoffmann, State Cultural Resources Specialist, NRCS, Salt Lake City, Utah

January 9, 2020

Mr. Luke Duncan
Chairman
Ute Indian Tribe of the Uintah & Ouray Reservation, Utah
P.O. Box 190
Fort Duchesne, Utah 84026

Reference: Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah (UDSH Project No. U18TN0544)

Dear Mr. Duncan:

Enclosed is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah.* The Natural Resources Conservation Service (NRCS) is providing technical and financial assistance through the Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566 Stat. 666 as amended [16 U.S.C. Section 1001 et. Seq.]) 1954, as amended, to the Kane County Water Conservancy District (KCWCD), as the project sponsor, to construct a new dam and improve water management infrastructure within the East Fork Virgin River Watershed, located north of Orderville, Utah. Specific improvements include the construction of a 6,055-acre foot reservoir (Cove Reservoir) that would provide enhanced conservation and a reliable water source for local agricultural users and maintain pressure through the local irrigation system. In addition, the existing Glendale hydroelectric power plant would be relocated and upgraded, which would double the amount of green energy created. Furthermore, the water from Cove Reservoir would be released during the summer months, providing additional water flow and reducing high water temperatures for the endangered Virging River chub and woundfin. To assess the environmental impacts of the project, a Watershed Plan and Environmental Assessment is being prepared by Transcon Environmental, on behalf of the NRCS, in cooperation with the Washington County Water Conservancy District, the Bureau of Land Management (BLM), and the National Park Service.

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Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)
Norm Evenstad, Water Resources Coordinator, NRCS, Salt Lake City, Utah
Derek Hamilton, Biologist, NRCS, Salt Lake City, Utah
Kristine Curry, Archaeologist, SITLA, Salt Lake City, Utah
Tara S. Hoffmann, State Cultural Resources Specialist, NRCS, Salt Lake City, Utah

January 9, 2020

Ms. Dawn Hubbs
Tribal Historic Preservation Officer
Hualapai Tribe
P.O. Box 310
941 Hualapai Way
Peach Springs Arizona 86434

Reference: Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah (UDSH Project No. U18TN0544)

Dear Ms. Hubbs:

Enclosed is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah.* The Natural Resources Conservation Service (NRCS) is providing technical and financial assistance through the Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566 Stat. 666 as amended [16 U.S.C. Section 1001 et. Seq.]) 1954, as amended, to the Kane County Water Conservancy District (KCWCD), as the project sponsor, to construct a new dam and improve water management infrastructure within the East Fork Virgin River Watershed, located north of Orderville, Utah. Specific improvements include the construction of a 6,055-acre foot reservoir (Cove Reservoir) that would provide enhanced conservation and a reliable water source for local agricultural users and maintain pressure through the local irrigation system. In addition, the existing Glendale hydroelectric power plant would be relocated and upgraded, which would double the amount of green energy created. Furthermore, the water from Cove Reservoir would be released during the summer months, providing additional water flow and reducing high water temperatures for the endangered Virging River chub and woundfin. To assess the environmental impacts of the project, a Watershed Plan and Environmental Assessment is being prepared by Transcon Environmental, on behalf of the NRCS, in cooperation with the Washington County Water Conservancy District, the Bureau of Land Management (BLM), and the National Park Service.

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Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

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Norm Evenstad, Water Resources Coordinator, NRCS, Salt Lake City, Utah
Derek Hamilton, Biologist, NRCS, Salt Lake City, Utah
Kristine Curry, Archaeologist, SITLA, Salt Lake City, Utah
Tara S. Hoffmann, State Cultural Resources Specialist, NRCS, Salt Lake City, Utah

January 9, 2020

Mr. Terry Knight
Tribal Historic Preservation Officer
Ute Mountain Ute Tribe
P.O. Box 468
Towaoc, Colorado 81334

Reference: Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah (UDSH Project No. U18TN0544)

Dear Mr. Knight:

Enclosed is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah.* The Natural Resources Conservation Service (NRCS) is providing technical and financial assistance through the Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566 Stat. 666 as amended [16 U.S.C. Section 1001 et. Seq.]) 1954, as amended, to the Kane County Water Conservancy District (KCWCD), as the project sponsor, to construct a new dam and improve water management infrastructure within the East Fork Virgin River Watershed, located north of Orderville, Utah. Specific improvements include the construction of a 6,055-acre foot reservoir (Cove Reservoir) that would provide enhanced conservation and a reliable water source for local agricultural users and maintain pressure through the local irrigation system. In addition, the existing Glendale hydroelectric power plant would be relocated and upgraded, which would double the amount of green energy created. Furthermore, the water from Cove Reservoir would be released during the summer months, providing additional water flow and reducing high water temperatures for the endangered Virging River chub and woundfin. To assess the environmental impacts of the project, a Watershed Plan and Environmental Assessment is being prepared by Transcon Environmental, on behalf of the NRCS, in cooperation with the Washington County Water Conservancy District, the Bureau of Land Management (BLM), and the National Park Service.

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42KA8901/ Private	Multicomponent: prehistoric lithic scatter, historic artifact scatters	Not Eligible	No Effects
42KA8902/ Private	Historic artifact scatter	Not Eligible	No Effects
42KA8903/ Private	Historic artifact scatter	Not Eligible	No Effects
42KA8904/ Private	Prehistoric ceramic, lithic, and FCR scatter	Eligible—D	*No Adverse Effect to Historic Properties.* Site will be avoided by at least 50 feet by all project activities. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.
42KA8972/ BLM	Prehistoric lithic scatter	Not Eligible	No Effects
42KA8973/ BLM	Prehistoric artifact scatter	Not Eligible	No Effects
42KA8974/ Private	Prehistoric artifact scatter	Eligible—D	*No Adverse Effect to Historic Properties* if the site is avoided. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.

Based on the results of the cultural resources survey and adherence to the avoidance stipulations described above, the NRCS recommends that the project proceed as planned with a determination

of ***no adverse effect to historic properties***. The NRCS requests concurrence for the determination of project effects and site eligibility. If you have any questions, comments, or concerns, please contact Tara S. Hoffmann, State Cultural Resources Specialist, at 801-524-4556 at your convenience.

Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)
Nichol Shurack, Tribal Archaeologist, Ute Mountain Ute Tribe, P.O. Box 468, Towaoc, CO 81334
Norm Evenstad, Water Resources Coordinator, NRCS, Salt Lake City, Utah
Derek Hamilton, Biologist, NRCS, Salt Lake City, Utah
Kristine Curry, Archaeologist, SITLA, Salt Lake City, Utah
Tara S. Hoffmann, State Cultural Resources Specialist, NRCS, Salt Lake City, Utah

January 9, 2020

Mr. Leigh Kuwanwisiwma
Director
Hopi Culture Preservation Office
The Hopi Tribe
P.O. Box 123
Kykotsmovi, Arizona 86039

Reference: Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah (UDSH Project No. U18TN0544)

Dear Mr. Kuwanwisiwma:

Enclosed is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah.* The Natural Resources Conservation Service (NRCS) is providing technical and financial assistance through the Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566 Stat. 666 as amended [16 U.S.C. Section 1001 et. Seq.]) 1954, as amended, to the Kane County Water Conservancy District (KCWCD), as the project sponsor, to construct a new dam and improve water management infrastructure within the East Fork Virgin River Watershed, located north of Orderville, Utah. Specific improvements include the construction of a 6,055-acre foot reservoir (Cove Reservoir) that would provide enhanced conservation and a reliable water source for local agricultural users and maintain pressure through the local irrigation system. In addition, the existing Glendale hydroelectric power plant would be relocated and upgraded, which would double the amount of green energy created. Furthermore, the water from Cove Reservoir would be released during the summer months, providing additional water flow and reducing high water temperatures for the endangered Virging River chub and woundfin. To assess the environmental impacts of the project, a Watershed Plan and Environmental Assessment is being prepared by Transcon Environmental, on behalf of the NRCS, in cooperation with the Washington County Water Conservancy District, the Bureau of Land Management (BLM), and the National Park Service.

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A pedestrian cultural resource inventory of the undertaking was completed by Transcon Environmental on October 1 through 8 and October 10 through 13, 2018; supplemental surveys of the project occurred between June 12 through 14. A total of 9 new cultural resource sites (42KA8785, 42KA8900, 42KA8901, 42KA8902, 42KA8903, 42KA8904, 42KA8972, 42KA8973, and 42KA8974), 1 previous cultural resource site (42KA6331), and 15 isolated occurrences (IOs) were identified and recorded within the Project APE. Five archaeological sites and two historic structures were identified as a result of the inventory. Table 1 summarizes the sites identified and the NRCS' National Register of Historic Places (NRHP) eligibility determinations.

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Based on the results of the cultural resources survey and adherence to the avoidance stipulations described above, the NRCS recommends that the project proceed as planned with a determination of ***no adverse effect to historic properties***. The NRCS requests concurrence for the determination of project effects and site eligibility. If you have any questions, comments, or concerns, please contact Tara S. Hoffmann, State Cultural Resources Specialist, at 801-524-4556 at your convenience.

Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)
Norm Evenstad, Water Resources Coordinator, NRCS, Salt Lake City, Utah
Derek Hamilton, Biologist, NRCS, Salt Lake City, Utah
Kristine Curry, Archaeologist, SITLA, Salt Lake City, Utah
Tara S. Hoffmann, State Cultural Resources Specialist, NRCS, Salt Lake City, Utah

January 9, 2020

Ms. Dorena Martineau
Paiute Indian Tribe of Utah
440 North Paiute Drive
Cedar City, Utah 84721

Reference: Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah (UDSH Project No. U18TN0544)

Dear Ms. Martineau:

Enclosed is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah.* The Natural Resources Conservation Service (NRCS) is providing technical and financial assistance through the Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566 Stat. 666 as amended [16 U.S.C. Section 1001 et. Seq.]) 1954, as amended, to the Kane County Water Conservancy District (KCWCD), as the project sponsor, to construct a new dam and improve water management infrastructure within the East Fork Virgin River Watershed, located north of Orderville, Utah. Specific improvements include the construction of a 6,055-acre foot reservoir (Cove Reservoir) that would provide enhanced conservation and a reliable water source for local agricultural users and maintain pressure through the local irrigation system. In addition, the existing Glendale hydroelectric power plant would be relocated and upgraded, which would double the amount of green energy created. Furthermore, the water from Cove Reservoir would be released during the summer months, providing additional water flow and reducing high water temperatures for the endangered Virging River chub and woundfin. To assess the environmental impacts of the project, a Watershed Plan and Environmental Assessment is being prepared by Transcon Environmental, on behalf of the NRCS, in cooperation with the Washington County Water Conservancy District, the Bureau of Land Management (BLM), and the National Park Service.

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Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)
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Derek Hamilton, Biologist, NRCS, Salt Lake City, Utah
Kristine Curry, Archaeologist, SITLA, Salt Lake City, Utah
Tara S. Hoffmann, State Cultural Resources Specialist, NRCS, Salt Lake City, Utah

January 9, 2020

Mr. Timothy L. Nuvangyaoma
Chairman
Hopi Tribe Chairman's Office
P.O. Box 123
Kykotsmovi, Arizona 86039

Reference: Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah (UDSH Project No. U18TN0544)

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Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)
Norm Evenstad, Water Resources Coordinator, NRCS, Salt Lake City, Utah
Derek Hamilton, Biologist, NRCS, Salt Lake City, Utah
Kristine Curry, Archaeologist, SITLA, Salt Lake City, Utah
Tara S. Hoffmann, State Cultural Resources Specialist, NRCS, Salt Lake City, Utah

USDA United States Department of Agriculture
Natural Resources Conservation Service

Sites Visited:	42KA8904 and 42KA8785 (prehistoric artifact scatters)	Project:	Cove EFVR EA
Attendees:	Tara Hoffmann (NRCS Water Resources CRS) Charley Bulletts (Cultural Resources Director, Kaibab Paiute) Lindsey Evenson (Cultural Resources Director, Transcon)		
Date:	January 25, 2019		
Subject:	Site visit request by Charley Bulletts for 42KA8904		

Charley Bulletts asked to have a site visit to 42KA8904 (prehistoric artifact scatter) to see its proximity to the proposed project activities. Tara Hoffmann, Lindsey Evenson and Charley visited the site on January 25, 2019, where Charley briefly examined artifacts and we spoke about project activities that would occur near the site and potential effects from off road vehicle or pedestrian traffic. Charley said that he was not concerned about effects to the site from the reservoir and that things could move forward. Ms. Hoffmann informed Mr. Bulletts that she would be seeing the project through construction and that the site would be avoided (as currently planned).

Charley asked if there were any additional sites that would be beneficial to visit, and Ms. Hoffmann informed him of 42KA8785, due to its proximity to a proposed Tait Pit gravel source. Ms. Hoffmann and Mr. Bulletts visited the site and discussed avoidance options. It was agreed that the entire site would be avoided by the proposed gravel source and noted on designs as an avoidance area. Ms. Hoffmann conveyed this information to Transcon for incorporation into the environmental document.

*** Note: all confidential information discussed between NRCS and the Kaibab Paiute regarding specific site location information has been redacted from this document.

From: Charley Bulletts
To: Hoffmann, Tara - NRCS, Salt Lake City, UT
Subject: Re: Draft Cove Reservoir Report
Date: Wednesday, January 16, 2019 3:31:47 PM

Hello Tara
I thought you was off, could I call you this week at your office.
I have been very busy with some Jackson Flats stuff, but would like to get your feed back about
This report I only skimed through it a few times. Sorry for not getting back to you sooner.
Hope your year is starting off well.

Charley Bulletts
Southern Paiute Consortium, Director
H.C. 65 Box 2
Fredonia, AZ 86022
Work: 928-643-6278
Cell: 435-689-1904
Fax # 888-939-3777

On Wed, Jan 16, 2019 at 2:31 PM Hoffmann, Tara - NRCS, Salt Lake City, UT <tara.hoffmann@ut.usda.gov> wrote:

> Hi Charley,
>
> Hope you had a wonderful holiday! Did you get a chance to take a look at the report?
>
> Thanks,
>
> Tara
>
> ---
>
> **From:** Charley Bulletts <cbulletts@kaibabpaiute-nsn.gov>
> **Sent:** Wednesday, January 2, 2019 10:50 AM
> **To:** Hoffmann, Tara - NRCS, Salt Lake City, UT <tara.hoffmann@ut.usda.gov>
> **Subject:** Re: Draft Cove Reservoir Report
>
> Not yet
>
> I m currently off work this week

But will get back to you next week

Happy New Year

Sent from my iPhone

On Jan 2, 2019, at 9:59 AM, Hoffmann, Tara - NRCS, Salt Lake City, UT <tara.hoffmann@ut.usda.gov> wrote:

> Hey Charley,
>
> Just checking to see if you've had a chance to look over the report?
>
> Happy New Year!
>
> Tara
>
> Tara S. Hoffmann
> USDA Natural Resources Conservation Service
> State Cultural Resources Specialist
> 801.524.4556
>
> ---
>
> **From:** "Charley Bulletts" <cbulletts@kaibabpaiute-nsn.gov>
> **Date:** Wednesday, December 12, 2018 at 1:25:59 PM
> **To:** "Hoffmann, Tara - NRCS, Salt Lake City, UT" <tara.hoffmann@ut.usda.gov>
> **Subject:** Re: [Take care when opening attachments] Draft Cove Reservoir Report
>
> Hey Thanks
>
> Tara I will look at it today
>
> Charley Bulletts
>
> Southern Paiute Consortium, Director
>
> H.C. 65 Box 2
>
> Fredonia, AZ 86022

Work: 928-643-6278

Cell: 435-689-1904

Fax # 888-939-3777

On Wed, Dec 12, 2018 at 11:12 AM Hoffmann, Tara - NRCS, Salt Lake City, UT <tara.hoffmann@ut.usda.gov> wrote:

> Hi Charley,
>
> I've attached the draft cultural resources report that I received from Transcon. Before I submit my comments to them I wanted to give you the chance to take a look at it. They mostly found historic sites but there are a couple of prehistoric sites, one of which will be outside of the actual project area and will not be disturbed.
>
> Thanks!
>
> Tara
>
> Tara S. Hoffmann
> USDA Natural Resources Conservation Service
> State Cultural Resources Specialist
> 801.524.4556
>
> This electronic message contains information generated by the USDA solely for the intended recipients. Any unauthorized interception of this message or the use or disclosure of the information it contains may violate the law and subject the violator to civil or criminal penalties. If you believe you have

> received this message in error, please notify the sender and delete the email immediately.

From: Charley Bulletts
To: Hoffmann, Tara - NRCS, Salt Lake City, UT
Subject: Re: Summary of cultural resources findings- Cove Reservoir
Date: Monday, October 29, 2018 10:22:11 AM

Thanks Tara I look forward to the report
I will be in the office this week.
Have a good week

Charley Bulletts
Southern Paiute Consortium, Director
H.C. 65 Box 2
Fredonia, AZ 86022
Work: 928-643-6278
Cell: 435-689-1904
Fax # 888-939-3777

On Mon, Oct 29, 2018 at 8:32 AM Hoffmann, Tara - NRCS, Salt Lake City, UT <tara.hoffmann@ut.usda.gov> wrote:

> Hi Charley,
>
> As a heads up, I wanted to send you Transcon's summary of the cultural resources findings for Cove Reservoir. I also just received a copy of the draft report and will be reviewing that over the next couple of weeks.
>
> As a result of the Class III (intensive pedestrian) cultural resources survey, there were a total of **five new isolated occurrences** (IOs) identified within the project APE: IO-01--IO-05; all five of these IOs are recommended Not Eligible for listing on the National Register of Historic Places (NRHP) under any Criteria.
>
> There were also a total of **five new cultural resource sites** identified within the project APE: 42KA8900--42KA8904. The fifth site, 42KA8904, is a large prehistoric temporary camp with artifact (lithic, ceramic, and FCR) scatters; we have decided to recommend this site Eligible for listing on the NRHP under Criterion D, for possible subsurface cultural deposits and information potential. The remaining four sites are recommended Not Eligible for NRHP listing under any Criteria.
>
> Additionally, there are a total of **two previously identified cultural resource sites** within the project area, within the Bald Knolls Community Pit: 42KA6331 and 42KA6332. Both of these sites are prehistoric lithic scatters, and both are recommended Eligible for NRHP listing under Criterion D. These sites were not revisited or reevaluated for their resources, per request of the BLM Kanab Field Office archaeologist.

NEWLY IDENTIFIED CULTURAL RESOURCE SITES WITHIN THE PROJECT APE				
Site No.	**Field No.**	**Description**	**Jurisdiction**	**Eligibility Recommendation**
42KA8900	BFS-01	Historic artifact scatter	Private	Not Eligible
42KA8901	BFS-02	Multi-component: prehistoric lithic scatter; historic artifact scatters	BLM	Not Eligible
42KA8902	BFS-03	Historic artifact scatter	Private	Not Eligible
42KA8903	BFS-04	Historic artifact scatter	Private	Not Eligible
42KA8904	BFS-05	Prehistoric temporary camp and artifact (lithic, ceramic, and FCR) scatter	Private	Eligible - D

NEWLY IDENTIFIED ISOLATED OCCURRENCES WITHIN THE PROJECT APE				
IO No.	**Temporal Affiliation**	**Description**	**UTMs (NAD '83, Zone 12)**	
			Easting	**Northing**
IO-01	Historic	Two historic coal/wood-burning stoves	356826	4129653
IO-02	Prehistoric	Two prehistoric whiteware ceramic sherds	351662	4126634
IO-03	Historic	One historic Chevy vehicle trunk lid (1966 Florida license plate)	352635	4126505
IO-04	Prehistoric	One prehistoric white ware sherd	351823	4126323
IO-05	Prehistoric	Five prehistoric obsidian shatter pieces (three snowflake obsidian, one mahogany, and one black)	353290	4126227

Let me know if you have any questions on this. I will know more about the sites and their locations once I read the draft report, probably later this week since I am going to be in Richfield doing fieldwork for the next few days.

Cheers,

Tara

This electronic message contains information generated by the USDA solely for the intended recipients. Any unauthorized interception of this message or the use or disclosure of the information it contains may violate the law and subject the violator to civil or criminal penalties. If you believe you have received this message in error, please notify the sender and delete the email immediately.

THE PAIUTE INDIAN TRIBE OF UTAH

440 North Paiute Drive • Cedar City, Utah 84721 • (435) 586-1112

January 21, 2020

Emily Fife/State Conservationist
Natural Resources Conservation Service
Utah State Office
125 South State Street, Room 4010
Salt Lake City, Utah 84138

Dear Ms. Fife

Subject: ***CRI Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah (UDSH Project No. U18TN0544)***

The Paiute Indian Tribe of Utah is in receipt of your letter dated January 9, 2020 and has reviewed the material and do not have any objections. Currently, we are not aware of any cultural resource sites, practices, or locations of importance in the Tribe's traditional, religious or culture. We concur with your determination of eligibility and effort for this undertaking. This letter serves as our comment on the determinations you have made.

As you are aware the tribes support the identification and avoidance of prehistoric archaeological sites and traditional cultural properties.

The Paiute Tribe sincerely appreciates your accomplishments and consideration you and your staff have made to consult with the Tribes.

Sincerely,

Dorena Martineau

Dorena Martineau/Cultural Resource
Paiute Indian Tribe of Utah
440 North Paiute Drive
Cedar City, Utah 84721
435-586-1112 ext. 107

January 9, 2020

FEB 0 3 2020

Mr. Leigh Kuwanwisiwma
Director
Hopi Culture Preservation Office
The Hopi Tribe
P.O. Box 123
Kykotsmovi, Arizona 86039

Reference: Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah (UDSH Project No. U18TN0544)

Dear Mr. Kuwanwisiwma:

Enclosed is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah.* The Natural Resources Conservation Service (NRCS) is providing technical and financial assistance through the Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566 Stat. 666 as amended [16 U.S.C. Section 1001 et. Seq.]) 1954, as amended, to the Kane County Water Conservancy District (KCWCD), as the project sponsor, to construct a new dam and improve water management infrastructure within the East Fork Virgin River Watershed, located north of Orderville, Utah. Specific improvements include the construction of a 6,055-acre foot reservoir (Cove Reservoir) that would provide enhanced conservation and a reliable water source for local agricultural users and maintain pressure through the local irrigation system. In addition, the existing Glendale hydroelectric power plant would be relocated and upgraded, which would double the amount of green energy created. Furthermore, the water from Cove Reservoir would be released during the summer months, providing additional water flow and reducing high water temperatures for the endangered Virging River chub and woundfin. To assess the environmental impacts of the project, a Watershed Plan and Environmental Assessment is being prepared by Transcon Environmental, on behalf of the NRCS, in cooperation with the Washington County Water Conservancy District, the Bureau of Land Management (BLM), and the National Park Service.

The Area of Potential Effects (APE) for the project encompasses a total of 791.68 acres, which includes the proposed reservoir area, the hyrdroelectric plant locations, four borrow pits, a linear survey of a new water pipeline, powerline, and utility corridor locations, and a spot check/survey of two borrow pit locations. Of the total acreage, 152.18 acres are on BLM Kanab Field-Office-managed land, 70.33 acres are on State of Utah, School and Institutional Trust Lands Administration (SITLA)-managed lands, and 569.17 are on privately-owned lands. The NRCS is acting as the lead Federal agency for the purposes of Section 106 consultation, which will also cover SITLA's responsibilities under Utah Code Annotated Section 9-8-404. The BLM and the U.S. Army Corps of Engineers are cooperating agencies.

Natural Resources Conservation Service 125 South State Street, Room 4010, Salt Lake City, UT 84138
www.ut.nrcs.usda.gov 801-524-4550 Fax 844-715-4928
USDA is an equal opportunity provider, employer, and lender.

Based on the results of the cultural resources survey and adherence to the avoidance stipulations described above, the NRCS recommends that the project proceed as planned with a determination of ***no adverse effect to historic properties***. The NRCS requests concurrence for the determination of project effects and site eligibility. If you have any questions, comments, or concerns, please contact Tara S. Hoffmann, State Cultural Resources Specialist, at 801-524-4556 at your convenience.

Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Concur
for
Kevin Kompteus
1-28-20

Enclosure

cc: (w/o encl)
Norm Evenstad, Water Resources Coordinator, NRCS, Salt Lake City, Utah
Derek Hamilton, Biologist, NRCS, Salt Lake City, Utah
Kristine Curry, Archaeologist, SITLA, Salt Lake City, Utah
Tara S. Hoffmann, State Cultural Resources Specialist, NRCS, Salt Lake City, Utah

Agency Consultation

January 9, 2020

Mr. Brian Storm
Archeologist
Bureau of Land Management
Kanab Field Office
669 S Hwy 89A
Kanab, Utah 84741

Reference: Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah (UDSH Project No. U18TN0544)

Dear Mr. Storm:

Enclosed is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah.* The Natural Resources Conservation Service (NRCS) is providing technical and financial assistance through the Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566 Stat. 666 as amended [16 U.S.C. Section 1001 et. Seq.]) 1954, as amended, to the Kane County Water Conservancy District (KCWCD), as the project sponsor, to construct a new dam and improve water management infrastructure within the East Fork Virgin River Watershed, located north of Orderville, Utah. Specific improvements include the construction of a 6,055-acre foot reservoir (Cove Reservoir) that would provide enhanced conservation and a reliable water source for local agricultural users and maintain pressure through the local irrigation system. In addition, the existing Glendale hydroelectric power plant would be relocated and upgraded, which would double the amount of green energy created. Furthermore, the water from Cove Reservoir would be released during the summer months, providing additional water flow and reducing high water temperatures for the endangered Virging River chub and woundfin. To assess the environmental impacts of the project, a Watershed Plan and Environmental Assessment is being prepared by Transcon Environmental, on behalf of the NRCS, in cooperation with the Washington County Water Conservancy District, the Bureau of Land Management (BLM), and the National Park Service.

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A pedestrian cultural resource inventory of the undertaking was completed by Transcon Environmental on October 1 through 8 and October 10 through 13, 2018; supplemental surveys of the project occurred between June 12 through 14. A total of 9 new cultural resource sites (42KA8785, 42KA8900, 42KA8901, 42KA8902, 42KA8903, 42KA8904, 42KA8972, 42KA8973, and 42KA8974), 1 previous cultural resource site (42KA6331), and 15 isolated occurrences (IOs) were identified and recorded within the Project APE. Five archaeological sites and two historic structures were identified as a result of the inventory. Table 1 summarizes the sites identified and the NRCS' National Register of Historic Places (NRHP) eligibility determinations.

Table 1. Summary of sites and structures in the survey area

Site Number/ Land Status	Site Type	NRHP Eligibility	Effects
42KA6331/ BLM	Prehistoric lithic scatter	Eligible—D (previously determined)	*No Adverse Effect to Historic Properties.* Site will be avoided by at least 50 feet by all project activities. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.
42KA8785/ Private	Prehistoric artifact scatter	Eligible – D	*No Adverse Effect to Historic Properties*. Site will be avoided by at least 50 feet by all project activities. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.
42KA8900/ Private	Historic artifact scatter	Not Eligible	No Effects
42KA8901/ Private	Multicomponent: prehistoric lithic scatter, historic artifact scatters	Not Eligible	No Effects
42KA8902/ Private	Historic artifact scatter	Not Eligible	No Effects
42KA8903/ Private	Historic artifact scatter	Not Eligible	No Effects
42KA8904/ Private	Prehistoric ceramic, lithic, and FCR scatter	Eligible—D	*No Adverse Effect to Historic Properties.* Site will be avoided by at least 50 feet by all project activities. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.
42KA8972/ BLM	Prehistoric lithic scatter	Not Eligible	No Effects
42KA8973/ BLM	Prehistoric artifact scatter	Not Eligible	No Effects
42KA8974/ Private	Prehistoric artifact scatter	Eligible—D	*No Adverse Effect to Historic Properties* if the site is avoided. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.

Based on the results of the cultural resources survey and adherence to the avoidance stipulations described above, the NRCS recommends that the project proceed as planned with a determination of ***no adverse effect to historic properties***. The NRCS requests concurrence for the determination of project effects and site eligibility. If you have any questions, comments, or concerns, please contact Tara S. Hoffmann, State Cultural Resources Specialist, at 801-524-4556 at your convenience.

Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)
Norm Evenstad, Water Resources Coordinator, NRCS, Salt Lake City, Utah
Derek Hamilton, Biologist, NRCS, Salt Lake City, Utah
Kristine Curry, Archaeologist, SITLA, Salt Lake City, Utah
Tara S. Hoffmann, State Cultural Resources Specialist, NRCS, Salt Lake City, Utah

January 9, 2020

Mr. Hollis Jencks
Project Manager
Bountiful Regulatory Office
U.S. Army Corps of Engineers
533 West 3600 South, Suite 150
Bountiful, UT 84010-7744

Reference: Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah (UDSH Project No. U18TN0544)

Dear Mr. Jencks:

Enclosed is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah.* The Natural Resources Conservation Service (NRCS) is providing technical and financial assistance through the Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566 Stat. 666 as amended [16 U.S.C. Section 1001 et. Seq.]) 1954, as amended, to the Kane County Water Conservancy District (KCWCD), as the project sponsor, to construct a new dam and improve water management infrastructure within the East Fork Virgin River Watershed, located north of Orderville, Utah. Specific improvements include the construction of a 6,055-acre foot reservoir (Cove Reservoir) that would provide enhanced conservation and a reliable water source for local agricultural users and maintain pressure through the local irrigation system. In addition, the existing Glendale hydroelectric power plant would be relocated and upgraded, which would double the amount of green energy created. Furthermore, the water from Cove Reservoir would be released during the summer months, providing additional water flow and reducing high water temperatures for the endangered Virging River chub and woundfin. To assess the environmental impacts of the project, a Watershed Plan and Environmental Assessment is being prepared by Transcon Environmental, on behalf of the NRCS, in cooperation with the Washington County Water Conservancy District, the Bureau of Land Management (BLM), and the National Park Service.

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42KA8900/ Private	Historic artifact scatter	Not Eligible	No Effects
42KA8901/ Private	Multicomponent: prehistoric lithic scatter, historic artifact scatters	Not Eligible	No Effects
42KA8902/ Private	Historic artifact scatter	Not Eligible	No Effects
42KA8903/ Private	Historic artifact scatter	Not Eligible	No Effects
42KA8904/ Private	Prehistoric ceramic, lithic, and FCR scatter	Eligible—D	*No Adverse Effect to Historic Properties.* Site will be avoided by at least 50 feet by all project activities. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.
42KA8972/ BLM	Prehistoric lithic scatter	Not Eligible	No Effects
42KA8973/ BLM	Prehistoric artifact scatter	Not Eligible	No Effects
42KA8974/ Private	Prehistoric artifact scatter	Eligible—D	*No Adverse Effect to Historic Properties* if the site is avoided. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.

Based on the results of the cultural resources survey and adherence to the avoidance stipulations described above, the NRCS recommends that the project proceed as planned with a determination of ***no adverse effect to historic properties***. The NRCS requests concurrence for the determination of project effects and site eligibility. If you have any questions, comments, or concerns, please contact Tara S. Hoffmann, State Cultural Resources Specialist, at 801-524-4556 at your convenience.

Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)
Norm Evenstad, Water Resources Coordinator, NRCS, Salt Lake City, Utah
Derek Hamilton, Biologist, NRCS, Salt Lake City, Utah
Kristine Curry, Archaeologist, SITLA, Salt Lake City, Utah
Tara S. Hoffmann, State Cultural Resources Specialist, NRCS, Salt Lake City, Utah

Second Cultural Resource Inventory Report

SHPO Consultation

January 23, 2023

Christopher Merritt, PhD
State Historic Preservation Officer
Utah Division of State History
300 Rio Grande Avenue
Salt Lake City, Utah 84101-1182

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840)

Dear Dr. Merritt:

Included in this submission is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah*, and associated data. The Natural Resources Conservation Service (NRCS) and Kane County Water Conservancy District (KCWCD) are proposing the addition of a pipeline to their Cove Reservoir Project (U18TN0544), which originally consisted of a reservoir and associated facilities. The original U18TN0544 Class III inventory was conducted in October of 2018. The additional pipeline is being completed as *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840). This addendum and supplemental inventory area are the result of a change in project complexity, changing from an Environmental Assessment to an EIS.

The Addendum Project Area of Potential Effects (APE) totals 9.06 miles (68.83 acres) in length in Kane County, Utah. Throughout the addendum Project area, for a total of 9.06 miles (47,836 feet), a new pipeline will be placed within or parallel to existing irrigation ditches as part of the Cove East Fork Virgin River Plan-EIS Project improvements located immediately southwest of the town of Orderville, Utah. To account for flexibility in design, a survey corridor of 15 meters (approximately 50 feet) was evaluated. This resulted in a total APE of 68.83 acres. Of this, the APE is comprised of 68.71 acres of Private land, 0.11 acres of land administered by the Bureau of Land Management, Kanab Field Office, and 0.01 acres of lands managed by the Utah School and Institutional Trust Lands Administration. The NRCS is acting as the lead federal agency for the purposes of Section 106 consultation, which will also cover SITLA's responsibilities under Utah Code Annotated Section 9-8-404. The BLM is a cooperating agency.

Class III (intensive pedestrian) and Class II (reconnaissance) cultural resources inventory were conducted between November 15 to 19, 2021 and on March 20, 2022 by Transcon Environmental. A total of five cultural resource sites (one previously identified and four newly recorded) were identified within the APE (42KA1157, 42KA9490, 42KA9491, 42KA9492, 42KA9493). Two previously recorded site that were mapped within the current APE but relocated outside of the APE (42KA4538 and 42KA4539) were also revisited and updated.

Table 1 summarizes the sites identified, the NRCS' eligibility determinations, project effects, project designs measures, and proposed mitigation measures.

TABLE 4 PROJECT SUMMARY AND CONCLUSIONS						
Site No.	**Temporal Affiliation**	**Site Description**	**Eligibility**	**Effects**	**Project Design Impacts**	**Site Protective or Avoidance Measures**
42KA1157	Prehistoric	Prehistoric artifact scatter	Eligible—D	*No Adverse Effect*	Installation of new buried pipe along the northeast portion of the site.	None; the portion of the site within the Project APE is heavily disturbed by previous road construction/maintenance, plowing, livestock and a sewer line, it has also been previously tested and is non-contributing to the overall eligibility of the site.
42KA4538	Historic	Historic bridge abutment	Not Eligible	No effect	N/A; also, outside of the current Project APE.	N/A; also, outside of the current Project APE.
42KA4539	Historic	Historic ditch/ flume	Not Eligible	No effect	N/A; also, outside of the current Project APE.	N/A; also, outside of the current Project APE.
42KA9490 (FS-01)	Historic	Historic ditch (*Mount Carmel Irrigation Ditch–West Ditch*)	Eligible—A, C, D	*Adverse Effect*	The open ditch will be converted to buried pipe.	An inadvertent discovery plan will be prepared, as well as a MOA with associated Historic Properties Treatment Plan to mitigate the adverse effects to the site.
42KA9491 (FS-02)	Historic	Historic ditch (*Mount Carmel Irrigation Ditch–East Ditch*)	Eligible—A, D	*Adverse Effect*	The open ditch will be converted to buried pipe.	An inadvertent discovery plan will be prepared, as well as a MOA with associated Historic Properties Treatment Plan to mitigate the adverse effects to the site.
42KA9492 (FS-03)	Historic	Historic road (*Lamb's Lane*)	Not Eligible	No effect	N/A	N/A
42KA9493 (FS-04)	Historic	Historic road (*Tait Lane*)	Not Eligible	No effect	N/A	N/A

To summarize, as a result of the proposed project, two historic ditches (42KA9490 and 42KA9491), the Mount Carmel Irrigation West and East Ditches, will be converted from open ditch to buried pipe. Given that both sites are eligible for the NRHP under multiple criteria, the piping will result in adverse effects to both sites. To resolve the adverse effects, an inadvertent discovery plan will be prepared and supplied to construction crews, in additional to the preparation and execution of a Memorandum of Agreement with associated Treatment Plan. The MOA will be prepared in consultation with the Utah SHPO, KCWCD, interested THPOs, tribes, and other organizations.

Thus, the NRCS recommends that the project proceed as planned with a determination of ***adverse effect to historic properties***. The NRCS requests concurrence for the determination of project effects and site eligibility. If you have any questions, comments, or concerns, please contact Tara S. Hoffmann, State Cultural Resources Specialist, at 801-524-4556 at your convenience.

Sincerely,

TRISHA CRACROFT
Acting State Conservationist

Enclosure

cc: (w/o encl)
Tara Hoffmann, State Cultural Resources specialist, NRCS, Salt Lake City, UT
Brandon Todd, ASTC-Field Operations, NRCS, Richfield, UT
Kristi Westwood, District Conservationist, NRCS, Panguitch, UT
Norm Evenstad, Assistant State Conservationist Water Resources, NRCS, Salt Lake City, UT
Derek Hamilton, Water Resources Coordinator, NRCS, Salt Lake City, UT
Brian Storm, Archaeologist, BLM, Kanab, UT
Kristine Curry, Archaeologist, SITLA, Salt Lake City, UT
Ian Snyder, Project Manager/Environmental Planner, Transcon Environmental, Ferndale, CA

Spencer J. Cox
Governor

Deidre M. Henderson
Lieutenant Governor

Jill Remington Love
Executive Director
Utah Department of Cultural and Community Engagement

February 6, 2023

Trisha Cracroft
Acting State Conservationist
Natural Resources Conservation Service
125 South State Street, Room 4010
Salt Lake City, Utah 84138-1100

RE: Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah

For future correspondence, please reference Case No. 23-0280

Dear Trisha,

The Utah State Historic Preservation Office received your submission and request for our comment on the above-referenced undertaking on February 03, 2023.

We concur with your determinations of eligibility and finding of "Adverse effect" for this undertaking.

This letter serves as our comment on the determinations you have made within the consultation process specified in §36CFR800.4. If you have questions, please contact me at 801-245-7263 or by email at cmerritt@utah.gov.

Sincerely,

Christopher W. Merritt
State Historic Preservation Officer

Tribal Consultation

January 23, 2023

Mr. Richard M. Begay
THPO and Department Manager
Navajo Nation Historic Preservation Department
P.O. Box 4950
Window Rock, Arizona 86515

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840)

Dear Mr. Begay:

Included in this submission is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah*, and associated data. The Natural Resources Conservation Service (NRCS) and Kane County Water Conservancy District (KCWCD) are proposing the addition of a pipeline to their Cove Reservoir Project (U18TN0544), which originally consisted of a reservoir and associated facilities. The original U18TN0544 Class III inventory was conducted in October of 2018. The additional pipeline is being completed as *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840). This addendum and supplemental inventory area are the result of a change in project complexity, changing from an Environmental Assessment to an EIS.

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Table 1 summarizes the sites identified, the NRCS' eligibility determinations, project effects, project designs measures, and proposed mitigation measures.

TABLE 4						
PROJECT SUMMARY AND CONCLUSIONS						
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42KA4538	Historic	Historic bridge abutment	Not Eligible	No effect	N/A; also, outside of the current Project APE.	N/A; also, outside of the current Project APE.
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To summarize, as a result of the proposed project, two historic ditches (42KA9490 and 42KA9491), the Mount Carmel Irrigation West and East Ditches, will be converted from open ditch to buried pipe. Given that both sites are eligible for the NRHP under multiple criteria, the piping will result in adverse effects to both sites. To resolve the adverse effects, an inadvertent discovery plan will be prepared and supplied to construction crews, in additional to the preparation and execution of a Memorandum of Agreement with associated Treatment Plan. The MOA will be prepared in consultation with the Utah SHPO, KCWCD, interested THPOs, tribes, and other organizations.

January 23, 2023

Ms. Betsy Chapoose
THPO
Cultural Rights Protection Department
Ute Indian Tribe of the Uintah & Ouray Reservation, Utah
P.O. Box 190
Fort Duchesne, Utah 84026

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840)

Dear Ms. Chapoose:

Included in this submission is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah*, and associated data. The Natural Resources Conservation Service (NRCS) and Kane County Water Conservancy District (KCWCD) are proposing the addition of a pipeline to their Cove Reservoir Project (U18TN0544), which originally consisted of a reservoir and associated facilities. The original U18TN0544 Class III inventory was conducted in October of 2018. The additional pipeline is being completed as *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840). This addendum and supplemental inventory area are the result of a change in project complexity, changing from an Environmental Assessment to an EIS.

The Addendum Project Area of Potential Effects (APE) totals 9.06 miles (68.83 acres) in length in Kane County, Utah. Throughout the addendum Project area, for a total of 9.06 miles (47,836 feet), a new pipeline will be placed within or parallel to existing irrigation ditches as part of the Cove East Fork Virgin River Plan-EIS Project improvements located immediately southwest of the town of Orderville, Utah. To account for flexibility in design, a survey corridor of 15 meters (approximately 50 feet) was evaluated. This resulted in a total APE of 68.83 acres. Of this, the APE is comprised of 68.71 acres of Private land, 0.11 acres of land administered by the Bureau of Land Management, Kanab Field Office, and 0.01 acres of lands managed by the Utah School and Institutional Trust Lands Administration. The NRCS is acting as the lead federal agency for the purposes of Section 106 consultation, which will also cover SITLA's responsibilities under Utah Code Annotated Section 9-8-404. The BLM is a cooperating agency.

Class III (intensive pedestrian) and Class II (reconnaissance) cultural resources inventory were conducted between November 15 to 19, 2021 and on March 20, 2022 by Transcon Environmental. A total of five cultural resource sites (one previously identified and four newly recorded) were identified within the APE (42KA1157, 42KA9490, 42KA9491, 42KA9492, 42KA9493). Two previously recorded site that were mapped within the current APE but relocated outside of the APE (42KA4538 and 42KA4539) were also revisited and updated.

Table 1 summarizes the sites identified, the NRCS' eligibility determinations, project effects, project designs measures, and proposed mitigation measures.

TABLE 4 PROJECT SUMMARY AND CONCLUSIONS						
Site No.	**Temporal Affiliation**	**Site Description**	**Eligibility**	**Effects**	**Project Design Impacts**	**Site Protective or Avoidance Measures**
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42KA4538	Historic	Historic bridge abutment	Not Eligible	No effect	N/A; also, outside of the current Project APE.	N/A; also, outside of the current Project APE.
42KA4539	Historic	Historic ditch/ flume	Not Eligible	No effect	N/A; also, outside of the current Project APE.	N/A; also, outside of the current Project APE.
42KA9490 (FS-01)	Historic	Historic ditch (*Mount Carmel Irrigation Ditch–West Ditch*)	Eligible—A, C, D	*Adverse Effect*	The open ditch will be converted to buried pipe.	An inadvertent discovery plan will be prepared, as well as a MOA with associated Historic Properties Treatment Plan to mitigate the adverse effects to the site.
42KA9491 (FS-02)	Historic	Historic ditch (*Mount Carmel Irrigation Ditch–East Ditch*)	Eligible—A, D	*Adverse Effect*	The open ditch will be converted to buried pipe.	An inadvertent discovery plan will be prepared, as well as a MOA with associated Historic Properties Treatment Plan to mitigate the adverse effects to the site.
42KA9492 (FS-03)	Historic	Historic road (*Lamb's Lane*)	Not Eligible	No effect	N/A	N/A
42KA9493 (FS-04)	Historic	Historic road (*Tait Lane*)	Not Eligible	No effect	N/A	N/A

To summarize, as a result of the proposed project, two historic ditches (42KA9490 and 42KA9491), the Mount Carmel Irrigation West and East Ditches, will be converted from open ditch to buried pipe. Given that both sites are eligible for the NRHP under multiple criteria, the piping will result in adverse effects to both sites. To resolve the adverse effects, an inadvertent discovery plan will be prepared and supplied to construction crews, in additional to the preparation and execution of a Memorandum of Agreement with associated Treatment Plan. The MOA will be prepared in consultation with the Utah SHPO, KCWCD, interested THPOs, tribes, and other organizations.

January 23, 2023

Mr. Darren Daboda
THPO
Moapa Band of Paiutes
1 Lincoln Street
PO Box 340
Moapa, Nevada 89025

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840)

Dear Mr. Daboda:

Included in this submission is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah*, and associated data. The Natural Resources Conservation Service (NRCS) and Kane County Water Conservancy District (KCWCD) are proposing the addition of a pipeline to their Cove Reservoir Project (U18TN0544), which originally consisted of a reservoir and associated facilities. The original U18TN0544 Class III inventory was conducted in October of 2018. The additional pipeline is being completed as *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840). This addendum and supplemental inventory area are the result of a change in project complexity, changing from an Environmental Assessment to an EIS.

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PROJECT SUMMARY AND CONCLUSIONS

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42KA4539	Historic	Historic ditch/ flume	Not Eligible	No effect	N/A; also, outside of the current Project APE.	N/A; also, outside of the current Project APE.
42KA9490 (FS-01)	Historic	Historic ditch (*Mount Carmel Irrigation Ditch– West Ditch*)	Eligible—A, C, D	*Adverse Effect*	The open ditch will be converted to buried pipe.	An inadvertent discovery plan will be prepared, as well as a MOA with associated Historic Properties Treatment Plan to mitigate the adverse effects to the site.
42KA9491 (FS-02)	Historic	Historic ditch (*Mount Carmel Irrigation Ditch– East Ditch*)	Eligible—A, D	*Adverse Effect*	The open ditch will be converted to buried pipe.	An inadvertent discovery plan will be prepared, as well as a MOA with associated Historic Properties Treatment Plan to mitigate the adverse effects to the site.
42KA9492 (FS-03)	Historic	Historic road (*Lamb's Lane*)	Not Eligible	No effect	N/A	N/A
42KA9493 (FS-04)	Historic	Historic road (*Tait Lane*)	Not Eligible	No effect	N/A	N/A

January 23, 2023

Dr. Kurt Dongoske
Director and Tribal Historic Preservation Officer
Pueblo of Zuni
P.O. Box 1149
Zuni, New Mexico 87327

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840)

Dear Dr. Dongoske:

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January 23, 2023

Stewart B. Koyiyumptewa, THPO
Hopi Tribe of Arizona
Hopi Cultural Preservation Office
P.O Box 123
Kykotsmovi, Arizona 86039

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840)

Dear Mr. Koyiyumptewa :

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42KA9490 (FS-01)	Historic	Historic ditch (*Mount Carmel Irrigation Ditch–West Ditch*)	Eligible—A, C, D	*Adverse Effect*	The open ditch will be converted to buried pipe.	An inadvertent discovery plan will be prepared, as well as a MOA with associated Historic Properties Treatment Plan to mitigate the adverse effects to the site.
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To summarize, as a result of the proposed project, two historic ditches (42KA9490 and 42KA9491), the Mount Carmel Irrigation West and East Ditches, will be converted from open ditch to buried pipe. Given that both sites are eligible for the NRHP under multiple criteria, the piping will result in adverse effects to both sites. To resolve the adverse effects, an inadvertent discovery plan will be prepared and supplied to construction crews, in additional to the preparation and execution of a Memorandum of Agreement with associated Treatment Plan. The MOA will be prepared in consultation with the Utah SHPO, KCWCD, interested THPOs, tribes, and other organizations.

Thus, the NRCS recommends that the project proceed as planned with a determination of ***adverse effect to historic properties***. The NRCS requests concurrence for the determination of project effects and site eligibility. If you have any questions, comments, or concerns, please contact Tara S. Hoffmann, State Cultural Resources Specialist, at 801-524-4556 at your convenience.

Sincerely,



TRISHA CRACROFT
Acting State Conservationist

Enclosure

cc: (w/o encl)
Tara Hoffmann, State Cultural Resources specialist, NRCS, Salt Lake City, UT
Brandon Todd, ASTC-Field Operations, NRCS, Richfield, UT
Kristi Westwood, District Conservationist, NRCS, Panguitch, UT
Norm Evenstad, Assistant State Conservationist Water Resources, NRCS, Salt Lake City, UT
Derek Hamilton, Water Resources Coordinator, NRCS, Salt Lake City, UT
Brian Storm, Archaeologist, BLM, Kanab, UT
Kristine Curry, Archaeologist, SITLA, Salt Lake City, UT
Ian Snyder, Project Manager/Environmental Planner, Transcon Environmental, Ferndale, CA

January 23, 2023

Mr. Terry Knight
Tribal Historic Preservation
Officer
Ute Mountain Ute Tribe
P.O. Box 468
Towaoc, Colorado 81334

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840)

Dear Mr. Knight:

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Sincerely,

Digitally signed by TRISHA CRACROFT
Date: 2023.01.24 15:28:20 -07'00'

TRISHA CRACROFT
Acting State Conservationist

Enclosure

cc: (w/o encl)
Tara Hoffmann, State Cultural Resources specialist, NRCS, Salt Lake City, UT
Brandon Todd, ASTC-Field Operations, NRCS, Richfield, UT
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January 23, 2023

Shanandoah (Shanan) Anderson
Cultural Manager
Moapa Band of Paiute Indians of the Moapa River Indian Reservation
P.O. Box 340
Moapa, Nevada 89025-0340

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840)

Dear Mr. Anderson:

Included in this submission is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah.* The Natural Resources Conservation Service (NRCS) and Kane County Water Conservancy District (KCWCD) are proposing the addition of a pipeline to their Cove Reservoir Project (U18TN0544), which originally consisted of a reservoir and associated facilities. The original U18TN0544 Class III inventory was conducted in October of 2018. The additional pipeline is being completed as *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840). This addendum and supplemental inventory area are the result of a change in project complexity, changing from an Environmental Assessment to an EIS.

The Addendum Project Area of Potential Effects (APE) totals 9.06 miles (68.83 acres) in length in Kane County, Utah. Throughout the addendum Project area, for a total of 9.06 miles (47,836 feet), a new pipeline will be placed within or parallel to existing irrigation ditches as part of the Cove East Fork Virgin River Plan-EIS Project improvements located immediately southwest of the town of Orderville, Utah. To account for flexibility in design, a survey corridor of 15 meters (approximately 50 feet) was evaluated. This resulted in a total APE of 68.83 acres. Of this, the APE is comprised of 68.71 acres of Private land, 0.11 acres of land administered by the Bureau of Land Management, Kanab Field Office, and 0.01 acres of lands managed by the Utah School and Institutional Trust Lands Administration. The NRCS is acting as the lead federal agency for the purposes of Section 106 consultation, which will also cover SITLA's responsibilities under Utah Code Annotated Section 9-8-404. The BLM is a cooperating agency.

Class III (intensive pedestrian) and Class II (reconnaissance) cultural resources inventory were conducted between November 15 to 19, 2021 and on March 20, 2022 by Transcon Environmental. A total of five cultural resource sites (one previously identified and four newly recorded) were identified within the APE (42KA1157, 42KA9490, 42KA9491, 42KA9492, 42KA9493). Two previously recorded site that were mapped within the current APE but relocated outside of the APE (42KA4538 and 42KA4539) were also revisited and updated.

Table 1 summarizes the sites identified, the NRCS' eligibility determinations, project effects, project designs measures, and proposed mitigation measures.

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PROJECT SUMMARY AND CONCLUSIONS						
Site No.	**Temporal Affiliation**	**Site Description**	**Eligibility**	**Effects**	**Project Design Impacts**	**Site Protective or Avoidance Measures**
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42KA4538	Historic	Historic bridge abutment	Not Eligible	No effect	N/A; also, outside of the current Project APE.	N/A; also, outside of the current Project APE.
42KA4539	Historic	Historic ditch/ flume	Not Eligible	No effect	N/A; also, outside of the current Project APE.	N/A; also, outside of the current Project APE.
42KA9490 (FS-01)	Historic	Historic ditch (*Mount Carmel Irrigation Ditch–West Ditch*)	Eligible—A, C, D	*Adverse Effect*	The open ditch will be converted to buried pipe.	An inadvertent discovery plan will be prepared, as well as a MOA with associated Historic Properties Treatment Plan to mitigate the adverse effects to the site.
42KA9491 (FS-02)	Historic	Historic ditch (*Mount Carmel Irrigation Ditch–East Ditch*)	Eligible—A, D	*Adverse Effect*	The open ditch will be converted to buried pipe.	An inadvertent discovery plan will be prepared, as well as a MOA with associated Historic Properties Treatment Plan to mitigate the adverse effects to the site.
42KA9492 (FS-03)	Historic	Historic road (*Lamb's Lane*)	Not Eligible	No effect	N/A	N/A
42KA9493 (FS-04)	Historic	Historic road (*Tait Lane*)	Not Eligible	No effect	N/A	N/A

To summarize, as a result of the proposed project, two historic ditches (42KA9490 and 42KA9491), the Mount Carmel Irrigation West and East Ditches, will be converted from open ditch to buried pipe. Given that both sites are eligible for the NRHP under multiple criteria, the piping will result in adverse effects to both sites. To resolve the adverse effects, an inadvertent discovery plan will be prepared and supplied to construction crews, in additional to the preparation and execution of a Memorandum of Agreement with associated Treatment Plan. The MOA will be prepared in consultation with the Utah SHPO, KCWCD, interested THPOs, tribes, and other organizations.

January 23, 2023

Mr. Daniel Bullets
Kaibab Band of Paiute Indians of the Kaibab Indian Reservation
Cultural Preservation Office
HC65, Box 2
Fredonia, Arizona 86022

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840)

Dear Mr. Bullets:

Included in this submission is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah.* The Natural Resources Conservation Service (NRCS) and Kane County Water Conservancy District (KCWCD) are proposing the addition of a pipeline to their Cove Reservoir Project (U18TN0544), which originally consisted of a reservoir and associated facilities. The original U18TN0544 Class III inventory was conducted in October of 2018. The additional pipeline is being completed as *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840). This addendum and supplemental inventory area are the result of a change in project complexity, changing from an Environmental Assessment to an EIS.

The Addendum Project Area of Potential Effects (APE) totals 9.06 miles (68.83 acres) in length in Kane County, Utah. Throughout the addendum Project area, for a total of 9.06 miles (47,836 feet), a new pipeline will be placed within or parallel to existing irrigation ditches as part of the Cove East Fork Virgin River Plan-EIS Project improvements located immediately southwest of the town of Orderville, Utah. To account for flexibility in design, a survey corridor of 15 meters (approximately 50 feet) was evaluated. This resulted in a total APE of 68.83 acres. Of this, the APE is comprised of 68.71 acres of Private land, 0.11 acres of land administered by the Bureau of Land Management, Kanab Field Office, and 0.01 acres of lands managed by the Utah School and Institutional Trust Lands Administration. The NRCS is acting as the lead federal agency for the purposes of Section 106 consultation, which will also cover SITLA's responsibilities under Utah Code Annotated Section 9-8-404. The BLM is a cooperating agency.

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42KA4539	Historic	Historic ditch/ flume	Not Eligible	No effect	N/A; also, outside of the current Project APE.	N/A; also, outside of the current Project APE.
42KA9490 (FS-01)	Historic	Historic ditch (*Mount Carmel Irrigation Ditch–West Ditch*)	Eligible—A, C, D	*Adverse Effect*	The open ditch will be converted to buried pipe.	An inadvertent discovery plan will be prepared, as well as a MOA with associated Historic Properties Treatment Plan to mitigate the adverse effects to the site.
42KA9491 (FS-02)	Historic	Historic ditch (*Mount Carmel Irrigation Ditch–East Ditch*)	Eligible—A, D	*Adverse Effect*	The open ditch will be converted to buried pipe.	An inadvertent discovery plan will be prepared, as well as a MOA with associated Historic Properties Treatment Plan to mitigate the adverse effects to the site.
42KA9492 (FS-03)	Historic	Historic road (*Lamb's Lane*)	Not Eligible	No effect	N/A	N/A
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To summarize, as a result of the proposed project, two historic ditches (42KA9490 and 42KA9491), the Mount Carmel Irrigation West and East Ditches, will be converted from open ditch to buried pipe. Given that both sites are eligible for the NRHP under multiple criteria, the piping will result in adverse effects to both sites. To resolve the adverse effects, an inadvertent discovery plan will be prepared and supplied to construction crews, in additional to the preparation and execution of a Memorandum of Agreement with associated Treatment Plan. The MOA will be prepared in consultation with the Utah SHPO, KCWCD, interested THPOs, tribes, and other organizations.

January 23, 2023

Mr. Luke Duncan
Chairman
Ute Indian Tribe of the Uintah & Ouray Reservation, Utah
P.O. Box 190
Fort Duchesne, Utah 84026

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840)

Dear Mr. Duncan:

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42KA4539	Historic	Historic ditch/ flume	Not Eligible	No effect	N/A; also, outside of the current Project APE.	N/A; also, outside of the current Project APE.
42KA9490 (FS-01)	Historic	Historic ditch (*Mount Carmel Irrigation Ditch–West Ditch*)	Eligible—A, C, D	*Adverse Effect*	The open ditch will be converted to buried pipe.	An inadvertent discovery plan will be prepared, as well as a MOA with associated Historic Properties Treatment Plan to mitigate the adverse effects to the site.
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To summarize, as a result of the proposed project, two historic ditches (42KA9490 and 42KA9491), the Mount Carmel Irrigation West and East Ditches, will be converted from open ditch to buried pipe. Given that both sites are eligible for the NRHP under multiple criteria, the piping will result in adverse effects to both sites. To resolve the adverse effects, an inadvertent discovery plan will be prepared and supplied to construction crews, in additional to the preparation and execution of a Memorandum of Agreement with associated Treatment Plan. The MOA will be prepared in consultation with the Utah SHPO, KCWCD, interested THPOs, tribes, and other organizations.

January 23, 2023

Mr. Manuel Heart
Chairman
Ute Mountain Ute Tribe
P.O. Box JJ
125 Mikewash Road
Towaoc, Colorado 81334

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840)

Dear Mr. Heart:

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42KA4538	Historic	Historic bridge abutment	Not Eligible	No effect	N/A; also, outside of the current Project APE.	N/A; also, outside of the current Project APE.
42KA4539	Historic	Historic ditch/ flume	Not Eligible	No effect	N/A; also, outside of the current Project APE.	N/A; also, outside of the current Project APE.
42KA9490 (FS-01)	Historic	Historic ditch (*Mount Carmel Irrigation Ditch–West Ditch*)	Eligible—A, C, D	*Adverse Effect*	The open ditch will be converted to buried pipe.	An inadvertent discovery plan will be prepared, as well as a MOA with associated Historic Properties Treatment Plan to mitigate the adverse effects to the site.
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To summarize, as a result of the proposed project, two historic ditches (42KA9490 and 42KA9491), the Mount Carmel Irrigation West and East Ditches, will be converted from open ditch to buried pipe. Given that both sites are eligible for the NRHP under multiple criteria, the piping will result in adverse effects to both sites. To resolve the adverse effects, an inadvertent discovery plan will be prepared and supplied to construction crews, in additional to the preparation and execution of a Memorandum of Agreement with associated Treatment Plan. The MOA will be prepared in consultation with the Utah SHPO, KCWCD, interested THPOs, tribes, and other organizations.

January 23, 2023

Mr. Terry Knight
Tribal Historic Preservation Officer
Ute Mountain Ute Tribe
P.O. Box 468
Towaoc, Colorado 81334

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840)

Dear Mr. Knight:

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January 23, 2023

Mr. Malcolm Lehi
Council Representative
White Mesa, Ute Council
P.O. Box 7096
White Mesa, Utah 84511

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840)

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42KA1157	Prehistoric	Prehistoric artifact scatter	Eligible—D	*No Adverse Effect*	Installation of new buried pipe along the northeast portion of the site.	None; the portion of the site within the Project APE is heavily disturbed by previous road construction/maintenance, plowing, livestock and a sewer line, it has also been previously tested and is non-contributing to the overall eligibility of the site.
42KA4538	Historic	Historic bridge abutment	Not Eligible	No effect	N/A; also, outside of the current Project APE.	N/A; also, outside of the current Project APE.
42KA4539	Historic	Historic ditch/ flume	Not Eligible	No effect	N/A; also, outside of the current Project APE.	N/A; also, outside of the current Project APE.
42KA9490 (FS-01)	Historic	Historic ditch (*Mount Carmel Irrigation Ditch–West Ditch*)	Eligible—A, C, D	*Adverse Effect*	The open ditch will be converted to buried pipe.	An inadvertent discovery plan will be prepared, as well as a MOA with associated Historic Properties Treatment Plan to mitigate the adverse effects to the site.
42KA9491 (FS-02)	Historic	Historic ditch (*Mount Carmel Irrigation Ditch–East Ditch*)	Eligible—A, D	*Adverse Effect*	The open ditch will be converted to buried pipe.	An inadvertent discovery plan will be prepared, as well as a MOA with associated Historic Properties Treatment Plan to mitigate the adverse effects to the site.
42KA9492 (FS-03)	Historic	Historic road (*Lamb's Lane*)	Not Eligible	No effect	N/A	N/A
42KA9493 (FS-04)	Historic	Historic road (*Tait Lane*)	Not Eligible	No effect	N/A	N/A

To summarize, as a result of the proposed project, two historic ditches (42KA9490 and 42KA9491), the Mount Carmel Irrigation West and East Ditches, will be converted from open ditch to buried pipe. Given that both sites are eligible for the NRHP under multiple criteria, the piping will result in adverse effects to both sites. To resolve the adverse effects, an inadvertent discovery plan will be prepared and supplied to construction crews, in additional to the preparation and execution of a Memorandum of Agreement with associated Treatment Plan. The MOA will be prepared in consultation with the Utah SHPO, KCWCD, interested THPOs, tribes, and other organizations.

January 23, 2023

Ms. Dorena Martineau
Paiute Indian Tribe of Utah
440 North Paiute Drive
Cedar City, Utah 84721

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840)

Dear Ms. Martineau:

Included in this submission is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah.* The Natural Resources Conservation Service (NRCS) and Kane County Water Conservancy District (KCWCD) are proposing the addition of a pipeline to their Cove Reservoir Project (U18TN0544), which originally consisted of a reservoir and associated facilities. The original U18TN0544 Class III inventory was conducted in October of 2018. The additional pipeline is being completed as *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840). This addendum and supplemental inventory area are the result of a change in project complexity, changing from an Environmental Assessment to an EIS.

The Addendum Project Area of Potential Effects (APE) totals 9.06 miles (68.83 acres) in length in Kane County, Utah. Throughout the addendum Project area, for a total of 9.06 miles (47,836 feet), a new pipeline will be placed within or parallel to existing irrigation ditches as part of the Cove East Fork Virgin River Plan-EIS Project improvements located immediately southwest of the town of Orderville, Utah. To account for flexibility in design, a survey corridor of 15 meters (approximately 50 feet) was evaluated. This resulted in a total APE of 68.83 acres. Of this, the APE is comprised of 68.71 acres of Private land, 0.11 acres of land administered by the Bureau of Land Management, Kanab Field Office, and 0.01 acres of lands managed by the Utah School and Institutional Trust Lands Administration. The NRCS is acting as the lead federal agency for the purposes of Section 106 consultation, which will also cover SITLA's responsibilities under Utah Code Annotated Section 9-8-404. The BLM is a cooperating agency.

Class III (intensive pedestrian) and Class II (reconnaissance) cultural resources inventory were conducted between November 15 to 19, 2021 and on March 20, 2022 by Transcon Environmental. A total of five cultural resource sites (one previously identified and four newly recorded) were identified within the APE (42KA1157, 42KA9490, 42KA9491, 42KA9492, 42KA9493). Two previously recorded site that were mapped within the current APE but relocated outside of the APE (42KA4538 and 42KA4539) were also revisited and updated.

Table 1 summarizes the sites identified, the NRCS' eligibility determinations, project effects, project designs measures, and proposed mitigation measures.

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42KA4539	Historic	Historic ditch/ flume	Not Eligible	No effect	N/A; also, outside of the current Project APE.	N/A; also, outside of the current Project APE.
42KA9490 (FS-01)	Historic	Historic ditch (*Mount Carmel Irrigation Ditch–West Ditch*)	Eligible—A, C, D	*Adverse Effect*	The open ditch will be converted to buried pipe.	An inadvertent discovery plan will be prepared, as well as a MOA with associated Historic Properties Treatment Plan to mitigate the adverse effects to the site.
42KA9491 (FS-02)	Historic	Historic ditch (*Mount Carmel Irrigation Ditch–East Ditch*)	Eligible—A, D	*Adverse Effect*	The open ditch will be converted to buried pipe.	An inadvertent discovery plan will be prepared, as well as a MOA with associated Historic Properties Treatment Plan to mitigate the adverse effects to the site.
42KA9492 (FS-03)	Historic	Historic road (*Lamb's Lane*)	Not Eligible	No effect	N/A	N/A
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To summarize, as a result of the proposed project, two historic ditches (42KA9490 and 42KA9491), the Mount Carmel Irrigation West and East Ditches, will be converted from open ditch to buried pipe. Given that both sites are eligible for the NRHP under multiple criteria, the piping will result in adverse effects to both sites. To resolve the adverse effects, an inadvertent discovery plan will be prepared and supplied to construction crews, in additional to the preparation and execution of a Memorandum of Agreement with associated Treatment Plan. The MOA will be prepared in consultation with the Utah SHPO, KCWCD, interested THPOs, tribes, and other organizations.

January 23, 2023

Mr. Timothy L. Nuvangyaoma
Chairman
Hopi Tribe Chairman's Office
P.O. Box 123
Kykotsmovi, Arizona 86039

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840)

Dear Mr. Nuvangyaoma:

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To summarize, as a result of the proposed project, two historic ditches (42KA9490 and 42KA9491), the Mount Carmel Irrigation West and East Ditches, will be converted from open ditch to buried pipe. Given that both sites are eligible for the NRHP under multiple criteria, the piping will result in adverse effects to both sites. To resolve the adverse effects, an inadvertent discovery plan will be prepared and supplied to construction crews, in additional to the preparation and execution of a Memorandum of Agreement with associated Treatment Plan. The MOA will be prepared in consultation with the Utah SHPO, KCWCD, interested THPOs, tribes, and other organizations.

January 23, 2023

Mr. Buu Nygren
President
Navajo Nation Office of the President
P.O. Box 7440
Window Rock, Arizona 86515

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840)

Dear Mr. Nygren:

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January 23, 2023

Mr. Val Panteah Sr.
Governor
Pueblo of Zuni
P.O. Box 339
Zuni, New Mexico 87327

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840)

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January 23, 2023

Laura Parry
Chairwoman
Moapa Band of Paiute Indians of the Moapa River Indian
Reservation, Nevada
P.O. Box 340
Moapa, Nevada 89025-0340

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840)

Dear Ms. Parry:

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January 23, 2023

Mr. Johnny Lehi, Jr.
President
San Juan Southern Paiute Tribe of Arizona
50 South Main Street, Suite 201
P.O. Box 2950
Tuba City, Arizona 86045

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840)

Dear President Lehi:

Included in this submission is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah.* The Natural Resources Conservation Service (NRCS) and Kane County Water Conservancy District (KCWCD) are proposing the addition of a pipeline to their Cove Reservoir Project (U18TN0544), which originally consisted of a reservoir and associated facilities. The original U18TN0544 Class III inventory was conducted in October of 2018. The additional pipeline is being completed as *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840). This addendum and supplemental inventory area are the result of a change in project complexity, changing from an Environmental Assessment to an EIS.

The Addendum Project Area of Potential Effects (APE) totals 9.06 miles (68.83 acres) in length in Kane County, Utah. Throughout the addendum Project area, for a total of 9.06 miles (47,836 feet), a new pipeline will be placed within or parallel to existing irrigation ditches as part of the Cove East Fork Virgin River Plan-EIS Project improvements located immediately southwest of the town of Orderville, Utah. To account for flexibility in design, a survey corridor of 15 meters (approximately 50 feet) was evaluated. This resulted in a total APE of 68.83 acres. Of this, the APE is comprised of 68.71 acres of Private land, 0.11 acres of land administered by the Bureau of Land Management, Kanab Field Office, and 0.01 acres of lands managed by the Utah School and Institutional Trust Lands Administration. The NRCS is acting as the lead federal agency for the purposes of Section 106 consultation, which will also cover SITLA's responsibilities under Utah Code Annotated Section 9-8-404. The BLM is a cooperating agency.

Class III (intensive pedestrian) and Class II (reconnaissance) cultural resources inventory were conducted between November 15 to 19, 2021 and on March 20, 2022 by Transcon Environmental. A total of five cultural resource sites (one previously identified and four newly recorded) were identified within the APE (42KA1157, 42KA9490, 42KA9491, 42KA9492, 42KA9493). Two previously recorded site that were mapped within the current APE but relocated outside of the APE (42KA4538 and 42KA4539) were also revisited and updated.

Table 1 summarizes the sites identified, the NRCS' eligibility determinations, project effects, project designs measures, and proposed mitigation measures.

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42KA4538	Historic	Historic bridge abutment	Not Eligible	No effect	N/A; also, outside of the current Project APE.	N/A; also, outside of the current Project APE.
42KA4539	Historic	Historic ditch/ flume	Not Eligible	No effect	N/A; also, outside of the current Project APE.	N/A; also, outside of the current Project APE.
42KA9490 (FS-01)	Historic	Historic ditch (*Mount Carmel Irrigation Ditch–West Ditch*)	Eligible—A, C, D	*Adverse Effect*	The open ditch will be converted to buried pipe.	An inadvertent discovery plan will be prepared, as well as a MOA with associated Historic Properties Treatment Plan to mitigate the adverse effects to the site.
42KA9491 (FS-02)	Historic	Historic ditch (*Mount Carmel Irrigation Ditch–East Ditch*)	Eligible—A, D	*Adverse Effect*	The open ditch will be converted to buried pipe.	An inadvertent discovery plan will be prepared, as well as a MOA with associated Historic Properties Treatment Plan to mitigate the adverse effects to the site.
42KA9492 (FS-03)	Historic	Historic road (*Lamb's Lane*)	Not Eligible	No effect	N/A	N/A
42KA9493 (FS-04)	Historic	Historic road (*Tait Lane*)	Not Eligible	No effect	N/A	N/A

To summarize, as a result of the proposed project, two historic ditches (42KA9490 and 42KA9491), the Mount Carmel Irrigation West and East Ditches, will be converted from open ditch to buried pipe. Given that both sites are eligible for the NRHP under multiple criteria, the piping will result in adverse effects to both sites. To resolve the adverse effects, an inadvertent discovery plan will be prepared and supplied to construction crews, in additional to the preparation and execution of a Memorandum of Agreement with associated Treatment Plan. The MOA will be prepared in consultation with the Utah SHPO, KCWCD, interested THPOs, tribes, and other organizations.

January 23, 2023

Ms. Ona Segundo
Chairwoman
Kaibab Band of Paiute Indians of the Kaibab Indian Reservation
Tribal Affairs Building
HC65, Box 2
Fredonia, Arizona 86022

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840)

Dear Ms. Segundo:

Included in this submission is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah.* The Natural Resources Conservation Service (NRCS) and Kane County Water Conservancy District (KCWCD) are proposing the addition of a pipeline to their Cove Reservoir Project (U18TN0544), which originally consisted of a reservoir and associated facilities. The original U18TN0544 Class III inventory was conducted in October of 2018. The additional pipeline is being completed as *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840). This addendum and supplemental inventory area are the result of a change in project complexity, changing from an Environmental Assessment to an EIS.

The Addendum Project Area of Potential Effects (APE) totals 9.06 miles (68.83 acres) in length in Kane County, Utah. Throughout the addendum Project area, for a total of 9.06 miles (47,836 feet), a new pipeline will be placed within or parallel to existing irrigation ditches as part of the Cove East Fork Virgin River Plan-EIS Project improvements located immediately southwest of the town of Orderville, Utah. To account for flexibility in design, a survey corridor of 15 meters (approximately 50 feet) was evaluated. This resulted in a total APE of 68.83 acres. Of this, the APE is comprised of 68.71 acres of Private land, 0.11 acres of land administered by the Bureau of Land Management, Kanab Field Office, and 0.01 acres of lands managed by the Utah School and Institutional Trust Lands Administration. The NRCS is acting as the lead federal agency for the purposes of Section 106 consultation, which will also cover SITLA's responsibilities under Utah Code Annotated Section 9-8-404. The BLM is a cooperating agency.

Class III (intensive pedestrian) and Class II (reconnaissance) cultural resources inventory were conducted between November 15 to 19, 2021 and on March 20, 2022 by Transcon Environmental. A total of five cultural resource sites (one previously identified and four newly recorded) were identified within the APE (42KA1157, 42KA9490, 42KA9491, 42KA9492, 42KA9493). Two previously recorded site that were mapped within the current APE but relocated outside of the APE (42KA4538 and 42KA4539) were also revisited and updated.

Table 1 summarizes the sites identified, the NRCS' eligibility determinations, project effects, project designs measures, and proposed mitigation measures.

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To summarize, as a result of the proposed project, two historic ditches (42KA9490 and 42KA9491), the Mount Carmel Irrigation West and East Ditches, will be converted from open ditch to buried pipe. Given that both sites are eligible for the NRHP under multiple criteria, the piping will result in adverse effects to both sites. To resolve the adverse effects, an inadvertent discovery plan will be prepared and supplied to construction crews, in additional to the preparation and execution of a Memorandum of Agreement with associated Treatment Plan. The MOA will be prepared in consultation with the Utah SHPO, KCWCD, interested THPOs, tribes, and other organizations.

January 23, 2023

Ms. Nichol Shurack
Tribal Archaeologist
Ute Mountain Ute Tribe
P.O. Box 468
Towaoc, CO 81334

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840)

Dear Ms. Shurack:

Included in this submission is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah.* The Natural Resources Conservation Service (NRCS) and Kane County Water Conservancy District (KCWCD) are proposing the addition of a pipeline to their Cove Reservoir Project (U18TN0544), which originally consisted of a reservoir and associated facilities. The original U18TN0544 Class III inventory was conducted in October of 2018. The additional pipeline is being completed as *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840). This addendum and supplemental inventory area are the result of a change in project complexity, changing from an Environmental Assessment to an EIS.

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January 23, 2023

Mr. Benny Tso
Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony
One Paiute Drive
Las Vegas, Nevada 89106

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840)

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Thus, the NRCS recommends that the project proceed as planned with a determination of ***adverse effect to historic properties***. The NRCS requests concurrence for the determination of project effects and site eligibility. If you have any questions, comments, or concerns, please contact Tara S. Hoffmann, State Cultural Resources Specialist, at 801-524-4556 at your convenience.

Sincerely,



TRISHA CRACROFT
Acting State Conservationist

Enclosure

cc: (w/o encl)
Tara Hoffmann, State Cultural Resources specialist, NRCS, Salt Lake City, UT
Brandon Todd, ASTC-Field Operations, NRCS, Richfield, UT
Kristi Westwood, District Conservationist, NRCS, Panguitch, UT
Norm Evenstad, Assistant State Conservationist Water Resources, NRCS, Salt Lake City, UT
Derek Hamilton, Water Resources Coordinator, NRCS, Salt Lake City, UT
Brian Storm, Archaeologist, BLM, Kanab, UT
Kristine Curry, Archaeologist, SITLA, Salt Lake City, UT
Ian Snyder, Project Manager/Environmental Planner, Transcon Environmental, Ferndale, CA

Agency Consultation

From:	Jennifer Bannick
To:	Brian Storm; Kristine Curry; Ellis Powelson
Cc:	Hoffmann, Tara - NRCS, Salt Lake City, UT; Eric Hansen; Lindsey Evenson
Subject:	U21TN0840 Cove East Fork Virgin River Plan-EIS Project -- Draft SHPO Package
Date:	Thursday, May 5, 2022 7:18:13 PM
Attachments:	image001.png

Hello Brian, Kristine, and Ellis,

The ***U21TN0840 Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah*** draft SHPO package is ready for agency review.

Unfortunately, these documents are too large to send via email, so they can be downloaded via the following OneDrive link: U21TN0840_SHPO Package_draft.zip

Please let us know if you have any questions or comments regarding these documents.

Thank you!
Jen

Jennifer Bannick
Archaeologist/Program Coordinator

Email: jbannick@transcon.com
Mobile: (801) 350-1353
Office: (801) 649-5141
Web: transcon.com
Mail: 579 W Galena Park Place, Unit 102
Draper, Utah 84020

Transcon environmental | Planners & Scientists

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Cultural and Paleo Clearance with Tier 1 Screening Form

Pursuant to the *Programmatic Agreement between the UDOT and the Utah SHPO Regarding Implementation of U.C.A. 9-8-404 for State Funded Transportation Projects in Utah*, UDOT has taken into account the effects of this undertaking on historic properties and has determined that the finding of effect is **No Historic Properties Affected**.

Pursuant to the *Memorandum of Understanding between the UDOT and the Utah Geological Survey Concerning Agency Responsibilities Pursuant to U.C.A. 79-3-508,* the UDOT has taken into account the effects of this undertaking on paleontological resources. If applicable, consultation letter from UGS is included in the environmental document.

PROJECT: Cove East Fork Virgin River Plan-EIS, Kane County, Utah – Addendum to Cultural Resources Inventory Report, Alpha Engineering's Cove Reservoir Project

DATE: June 1, 2022
PREPARER: Ellis B. Powelson
CONTACT: epowelson@utah.gov (801)362-9108

PROJECT STIPULATIONS

1) Clearance is contingent upon the contractor adhering to the proposed scope of work and remaining within cleared areas. **Notify Region Environmental of any scope changes.**
2) *UDOT Standard Specification 01355 Part 3.7, Environmental Clearances by Contractor*
3) *UDOT Standard Specification 01355 Part 3.8, Discovery of Historical Archaeological, or Paleontological Objects, Features, Sites or Human Remains*. **Notify Region Environmental immediately of any discoveries during construction.**

PROJECT DESCRIPTION

This is an addendum in support of Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544). The original Class III survey was conducted in October of 2018. The addendum and supplemental inventory area are the result of a change in project complexity, changing from an Environmental Assessment (EA) to an Environmental Impact Statement (EIS).

The Addendum project area measures a total of 68.30 acres (9.06 miles) and is located on lands managed by the Bureau of Land Management (BLM) Kanab Field Office (0.11 acre), SITLA (0.01 acre), and on privately-owned lands (68.18 acres). Class III (intensive pedestrian) supplemental survey will be conducted on 11.41 miles within the project APE (9.06 miles) with 0.02 mile on BLM Kanab Field Office-managed lands, 0.01 mile on SITLA-managed land, and 11.39 miles on privately owned lands. The supplemental inventory area is generally located within an existing UDOT highway right-of-way (ROW) on the eastern side of US-89 (State Street), along portions of Center Street and Cottonwood Lane to the east of US-89, and within agricultural fields and unnamed dirt roads that cross sections of Tait Lane, West 2500 South (Lambs Lane), Stevens Lane, and Muddy Creek Road on the western side of US-89 (State Street) within the town of Mount Carmel in Long Valley, Kane County, Utah. The survey will be linear and will be conducted in 15-meter wide transects throughout the project area. No portion of the project will be left unsurveyed due to prior survey efforts.

SCREENING PROCESS

Screened undertakings have the potential to affect historic properties, but have been determined by UDOT to require no further review or consultation under the Agreements. Screening may include any the following tasks and should be appropriate to the complexity, scale, and location of the undertaking. Documentation of the screening will be included in the project files, quarterly report submitted to SHPO, and environmental document.

Antiquities Project Number: U21TN0840

Literature Review

- ☐ Class I literature search (date completed and by whom):
- ☒ Records review (i.e. UDSH, UDOT, BLM, etc.): UDSH Sego database
- ☐ Project plans

☐ As-built project plans
☒ Aerial photographs: UGS Aerial Imagery Collection
☒ Historic Maps: BLM GLO records
☒ Topographic Maps: USGS TopoView
☒ ROW/Ownership/Parcel Data: UDOT ROW, BLM-Kanab, SITLA
☒ Other: Utah SHPO historic contexts, BLM field office predictive models and Class I documents, water rights, Sanborn maps, Utah Division of Water Rights (UDWR) records

Description of search results: A review of records available through the UDSH Sego database revealed that 6 previous surveys and 4 previously identified sites were mapped as overlapping, being immediately adjacent, or being crossed by some portion of the current Project APE. These sites consist of two prehistoric artifact scatters (42KA1157 and 42KA1965), a historic bridge abutment (42KA4538), and a historic ditch (42KA4539). GLO maps indicate a few historic improvements near the Project area including historic roads, ditches, transmission lines, ditches, fences, structures, agricultural fields, and a coal mine. Historic aerial imagery in the vicinity of the Project indicates a few visible historic developments, including established roads/highways, ditches, and cultivated fields. Historic land patent records indicate 22 land patents near the Project area, with dates ranging from 1880 to 1980. Historic grazing allotment records indicated seven active grazing allotments surrounding the Project area; however, none cross into or overlap any portion of the Project APE. Historic water rights records indicate that there are 10 historic water rights within 0.5 mile of the Project APE consisting of underground water sources, and surface water rights with sources from springs, and the East Fork Virgin River.

Field Review

☒ Pedestrian survey (Class III) (survey interval): 15m
☐ Field review other than Class III (reconnaissance, windshield, etc.):
☐ Other:
☐ None

Description of survey results (If no field survey was conducted, explain why not): The survey was conducted in 15-meter-wide transects throughout the entire Project APE. This resulted in a total of approximately 68.83 acres evaluated for cultural resources. No portion of the current Project was left unsurveyed due to prior survey efforts. A total of 48.66 acres were surveyed to Class III standards; some fenced off and inaccessible areas on private property with posted no trespassing signs within the APE (20.17 acres) were surveyed to Class II standards due to safety and trespassing concerns.

As a result of the survey, it was determined that a total of five cultural resource sites are located within the Project APE. Of the five sites identified within the Project APE, one previously recorded site (42KA1157 [also 42KA1965/42KA1958]) is recommended Eligible for listing on the NRHP under Criterion D for information potential; two sites are recommended Eligible for the NRHP under Criteria A and D (42KA9490 and 42KA9491) for their association with significant regional events and for information potential; site 42KA9490 is also recommended to be Eligible for listing on the NRHP under Criterion C as it embodies the distinctive characteristics of a type, period, and method of construction in the region; the remaining sites (42KA9492 and 42KA9493) are recommended Not Eligible for the NRHP under any Criteria. Three IOs (IO-01to IO-03) were also identified and recorded within the Project APE as a result of new survey.

Supporting Documentation

Reports and/or forms generated from any cultural resource inventories shall be submitted quarterly to the Utah Division of State History (UDSH) for filing.

Title of report: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah*

Consultation

☐ Utah SHPO (including APE consultation):

☐ Certified Local Government (CLG):
☒ Tribes:
☒ State/Federal Agencies: NRCS, BLM-Kanab, SITLA
☐ Knowledgeable Informants:
☐ Other:
☐ None:

Description of consultation efforts (If no consultation was done, explain why not):
As the lead agency for this project, Native American consultation is the responsibility of the NRCS.

☐ Controversy based on historic preservation issues? If yes, consultation with SHPO and UDOT Central Environmental is required. Additional consultation with FHWA may be required.

Finding of Effect

The undertaking will result in the following finding of effect:

☐ No Historic Properties Affected: no cultural resources present
☐ No Historic Properties Affected: cultural resources present but none eligible
☒ No Historic Properties Affected: historic properties present, but are completely avoided by the undertaking and the potential for substantial indirect effects is very low

Description of impacts: For information on site eligibility and effects, please see Table 1 below:

TABLE 1. PROJECT SUMMARY and CONCLUSIONS

Site No.	Temporal Affiliation	Site Description	Eligibility	Effects	Site Protective or Avoidance Measures
42KA1157	Prehistoric	Prehistoric artifact scatter	Eligible—D	*No Adverse Effect*	None; the portion of the site within the Project APE is heavily disturbed by previous road construction/maintenance, plowing, livestock and a sewer line, it has also been previously tested and is non-contributing to the overall eligibility of the site.
42KA4538	Historic	Historic bridge abutment	Not Eligible	No effect	N/A; also, outside of the current Project APE.
42KA4539	Historic	Historic ditch/ flume	Not Eligible	No effect	N/A; also, outside of the current Project APE.
42KA9490 (FS-01)	Historic	Historic ditch (*Mount Carmel Irrigation Ditch–West Ditch*)	Eligible—A, C, D	*No Adverse Effect*	An inadvertent discovery plan should be prepared, and a HPTP should be developed to mitigate adverse effects to the site.
42KA9491 (FS-02)	Historic	Historic ditch (*Mount Carmel Irrigation Ditch–East Ditch*)	Eligible—A, D	*No Adverse Effect*	An inadvertent discovery plan should be prepared, and a HPTP should be developed to mitigate adverse effects to the site.
42KA9492 (FS-03)	Historic	Historic road (*Lamb's Lane*)	Not Eligible	No effect	N/A
42KA9493 (FS-04)	Historic	Historic road (*Tait Lane*)	Not Eligible	No effect	N/A

Additional Information

Third Cultural Resource Inventory Report

SHPO Consultation

May 20, 2024

Dr. Christopher Merritt, PhD
State Historic Preservation Officer
Utah Division of State History
300 Rio Grande Avenue
Salt Lake City, Utah 84101-1182

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation* (Addendum Project; Utah Antiquities Project Number U23TN0682)

Dear Dr. Merritt:

Included in this submission is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah: Esplin Pit Evaluation.* The Natural Resources Conservation Service (NRCS) and Kane County Water Conservancy District (KCWCD) are proposing the addition of a borrow source to their Cove Reservoir Plan-EIS (U18TN0544, U21TN0840), which consists of a reservoir, irrigation pipeline, and associated facilities. Two previous Class III inventories, encompassing two alternative reservoir locations, pipelines, staging areas, construction access, borrow sources, and all other proposed ground disturbance, were completed under Project Numbers U18TN0544 and U21TN0840. The NRCS consulted with your office regarding those project numbers in letters dated January 9, 2020, and January 23, 2023, respectively. Concurrence on site eligibility and a determination of "adverse effect to historic properties" for the undertaking as a whole, was received on January 17, 2020, and February 6, 2023, respectively (Case Nos. 20-0121 and 23-0280). The additional borrow source, located east of Glendale, Utah, adjacent to Kanab Creek on the Glendale Bench has been evaluated under *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation.* The NRCS is serving as the lead Federal agency.

Per 36 CFR 800.16(d), the supplemental Area of Potential Effects (APE) totals 13.72 acres of private land. The APE is the site of a former borrow pit (Esplin Glendale Bench Pit or Esplin Pit) where basalt bedrock has previously been quarried for use as riprap for a previous NRCS Emergency Watershed Protection project (U12SH0189, U13SH0167; Case Nos. 12-0762 and 13-0512). The project proposes to reopen the borrow pit to procure riprap for construction and armoring of the planned Cove Reservoir Dam. Observed basalt exposures in the project area measure 10 to 20 feet thick, and procurement activities to fulfill the dam construction needs (approximately 29,000 cubic yards of riprap) would require quarrying 1.8 acres of basalt to a thickness of 10 feet.

Per 36 CFR 800.4, a desktop review of know cultural resources, followed by a Class III (intensive pedestrian) and Class II (reconnaissance) cultural resources inventory were conducted on October 10 and 11, 2023 by Secretary of the Interior -qualified archaeologists with Transcon Environmental (now Eocene Environmental Group). Due to slope steepness, 5.25 acres were inventoried at a Class II (reconnaissance) level. Two cultural resource sites (42KA7537 [Kanab Creek Cave], and 42KA9789), were identified and documented. Site 42KA7537 had previously been determined eligible for the National Register of Historic

Places (NRHP) under Criterion D (Case No. 13-0512). The NRCS has also determined that Site 42KA9789, a prehistoric campsite, is eligible for the NRHP under Criterion D.

Table 1 summarizes the avoidance and monitoring requirements during implementation. If requested during consultation, a tribal monitor can also be present.

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PROJECT SUMMARY AND CONCLUSIONS

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With the implementation of the aforementioned avoidance and minimization measures, the NRCS has determined that use of the proposed borrow source will result in **No Adverse Effect to Historic Properties**, per 36 CFR 800.5(b). The NRCS requests concurrence for the delineation of the APE, determinations of site eligibility and project effect. If you have any questions, comments, or concerns, please contact Tara S. Hoffmann, State Watershed Cultural Resources Specialist, at 801-524-4556 or tara.hoffmann@usda.gov, at your convenience.

Sincerely,



TRAVIS MOTE
Acting State Conservationist

Enclosure:
- Cultural Resources Report

cc: (w/o encl)
Anders Fillerup, Acting ASTC-Water Resources, NRCS, Vernal, UT
Tara Hoffmann, State Cultural Resources specialist, NRCS, Salt Lake City, UT
Brandon Todd, ASTC-Field Operations, NRCS, Richfield, UT
Kristi Westwood, District Conservationist, NRCS, Panguitch, UT
Norm Evenstad, Water Resources ACES, NRCS, Salt Lake City, UT
Derek Hamilton, Water Resources Coordinator, NRCS, Salt Lake City, UT
Jacob Herrera, Project Manager/Environmental Planner, Eocene Environmental Group, Mesa, AZ
Ron Bolander, Environmental Planner, Eocene Environmental Group, Draper, UT

June 2, 2024

Travis Mote
Acting State Conservationist
Natural Resources Conservation Service
125 South State Street, Room 4010
Salt Lake City, Utah 84138-1100

RE: Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation

For future correspondence, please reference Case No. 24-1261

Dear Travis Mote,

The Utah State Historic Preservation Office received your submission and request for our comment on the above-referenced undertaking on May 20, 2024.

We concur with your determinations of eligibility and effect for this undertaking.

This letter serves as our comment on the determinations you have made within the consultation process specified in §36CFR800.4. If you have questions, please contact me at (801) 535-2502 or by email at rmcgrath@utah.gov.

Sincerely,

Ryan P McGrath

Ryan McGrath
Compliance Archaeologist

Tribal Consultation

May 22, 2024

Mr. Richard M. Begay
THPO and Department Manager
Navajo Nation Historic Preservation Department
P.O. Box 4950
Window Rock, Arizona 86515

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation* (Addendum Project; Utah Antiquities Project Number U23TN0682)

Dear Manager Begay:

Enclosed is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah: Esplin Pit Evaluation.* The Natural Resources Conservation Service (NRCS) and Kane County Water Conservancy District (KCWCD) are proposing the addition of a borrow source to their Cove Reservoir Plan-EIS (U18TN0544, U21TN0840), which consists of a reservoir, irrigation pipeline, and associated facilities. Two previous Class III inventories, encompassing two alternative reservoir locations, pipelines, staging areas, construction access, borrow sources, and all other proposed ground disturbance, were completed under Project Numbers U18TN0544 and U21TN0840. The NRCS consulted with your office regarding those project numbers in letters dated January 9, 2020, and January 23, 2023, respectively. Concurrence on site eligibility and a determination of "adverse effect to historic properties" for the undertaking as a whole, was received on January 17, 2020, and February 6, 2023, respectively (Case Nos. 20-0121 and 23-0280). The additional borrow source, located east of Glendale, Utah, adjacent to Kanab Creek on the Glendale Bench has been evaluated under *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation.* The NRCS is serving as the lead Federal agency.

Per 36 CFR 800.16(d), the supplemental Area of Potential Effects (APE) totals 13.72 acres of private land. The APE is the site of a former borrow pit (Esplin Glendale Bench Pit or Esplin Pit) where basalt bedrock has previously been quarried for use as riprap for a previous NRCS Emergency Watershed Protection project (U12SH0189, U13SH0167; Case Nos. 12-0762 and 13-0512). The project proposes to reopen the borrow pit to procure riprap for construction and armoring of the planned Cove Reservoir Dam. Observed basalt exposures in the project area measure 10 to 20 feet thick, and procurement activities to fulfill the dam construction needs (approximately 29,000 cubic yards of riprap) would require quarrying 1.8 acres of basalt to a thickness of 10 feet.

Per 36 CFR 800.4, a desktop review of know cultural resources, followed by a Class III (intensive pedestrian) and Class II (reconnaissance) cultural resources inventory were conducted on October 10 and 11, 2023 by Secretary of the Interior -qualified archaeologists with Transcon Environmental (now Eocene Environmental Group). Due to slope steepness, 5.25 acres were inventoried at a Class II (reconnaissance) level. Two cultural resource sites (42KA7537 [Kanab Creek Cave], and 42KA9789), were identified and documented. Site 42KA7537 had previously been determined eligible for the National Register of Historic

Places (NRHP) under Criterion D (Case No. 13-0512). The NRCS has also determined that Site 42KA9789, a prehistoric campsite, is eligible for the NRHP under Criterion D.

Table 1 summarizes the avoidance and monitoring requirements during implementation. If requested during consultation, a tribal monitor can also be present.

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PROJECT SUMMARY AND CONCLUSIONS

Site Number	Site Description	Eligibility	Protective Measures
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Sincerely,



TRAVIS MOTE
Acting State Conservationist

Enclosure:
- Cultural Resources Report

cc: (w/o encl)
Anders Fillerup, Acting ASTC-Water Resources, NRCS, Vernal, UT
Tara Hoffmann, State Cultural Resources specialist, NRCS, Salt Lake City, UT
Brandon Todd, ASTC-Field Operations, NRCS, Richfield, UT
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Derek Hamilton, Water Resources Coordinator, NRCS, Salt Lake City, UT
Jacob Herrera, Project Manager/Environmental Planner, Eocene Environmental Group, Mesa, AZ
Ron Bolander, Environmental Planner, Eocene Environmental Group, Draper, UT

May 22, 2024

Mr. Daniel Bullets
Kaibab Band of Paiute Indians of the Kaibab Indian Reservation
Cultural Preservation Office
HC65, Box 2
Fredonia, Arizona 86022

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation* (Addendum Project; Utah Antiquities Project Number U23TN0682)

Dear Mr. Bullets:

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Acting State Conservationist

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- Cultural Resources Report

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Jacob Herrera, Project Manager/Environmental Planner, Eocene Environmental Group, Mesa, AZ
Ron Bolander, Environmental Planner, Eocene Environmental Group, Draper, UT

May 22, 2024

Ms. Betsy Chapoose
THPO
Cultural Rights Protection Department
Ute Indian Tribe of the Uintah & Ouray Reservation, Utah
P.O. Box 190
Fort Duchesne, Utah 84026

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation* (Addendum Project; Utah Antiquities Project Number U23TN0682)

Dear Ms. Chapoose:

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Sincerely,

TRAVIS MOTE
Acting State Conservationist

Enclosure:
- Cultural Resources Report

cc: (w/o encl)
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Ron Bolander, Environmental Planner, Eocene Environmental Group, Draper, UT

May 22, 2024

Darren Daboda
THPO
Moapa Band of Paiute Indians of the Moapa River Indian Reservation, Nevada
1 Lincoln Street
PO Box 340
Moapa, NV 89025

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation* (Addendum Project; Utah Antiquities Project Number U23TN0682)

Dear Mr. Daboda:

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Ron Bolander, Environmental Planner, Eocene Environmental Group, Draper, UT

May 22, 2024

Dr. Kurt Dongoske
Director and Tribal Historic Preservation Officer
Pueblo of Zuni
P.O. Box 1149
Zuni, New Mexico 87327

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation* (Addendum Project; Utah Antiquities Project Number U23TN0682)

Dear Director Dongoske:

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Places (NRHP) under Criterion D (Case No. 13-0512). The NRCS has also determined that Site 42KA9789, a prehistoric campsite, is eligible for the NRHP under Criterion D.

Table 1 summarizes the avoidance and monitoring requirements during implementation. If requested during consultation, a tribal monitor can also be present.

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With the implementation of the aforementioned avoidance and minimization measures, the NRCS has determined that use of the proposed borrow source will result in **No Adverse Effect to Historic Properties**, per 36 CFR 800.5(b). The NRCS requests concurrence for the delineation of the APE, determinations of site eligibility and project effect. If you have any questions, comments, or concerns, please contact Tara S. Hoffmann, State Watershed Cultural Resources Specialist, at 801-524-4556 or tara.hoffmann@usda.gov, at your convenience.

Sincerely,

TRAVIS MOTE
Acting State Conservationist

Enclosure:
- Cultural Resources Report

cc: (w/o encl)
Anders Fillerup, Acting ASTC-Water Resources, NRCS, Vernal, UT
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Ron Bolander, Environmental Planner, Eocene Environmental Group, Draper, UT

May 22, 2024

Ms. Autumn Gillard
Cultural Resource Manager
Paiute Indian Tribe of Utah
440 North Paiute Drive
Cedar City, Utah 84721

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation* (Addendum Project; Utah Antiquities Project Number U23TN0682)

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Sincerely,

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Acting State Conservationist

Enclosure:
- Cultural Resources Report

cc: (w/o encl)
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Tara Hoffmann, State Cultural Resources specialist, NRCS, Salt Lake City, UT
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Jacob Herrera, Project Manager/Environmental Planner, Eocene Environmental Group, Mesa, AZ
Ron Bolander, Environmental Planner, Eocene Environmental Group, Draper, UT

May 22, 2024

Mr. Manuel Heart
Chairman
Ute Mountain Ute Tribe
P.O. Box JJ
125 Mikewash Road
Towaoc, Colorado 81334

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation* (Addendum Project; Utah Antiquities Project Number U23TN0682)

Dear Chairman Heart:

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Ron Bolander, Environmental Planner, Eocene Environmental Group, Draper, UT

May 22, 2024

Mr. Terry Knight
Tribal Historic Preservation Officer
Ute Mountain Ute Tribe
P.O. Box 468
131 West Mike Wash Road
Towaoc, Colorado 81334

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation* (Addendum Project; Utah Antiquities Project Number U23TN0682)

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Ron Bolander, Environmental Planner, Eocene Environmental Group, Draper, UT

May 22, 2024

Stewart B. Koyiyumptewa
THPO
Hopi Tribe of Arizona
Hopi Cultural Preservation Office
P.O Box 123
Kykotsmovi, Arizona 86039

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation* (Addendum Project; Utah Antiquities Project Number U23TN0682)

Dear Mr. Koyiyumptewa:

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Ron Bolander, Environmental Planner, Eocene Environmental Group, Draper, UT

May 22, 2024

Governor Arden Kucate
Pueblo of Zuni
P.O. Box 339
Zuni, New Mexico 87327

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation* (Addendum Project; Utah Antiquities Project Number U23TN0682)

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May 22, 2024

Malcolm Lehi
Council Representative
White Mesa, Ute Council
P.O. Box 7096
White Mesa, Utah 84511

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation* (Addendum Project; Utah Antiquities Project Number U23TN0682)

Dear Representative Lehi:

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Places (NRHP) under Criterion D (Case No. 13-0512). The NRCS has also determined that Site 42KA9789, a prehistoric campsite, is eligible for the NRHP under Criterion D.

Table 1 summarizes the avoidance and monitoring requirements during implementation. If requested during consultation, a tribal monitor can also be present.

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With the implementation of the aforementioned avoidance and minimization measures, the NRCS has determined that use of the proposed borrow source will result in **No Adverse Effect to Historic Properties**, per 36 CFR 800.5(b). The NRCS requests concurrence for the delineation of the APE, determinations of site eligibility and project effect. If you have any questions, comments, or concerns, please contact Tara S. Hoffmann, State Watershed Cultural Resources Specialist, at 801-524-4556 or tara.hoffmann@usda.gov, at your convenience.

Sincerely,



TRAVIS MOTE
Acting State Conservationist

Enclosure:
- Cultural Resources Report

cc: (w/o encl)
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Ron Bolander, Environmental Planner, Eocene Environmental Group, Draper, UT

May 22, 2024

Mr. Roland Maldonado
Chairman
Kaibab Band of Paiute Indians of the Kaibab Indian Reservation
Tribal Affairs Building
HC65, Box 2
Fredonia, Arizona 86022

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation* (Addendum Project; Utah Antiquities Project Number U23TN0682)

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Sincerely,

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- Cultural Resources Report

cc: (w/o encl)
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Ron Bolander, Environmental Planner, Eocene Environmental Group, Draper, UT

May 22, 2024

Jacinthe “J” Messier
Tribal Archaeologist
Ute Mountain Ute Tribe
P.O. Box 468
131 West Mike Wash Road
Towaoc, CO 81334

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation* (Addendum Project; Utah Antiquities Project Number U23TN0682)

Dear Ms. Messier:

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May 22, 2024

Mr. Julius Murray
Chairman
Ute Indian Tribe of the Uintah & Ouray Reservation
P.O. Box 190
Fort Duchesne, Utah 84026

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation* (Addendum Project; Utah Antiquities Project Number U23TN0682)

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May 22, 2024

Mr. Timothy L. Nuvangyaoma
Chairman
Hopi Tribe Chairman's Office
P.O. Box 123
Kykotsmovi, Arizona 86039

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation* (Addendum Project; Utah Antiquities Project Number U23TN0682)

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Ron Bolander, Environmental Planner, Eocene Environmental Group, Draper, UT

May 22, 2024

President Buu Nygren
Navajo Nation Office of the President
P.O. Box 7440
Window Rock, Arizona 86515

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation* (Addendum Project; Utah Antiquities Project Number U23TN0682)

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May 22, 2024

Ms. Deryn Pete
Chairwoman
Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony
One Paiute Drive
Las Vegas, Nevada 89106

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation* (Addendum Project; Utah Antiquities Project Number U23TN0682)

Dear Chairwoman Pete:

Enclosed is a cultural resources report titled *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah: Esplin Pit Evaluation.* The Natural Resources Conservation Service (NRCS) and Kane County Water Conservancy District (KCWCD) are proposing the addition of a borrow source to their Cove Reservoir Plan-EIS (U18TN0544, U21TN0840), which consists of a reservoir, irrigation pipeline, and associated facilities. Two previous Class III inventories, encompassing two alternative reservoir locations, pipelines, staging areas, construction access, borrow sources, and all other proposed ground disturbance, were completed under Project Numbers U18TN0544 and U21TN0840. The NRCS consulted with your office regarding those project numbers in letters dated January 9, 2020, and January 23, 2023, respectively. Concurrence on site eligibility and a determination of "adverse effect to historic properties" for the undertaking as a whole, was received on January 17, 2020, and February 6, 2023, respectively (Case Nos. 20-0121 and 23-0280). The additional borrow source, located east of Glendale, Utah, adjacent to Kanab Creek on the Glendale Bench has been evaluated under *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation.* The NRCS is serving as the lead Federal agency.

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Places (NRHP) under Criterion D (Case No. 13-0512). The NRCS has also determined that Site 42KA9789, a prehistoric campsite, is eligible for the NRHP under Criterion D.

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With the implementation of the aforementioned avoidance and minimization measures, the NRCS has determined that use of the proposed borrow source will result in **No Adverse Effect to Historic Properties**, per 36 CFR 800.5(b). The NRCS requests concurrence for the delineation of the APE, determinations of site eligibility and project effect. If you have any questions, comments, or concerns, please contact Tara S. Hoffmann, State Watershed Cultural Resources Specialist, at 801-524-4556 or tara.hoffmann@usda.gov, at your convenience.

Sincerely,



TRAVIS MOTE
Acting State Conservationist

Enclosure:
- Cultural Resources Report

cc: (w/o encl)
Anders Fillerup, Acting ASTC-Water Resources, NRCS, Vernal, UT
Tara Hoffmann, State Cultural Resources specialist, NRCS, Salt Lake City, UT
Brandon Todd, ASTC-Field Operations, NRCS, Richfield, UT
Kristi Westwood, District Conservationist, NRCS, Panguitch, UT
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Jacob Herrera, Project Manager/Environmental Planner, Eocene Environmental Group, Mesa, AZ
Ron Bolander, Environmental Planner, Eocene Environmental Group, Draper, UT

May 22, 2024

Robert Preston, Jr.
President
San Juan Southern Paiute Tribe of Arizona
50 South Main Street, Suite 201
P.O. Box 2950
Tuba City, Arizona 86045

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation* (Addendum Project; Utah Antiquities Project Number U23TN0682)

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Sincerely,



TRAVIS MOTE
Acting State Conservationist

Enclosure:
- Cultural Resources Report

cc: (w/o encl)
Anders Fillerup, Acting ASTC-Water Resources, NRCS, Vernal, UT
Tara Hoffmann, State Cultural Resources specialist, NRCS, Salt Lake City, UT
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Jacob Herrera, Project Manager/Environmental Planner, Eocene Environmental Group, Mesa, AZ
Ron Bolander, Environmental Planner, Eocene Environmental Group, Draper, UT

May 22, 2024

Vickie Simmons
Chairwoman
Moapa Band of Paiute Indians of the Moapa River Indian Reservation, Nevada
P.O. Box 340
Moapa, Nevada 89025-0340

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation* (Addendum Project; Utah Antiquities Project Number U23TN0682)

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Jacob Herrera, Project Manager/Environmental Planner, Eocene Environmental Group, Mesa, AZ
Ron Bolander, Environmental Planner, Eocene Environmental Group, Draper, UT

May 22, 2024

Ms. Luana Thompson
Natural Resources Director
Ute Indian Tribe of the Uintah & Ouray Reservation
P.O. Box 190
Fort Duchesne, Utah 84026

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation* (Addendum Project; Utah Antiquities Project Number U23TN0682)

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May 22, 2024

Ms. Ila Yazzie
Vice Chairwoman
Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony
One Paiute Drive
Las Vegas, Nevada 89106

Reference: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation* (Addendum Project; Utah Antiquities Project Number U23TN0682)

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Jacob Herrera, Project Manager/Environmental Planner, Eocene Environmental Group, Mesa, AZ
Ron Bolander, Environmental Planner, Eocene Environmental Group, Draper, UT

From: Daniel Bulletts
To: Hoffmann, Tara - FPAC-NRCS, UT
Subject: Re: [Take care when opening attachments] rock source on Glendale Bench - two prehistoric sites
Date: Friday, May 24, 2024 2:23:43 PM

Hello,
Thank you for the update and keeping the Kaibab Band of Paiute Indians Cultural Resource department in the loop on this project. It's so good to hear that your organization is making a heartfelt effort into preserving these sites. What you have recommended sounds good to me and I have no further questions or comments about this project site protection.

Thank you again and please keep in touch,

On Wed, May 22, 2024 at 5:19 PM Hoffmann, Tara - FPAC-NRCS, UT <tara.hoffmann@usda.gov> wrote:

> Daniel,
>
> I wanted to bring to your attention new consultation for the proposed Cove Reservoir Watershed Plan and EIS (Kane County Water Conservancy District is the Sponsor, with NRCS providing partial funding). The overall project, which we previously consulted on, consists of a reservoir, irrigation pipelines, and associated components near Orderville. One of the rip rap sources for the project is located at a previously used borrow source out on the Glendale Bench along Kanab Creek. Charley and an elder visited this rock source back in 2013/14 with me and SHPO to see a prehistoric cave site where the artifact scatter in front of the cave was adversely affected by heavy equipment. We mitigated those effects with an MOA. During the recent cultural survey of the rock source, another eligible artifact scatter site was identified.
>
> To ensure avoidance of these two sites, we will be avoiding each site by 15 meters, installing fencing around the site boundaries (with the 15-m buffer), and having an archaeological monitor present during all ground disturbance within 15-m of the sites. Does this approach sound reasonable to you? Are there any other concerns with getting rock from around these two sites?
>
> I've attached the cultural report, site forms, avoidance area map, and a kmz file of the APE. We mailed a formal consultation letter to you and Chairman Maldonado on May 20, 2024 (attached).
>
> Feel free to give me a call to discuss.

Many thanks,

Tara

Tara S. Hoffmann, MA

State Watershed Cultural Resources Specialist/Tribal Liaison

Natural Resources Conservation Service

Salt Lake City, UT

O: 801-524-4556 C: 385-258-1266

This electronic message contains information generated by the USDA solely for the intended recipients. Any unauthorized interception of this message or the use or disclosure of the information it contains may violate the law and subject the violator to civil or criminal penalties. If you believe you have received this message in error, please notify the sender and delete the email immediately.

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Daniel Bulletts
Southern Paiute Consortium/Cultural Resource Director
Kaibab Band of Paiute Indians
HC 65 Box 02
Fredonia AZ 86022
928-643-6278

Indirect APE Memorandum

SHPO Consultation

June 6, 2025

Tara Hoffmann
Cultural Resources Specialist
Natural Resources Conservation Service

RE: Cove Reservoir APE Memo, Kane County, Utah

For future correspondence, please reference Case No. 25-1097

Dear Ms. Hoffmann,

The Utah State Historic Preservation Office received your submission and request for our comment on the above-referenced project on June 4, 2025. Based on the information provided to our office, we concur with your determinations of eligibility and with the finding that the visual/indirect APE is no adverse effect, and that the effect for the overall undertaking is still an adverse effect.

This information is provided to assist with Section 106 responsibilities as per §36CFR800. If you have questions, please contact me at (801) 245-7239 or by email at clhansen@utah.gov.

Sincerely,



Christopher Hansen
Preservation Planner/Deputy SHPO
Utah State Historic Preservation Office

Tribal Consultation

From: Hoffmann, Tara - FPAC-NRCS, UT
To: Carlene Yellowhair; Johnny Lehi, Jr. J.lehijr@sanjuanpaiute-nsn.gov
Subject: NRCS Utah Cove Reservoir Project, updated APE Sec. 106 consultation
Date: Wednesday, June 4, 2025 3:50:00 PM
Attachments: image001.png
Yellowhair .pdf
Cove Indirect APE_CR-Memo.pdf

President Yellowhair and Vice President Lehi, Jr.,

See attached formal Section 106 consultation letter with an updated Direct (Physical), Indirect, and Visual APE, identification of historic properties, and finding of effect, for the proposed Cove Reservoir Watershed Plan-EIS near Orderville, Utah. Let me know if you have any questions.

Sincerely,
Tara

Tara S. Hoffmann
Water & Cultural Resources Specialist
NRCS Utah | Water Resources

USDA U.S. DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service
125 S State St Rm 6416, Salt Lake City, UT, 84138
p: (801) 524-4556 | c: (385) 258-1266
e: tara.hoffmann@usda.gov | w: www.nrcs.usda.gov/ut

From:	Hoffmann, Tara - FPAC-NRCS, UT
To:	btso@lvpaiute.com; cspottedeagle@lvpaiute.com
Subject:	NRCS Utah Cove Reservoir Project, updated APE Sec. 106 consultation
Date:	Wednesday, June 4, 2025 3:48:00 PM
Attachments:	Cove Indirect APE_CR-Memo.pdf image001.png Tso .pdf Spotted Eagle .pdf

Chairman Tso and Vice Chair Spotted Eagle,

See attached formal Section 106 consultation letter with an updated Direct (Physical), Indirect, and Visual APE, identification of historic properties, and finding of effect, for the proposed Cove Reservoir Watershed Plan-EIS near Orderville, Utah. Let me know if you have any questions.

Sincerely,
Tara

Tara S. Hoffmann
Water & Cultural Resources Specialist
NRCS Utah | Water Resources

U.S. DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service
125 S State St Rm 6416, Salt Lake City, UT, 84138
p: (801) 524-4556 | c: (385) 258-1266
e: tara.hoffmann@usda.gov | w: www.nrcs.usda.gov/ut

From:	Hoffmann, Tara - FPAC-NRCS, UT
To:	Darren Daboda; Mario Monroe chair.mbop@moapabandofpaiutes.org; Moapa Cultural
Subject:	NRCS Utah Cove Reservoir Project, updated APE Sec. 106 consultation
Date:	Wednesday, June 4, 2025 3:47:00 PM
Attachments:	Cove Indirect APE_CR-Memo.pdf image001.png Moapa Cultural.pdf Monroe .pdf

Mr. Daboda, Chairman Monroe, and Cultural Manager,

See attached formal Section 106 consultation letter with an updated Direct (Physical), Indirect, and Visual APE, identification of historic properties, and finding of effect, for the proposed Cove Reservoir Watershed Plan-EIS near Orderville, Utah. Let me know if you have any questions.

Sincerely,
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e: tara.hoffmann@usda.gov | w: www.nrcs.usda.gov/ut

From:	Hoffmann, Tara - FPAC-NRCS, UT
To:	malcolm.lehi@utemountain.org
Subject:	NRCS Cove Reservoir Project, updated APE Sec. 106 consultation
Date:	Wednesday, June 4, 2025 3:45:00 PM
Attachments:	Cove Indirect APE_CR-Memo.pdf image001.png Begay .pdf Lehi .pdf

Dear Mr. Lehi,

See attached formal Section 106 consultation letter with an updated Direct (Physical), Indirect, and Visual APE, identification of historic properties, and finding of effect, for the proposed Cove Reservoir Watershed Plan-EIS near Orderville, Utah. Let me know if you have any questions.

Sincerely,
Tara

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NRCS Utah | Water Resources

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e: tara.hoffmann@usda.gov | w: www.nrcs.usda.gov/ut

From:	Hoffmann, Tara - FPAC-NRCS, UT
To:	Stewart Koyiyumptewa (skoyiyumptewa@hopi.nsn.us); Timothy Nuvangyaoma (Tnuvangyaoma@hopi.nsn.us)
Subject:	NRCS Cove Reservoir Project, updated APE Sec. 106 consultation
Date:	Wednesday, June 4, 2025 3:43:00 PM
Attachments:	Cove Indirect APE_CR-Memo.pdf image001.png Koyiyumptewa .pdf Nuvangyaoma .pdf

Mr. Koyiyumptewa and Mr. Nuvangyaoma,

See attached formal Section 106 consultation letter with an updated Direct (Physical), Indirect, and Visual APE, identification of historic properties, and finding of effect, for the proposed Cove Reservoir Watershed Plan-EIS near Orderville, Utah. Let me know if you have any questions.

Sincerely,
Tara

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Water & Cultural Resources Specialist
NRCS Utah | Water Resources

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e: tara.hoffmann@usda.gov | w: www.nrcs.usda.gov/ut

From:	Hoffmann, Tara - FPAC-NRCS, UT
To:	Clarence Rockwell crockwell@navajo-nsn.gov; Stephanie Holly sholly@navajo-nsn.gov
Subject:	NRCS Cove Reservoir Project, updated APE Sec. 106 consultation
Date:	Wednesday, June 4, 2025 3:42:00 PM
Attachments:	image001.png Nygren .pdf Holly .pdf Rockwell .pdf

Mr. Rockwell and Ms. Holly,

See attached formal Section 106 consultation letter with an updated Direct (Physical), Indirect, and Visual APE, identification of historic properties, and finding of effect, for the proposed Cove Reservoir Watershed Plan-EIS near Orderville, Utah. Let me know if you have any questions.

Sincerely,
Tara

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Water & Cultural Resources Specialist
NRCS Utah | Water Resources

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e: tara.hoffmann@usda.gov | w: www.nrcs.usda.gov/ut

From:	Hoffmann, Tara - FPAC-NRCS, UT
To:	lyellowhorse@utahpaiutes.org; Autumn Gillard
Subject:	NRCS Cove Reservoir Project, updated APE Sec. 106 consultation
Date:	Wednesday, June 4, 2025 3:41:00 PM
Attachments:	Cove Indirect APE_CR-Memo.pdf image001.png Gillard .pdf Yellowhorse .pdf

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Chairperson Yellowhorse and Ms. Gillard,

See attached formal Section 106 consultation letter with an updated Direct (Physical), Indirect, and Visual APE, identification of historic properties, and finding of effect, for the proposed Cove Reservoir Watershed Plan-EIS near Orderville, Utah. Let me know if you have any questions.

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Tara

Tara S. Hoffmann
Water & Cultural Resources Specialist
NRCS Utah | Water Resources

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e: tara.hoffmann@usda.gov | w: www.nrcs.usda.gov/ut

From:	Hoffmann, Tara - FPAC-NRCS, UT
To:	Kurt Dongoske (kdongoske@gmail.com); Arden Kucate (arden.kucate@ashiwi.org)
Subject:	NRCS Cove Reservoir Project, updated APE Sec. 106 consultation
Date:	Wednesday, June 4, 2025 3:40:00 PM
Attachments:	Cove Indirect APE_CR-Memo.pdf image001.png Dongoske .pdf Kucate .pdf

Governor Kucate and Mr. Dongoske,

See attached formal Section 106 consultation letter with an updated Direct (Physical), Indirect, and Visual APE, identification of historic properties, and finding of effect, for the proposed Cove Reservoir Watershed Plan-EIS near Orderville, Utah. Let me know if you have any questions.

Sincerely,
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Water & Cultural Resources Specialist
NRCS Utah | Water Resources

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e: tara.hoffmann@usda.gov | w: www.nrcs.usda.gov/ut

From:	Hoffmann, Tara - FPAC-NRCS, UT
To:	Daniel Bulletts; rolandm@kaibabpaiute-nsn.gov; kptchair@color-country.net
Subject:	NRCS Cove Reservoir Project, updated APE Sec. 106 consultation
Date:	Wednesday, June 4, 2025 3:39:00 PM
Attachments:	Cove Indirect APE_CR-Memo.pdf image001.png Bradley .pdf Bullets .pdf Maldonado .pdf

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Chairman Maldonado, Vice Chairperson Bradley, and Mr. Bullets,

See attached formal Section 106 consultation letter with an updated Direct (Physical), Indirect, and Visual APE, identification of historic properties, and finding of effect, for the proposed Cove Reservoir Watershed Plan-EIS near Orderville, Utah. Let me know if you have any questions.

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e: tara.hoffmann@usda.gov | w: www.nrcs.usda.gov/ut

From:	Hoffmann, Tara - FPAC-NRCS, UT
To:	president.buunygren@navajo-nsn.gov; Richard Begay (r.begay@navajo-nsn.gov)
Subject:	NRCS Cove Reservoir Project, updated APE Sec. 106 consultation
Date:	Wednesday, June 4, 2025 3:36:00 PM
Attachments:	Cove Indirect APE_CR-Memo.pdf image001.png Begay .pdf Nygren .pdf

President Nygren and Mr. Begay,

See attached formal Section 106 consultation letter with an updated Direct (Physical), Indirect, and Visual APE, identification of historic properties, and finding of effect, for the proposed Cove Reservoir Watershed Plan-EIS near Orderville, Utah. Let me know if you have any questions.

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Tara S. Hoffmann
Water & Cultural Resources Specialist
NRCS Utah | Water Resources

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USDA Natural Resources Conservation Service
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Salt Lake City, Utah 84138
Phone: 801-524-4550

Mr. Stewart B. Koyiyumptewa
THPO, Hopi Cultural Preservation Office
Hopi Tribe of Arizona
P.O. Box 123
Kykotsmovi, Arizona 86039

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

Dear Mr. Koyiyumptewa,

The NRCS is continuing Section 106 consultation for the proposed Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (aka Cove Reservoir Project), in Kane County, Utah. Included in this submission are a literature review cultural resources memo titled *Kane County Water Conservancy District's Cove Reservoir Project—Cultural Resources Review Memo, Indirect/Visual Areas of Potential Effect (APEs)*. The United States Department of Agriculture's Natural Resources Conservation Service (NRCS), with the and Kane County Water Conservancy District (KCWCD) are proposing to construct the new Cove Reservoir within the existing Glendale, Mt. Carmel, and Orderville irrigation systems. This proposed reservoir would be located immediately southwest of Orderville, Utah, off Cove Road. Additional improvements would include the construction of approximately 1.5 miles of new pipeline, the Glendale hydroelectric power plant, and 0.2 mile of new power line and 0.7 acre of utility corridor along U.S. Highway 89 (US-89) and Cove Road; these improvements would be located west of US-89 and the East Fork of the Virgin River in Glendale, Utah. The Project also proposes the potential use of three previously disturbed borrow pits—Lambs Pit, Tait Pit, and Esplin Pit—for Project-related construction needs. These proposed actions constitute an undertaking under Section 106.

The NRCS is serving as the lead federal agency pursuant to 36 CFR 800.2. The Bureau of Land Management-Kanab Field Office (BLM), U.S. Army Corps of Engineers, Sacramento District (Corps), Environmental Protection Agency (EPA), National Park Service (NPS), and Utah Trust Land Administration (TLA) have been identified as cooperating agencies. The NRCS shall act on behalf of all agencies in fulfilling our collective responsibilities under Section 106, including delineation of the APE, identification of historic properties, and finding of effect. The NRCS will inform all cooperating agencies of Section 106 consultation. This consultation will also cover TLA's responsibilities under Utah Annotated Code Section 9-8-404.

NRCS initially consulted with your office in letters sent January 9, 2020 (U18TN0844), and again on January 23, 2023 (U21TN0840). Concurrence on site eligibility and a determination of ***adverse effect to historic properties*** for the undertaking was received on January 17, 2020, and February 6, 2023, respectively (Case Nos. 20-0121 and 23-0280). Additional consultation occurred for an expansion of the APE for a borrow source in a letter dated May 20, 2024 (U23TN0682). Concurrence was received on May 20, 2024 (Case No. 24-1261). Following these consultations, the NRCS has revised the Area of Potential Effects (APE) to include the Direct (Physical), Visual, and Indirect APEs.

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Phone: 801-524-4550

Area of Potential Effects (APE) (36 CFR 800.4)

Table 1 summarizes the Direct, Visual, and Indirect APEs.

TABLE 1
TOTAL Area of Potential Effects (APE)

Area of Potential Effect	BLM	State	Private	Total
Indirect APE Acreage (Inundation Areas)	17.05	0.51	990.41	**1,007.97**
Visual APE Acreage (1 Mile Buffer of Cove Reservoir and Facilities)	245.00	1,698.01	3,009.28	**4,952.29**
Direct (Physical) APE Acreage (Cove Reservoir, Pipes, Canals, Esplin Pit, Tait Pit, Lamb's Pit)	0.23	70.33	641.9	**712.46**

- **Direct (Physical) APE**: Includes all potential physical ground disturbance, including construction, staging, access roads, borrow sources, and necessary buffers. It has been refined to a total of 712.46 acres.
- **Visual APE**: A radius of 1 mile around the periphery of the proposed Cove Reservoir was evaluated for potential visual resources that could be impacted by the current construction of the reservoir. GIS viewshed analysis was used to refine the final boundaries of the Visual APE, and areas without potential visibility of the project were removed from the Visual APE.
- **Indirect APE:** Includes the breach inundation zones (Sunny-Day and Rainy-Day) in the unlikely event of a dam breach.

Identification of Historic Properties (36 CFR 800.4)

To identify historic properties within the APEs, a literature review was completed by Eocene Environmental. Personnel meet or exceed the Secretary of the Interior Standards in Archeology. The literature review identified 26 cultural resources, 14 of which are eligible for the National Register of Historic Place (NRHP), and one unevaluated, but treated as eligible, within the partially overlapping Direct, Indirect, and Visual APEs. Of the 15 historic properties, only one historic property 42KA7537 (prehistoric cave and artifact scatter) meets the site type criteria for inclusion in the visual impact assessment and therefore do not require a formal visual effects assessment. Site 42KA7537 is only located in the Direct APE and will be avoided (see Case No. 24-1261).

Within the overlapping APEs, there are nine historic buildings/structures of which five are eligible for the NRHP, two are undetermined (treated as eligible), one has been demolished, and the final is ineligible/non-contributing. Within the Visual APE there are three eligible buildings/structures (Property ID Nos., 32819, 50442, and 33219). These historic properties are in Orderville, and the proposed Cove Reservoir would be obstructed from view by means of several ridges southwest of Gardner Hollow.

Within the Indirect APE breach inundation zone, there are three historic properties: Mt. Carmel School and Church (Property ID No. 37252); Dixon, Maynard, House and Studio (Property ID No. 40479); and Steven's Barn

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(Property ID No. 31786). Steven's Barn (Property ID NO. 31786) has likely been demolished. Due to distance, elevation, and the proposed reservoir safety features, these historic properties are unlikely to be adversely affected by the highly improbable failure of the proposed Cove Reservoir dam.

Finding of Effect (36 CFR 800.5)

The implementation of the undertaking will not alter the character-defining characteristics of the aforementioned historic properties that allow them to convey their significance since visual component is not the character-defining feature that makes the sites eligible. Therefore, the NRCS finding of effect for the Visual and Indirect APEs is No Adverse Effect. This results in no change to the finding of effect for the entirety of the undertaking, where the NRCS retains our previous determination of ***Adverse Effect to Historic Properties*** (Case No. 20-0121).

In an electronical transmittal on March 28, 2024, the NRCS notified the Advisory Council on Historic Preservation (Council) of the adverse effect determination by providing documentation specified in 36 CFR 800.11(e). The Council declined to participate in consultation in a letter dated April 20, 2024. Per 36 CFR 800.6, the NRCS is continuing consultation with your office, the Sponsors, agencies, applicable Native American tribes, and other consulting parties, to develop mitigation stipulations that will be executed in a Memorandum of Agreement. As the lead federal agency, the NRCS is informing the BLM, Corps, NPS, TLA, and EPA of ongoing Section 106 consultations. Per 36 CFR 800.4-800.5, the NRCS requests concurrence for the delineation of the APEs, identification of historic properties, and finding of effect. If you have any questions, comments, or concerns, please contact Tara S. Hoffmann, Water and Cultural Resources Specialist, at (385)-258-1266 at your convenience.

Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)

Anders Fillerup, NRCS, ASTC-Water Resources, Salt Lake City, Utah
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, Utah
Tara Hoffmann, NRCS, Water and Cultural Resources Specialist, Salt Lake City, Utah
Brandon Todd, NRCS, ASTC-Field Operations, Richfield, Utah
Kristi Westwood, NRCS, District Conservationist, Panguitch, Utah
Brian Storm, BLM, Archaeologist, Kanab, Utah
Kristine Curry, TLA, Archaeologist, Salt Lake City, Utah
Jason Gipson, Corps, Chief, Bountiful, Utah
Courtney Mackay, NPS, Archeologist, Springdale, Utah
Region 8, EPA, Denver, Colorado
Emily Paris, Eocene, Project Manager, Sparks, Nevada

USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE

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125 South State Street, Room 6416
Salt Lake City, Utah 84138
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Chairman Timothy Nuvangyaoma
Hopi Tribe of Arizona
P.O. Box 123
Kykotsmovi, Arizona 86039

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

Dear Chairman Nuvangyaoma,

The NRCS is continuing Section 106 consultation for the proposed Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (aka Cove Reservoir Project), in Kane County, Utah. Included in this submission are a literature review cultural resources memo titled *Kane County Water Conservancy District's Cove Reservoir Project—Cultural Resources Review Memo, Indirect/Visual Areas of Potential Effect (APEs)*. The United States Department of Agriculture's Natural Resources Conservation Service (NRCS), with the and Kane County Water Conservancy District (KCWCD) are proposing to construct the new Cove Reservoir within the existing Glendale, Mt. Carmel, and Orderville irrigation systems. This proposed reservoir would be located immediately southwest of Orderville, Utah, off Cove Road. Additional improvements would include the construction of approximately 1.5 miles of new pipeline, the Glendale hydroelectric power plant, and 0.2 mile of new power line and 0.7 acre of utility corridor along U.S. Highway 89 (US-89) and Cove Road; these improvements would be located west of US-89 and the East Fork of the Virgin River in Glendale, Utah. The Project also proposes the potential use of three previously disturbed borrow pits—Lambs Pit, Tait Pit, and Esplin Pit—for Project-related construction needs. These proposed actions constitute an undertaking under Section 106.

The NRCS is serving as the lead federal agency pursuant to 36 CFR 800.2. The Bureau of Land Management-Kanab Field Office (BLM), U.S. Army Corps of Engineers, Sacramento District (Corps), Environmental Protection Agency (EPA), National Park Service (NPS), and Utah Trust Land Administration (TLA) have been identified as cooperating agencies. The NRCS shall act on behalf of all agencies in fulfilling our collective responsibilities under Section 106, including delineation of the APE, identification of historic properties, and finding of effect. The NRCS will inform all cooperating agencies of Section 106 consultation. This consultation will also cover TLA's responsibilities under Utah Annotated Code Section 9-8-404.

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Area of Potential Effects (APE) (36 CFR 800.4)

Table 1 summarizes the Direct, Visual, and Indirect APEs.

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(Property ID No. 31786). Steven's Barn (Property ID NO. 31786) has likely been demolished. Due to distance, elevation, and the proposed reservoir safety features, these historic properties are unlikely to be adversely affected by the highly improbable failure of the proposed Cove Reservoir dam.

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Sincerely,

Emily Fife

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State Conservationist

Enclosure

cc: (w/o encl)

Anders Fillerup, NRCS, ASTC-Water Resources, Salt Lake City, Utah
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, Utah
Tara Hoffmann, NRCS, Water and Cultural Resources Specialist, Salt Lake City, Utah
Brandon Todd, NRCS, ASTC-Field Operations, Richfield, Utah
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Emily Paris, Eocene, Project Manager, Sparks, Nevada

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Chairman Roland Maldonado
Kaibab Band of Paiute Indians of the Kaibab Indian Reservation
Tribal Affairs Building
HC65, Box 2
Fredonia, Arizona 86022

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

Dear Chairman Maldonado,

The NRCS is continuing Section 106 consultation for the proposed Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (aka Cove Reservoir Project), in Kane County, Utah. Included in this submission are a literature review cultural resources memo titled *Kane County Water Conservancy District's Cove Reservoir Project—Cultural Resources Review Memo, Indirect/Visual Areas of Potential Effect (APEs)*. The United States Department of Agriculture's Natural Resources Conservation Service (NRCS), with the and Kane County Water Conservancy District (KCWCD) are proposing to construct the new Cove Reservoir within the existing Glendale, Mt. Carmel, and Orderville irrigation systems. This proposed reservoir would be located immediately southwest of Orderville, Utah, off Cove Road. Additional improvements would include the construction of approximately 1.5 miles of new pipeline, the Glendale hydroelectric power plant, and 0.2 mile of new power line and 0.7 acre of utility corridor along U.S. Highway 89 (US-89) and Cove Road; these improvements would be located west of US-89 and the East Fork of the Virgin River in Glendale, Utah. The Project also proposes the potential use of three previously disturbed borrow pits—Lambs Pit, Tait Pit, and Esplin Pit—for Project-related construction needs. These proposed actions constitute an undertaking under Section 106.

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Area of Potential Effects (APE) (36 CFR 800.4)

Table 1 summarizes the Direct, Visual, and Indirect APEs.

TABLE 1
TOTAL Area of Potential Effects (APE)

Area of Potential Effect	BLM	State	Private	Total
Indirect APE Acreage (Inundation Areas)	17.05	0.51	990.41	**1,007.97**
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Direct (Physical) APE Acreage (Cove Reservoir, Pipes, Canals, Esplin Pit, Tait Pit, Lamb's Pit)	0.23	70.33	641.9	**712.46**

- **Direct (Physical) APE**: Includes all potential physical ground disturbance, including construction, staging, access roads, borrow sources, and necessary buffers. It has been refined to a total of 712.46 acres.
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Identification of Historic Properties (36 CFR 800.4)

To identify historic properties within the APEs, a literature review was completed by Eocene Environmental. Personnel meet or exceed the Secretary of the Interior Standards in Archeology. The literature review identified 26 cultural resources, 14 of which are eligible for the National Register of Historic Place (NRHP), and one unevaluated, but treated as eligible, within the partially overlapping Direct, Indirect, and Visual APEs. Of the 15 historic properties, only one historic property 42KA7537 (prehistoric cave and artifact scatter) meets the site type criteria for inclusion in the visual impact assessment and therefore do not require a formal visual effects assessment. Site 42KA7537 is only located in the Direct APE and will be avoided (see Case No. 24-1261).

Within the overlapping APEs, there are nine historic buildings/structures of which five are eligible for the NRHP, two are undetermined (treated as eligible), one has been demolished, and the final is ineligible/non-contributing. Within the Visual APE there are three eligible buildings/structures (Property ID Nos., 32819, 50442, and 33219). These historic properties are in Orderville, and the proposed Cove Reservoir would be obstructed from view by means of several ridges southwest of Gardner Hollow.

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125 South State Street, Room 6416
Salt Lake City, Utah 84138
Phone: 801-524-4550

Within the Indirect APE breach inundation zone, there are three historic properties: Mt. Carmel School and Church (Property ID No. 37252); Dixon, Maynard, House and Studio (Property ID No. 40479); and Steven's Barn (Property ID No. 31786). Steven's Barn (Property ID NO. 31786) has likely been demolished. Due to distance, elevation, and the proposed reservoir safety features, these historic properties are unlikely to be adversely affected by the highly improbable failure of the proposed Cove Reservoir dam.

Finding of Effect (36 CFR 800.5)

The implementation of the undertaking will not alter the character-defining characteristics of the aforementioned historic properties that allow them to convey their significance since visual component is not the character-defining feature that makes the sites eligible. Therefore, the NRCS finding of effect for the Visual and Indirect APEs is No Adverse Effect. This results in no change to the finding of effect for the entirety of the undertaking, where the NRCS retains our previous determination of ***Adverse Effect to Historic Properties*** (Case No. 20-0121).

In an electronical transmittal on March 28, 2024, the NRCS notified the Advisory Council on Historic Preservation (Council) of the adverse effect determination by providing documentation specified in 36 CFR 800.11(e). The Council declined to participate in consultation in a letter dated April 20, 2024. Per 36 CFR 800.6, the NRCS is continuing consultation with your office, the Sponsors, agencies, applicable Native American tribes, and other consulting parties, to develop mitigation stipulations that will be executed in a Memorandum of Agreement. As the lead federal agency, the NRCS is informing the BLM, Corps, NPS, TLA, and EPA of ongoing Section 106 consultations. Per 36 CFR 800.4-800.5, the NRCS requests concurrence for the delineation of the APEs, identification of historic properties, and finding of effect. If you have any questions, comments, or concerns, please contact Tara S. Hoffmann, Water and Cultural Resources Specialist, at (385)-258-1266 at your convenience.

Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)

Anders Fillerup, NRCS, ASTC-Water Resources, Salt Lake City, Utah
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Vice Chairwoman Carmen Bradley
Kaibab Band of Paiute Indians of the Kaibab Indian Reservation
Tribal Affairs Building
HC65, Box 3
Fredonia, Arizona 86023

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

Dear Vice Chairwoman Bradley,

The NRCS is continuing Section 106 consultation for the proposed Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (aka Cove Reservoir Project), in Kane County, Utah. Included in this submission are a literature review cultural resources memo titled *Kane County Water Conservancy District's Cove Reservoir Project—Cultural Resources Review Memo, Indirect/Visual Areas of Potential Effect (APEs)*. The United States Department of Agriculture's Natural Resources Conservation Service (NRCS), with the and Kane County Water Conservancy District (KCWCD) are proposing to construct the new Cove Reservoir within the existing Glendale, Mt. Carmel, and Orderville irrigation systems. This proposed reservoir would be located immediately southwest of Orderville, Utah, off Cove Road. Additional improvements would include the construction of approximately 1.5 miles of new pipeline, the Glendale hydroelectric power plant, and 0.2 mile of new power line and 0.7 acre of utility corridor along U.S. Highway 89 (US-89) and Cove Road; these improvements would be located west of US-89 and the East Fork of the Virgin River in Glendale, Utah. The Project also proposes the potential use of three previously disturbed borrow pits—Lambs Pit, Tait Pit, and Esplin Pit—for Project-related construction needs. These proposed actions constitute an undertaking under Section 106.

The NRCS is serving as the lead federal agency pursuant to 36 CFR 800.2. The Bureau of Land Management-Kanab Field Office (BLM), U.S. Army Corps of Engineers, Sacramento District (Corps), Environmental Protection Agency (EPA), National Park Service (NPS), and Utah Trust Land Administration (TLA) have been identified as cooperating agencies. The NRCS shall act on behalf of all agencies in fulfilling our collective responsibilities under Section 106, including delineation of the APE, identification of historic properties, and finding of effect. The NRCS will inform all cooperating agencies of Section 106 consultation. This consultation will also cover TLA's responsibilities under Utah Annotated Code Section 9-8-404.

NRCS initially consulted with your office in letters sent January 9, 2020 (U18TN0844), and again on January 23, 2023 (U21TN0840). Concurrence on site eligibility and a determination of ***adverse effect to historic properties*** for the undertaking was received on January 17, 2020, and February 6, 2023, respectively (Case Nos. 20-0121 and 23-0280). Additional consultation occurred for an expansion of the APE for a borrow source in a letter dated May 20, 2024 (U23TN0682). Concurrence was received on May 20, 2024 (Case No. 24-1261). Following these consultations, the NRCS has revised the Area of Potential Effects (APE) to include the Direct (Physical), Visual, and Indirect APEs.

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Area of Potential Effects (APE) (36 CFR 800.4)

Table 1 summarizes the Direct, Visual, and Indirect APEs.

TABLE 1
TOTAL Area of Potential Effects (APE)

Area of Potential Effect	BLM	State	Private	Total
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Finding of Effect (36 CFR 800.5)

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Sincerely,

Emily Fife

EMILY FIFE
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Enclosure

cc: (w/o encl)

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USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE

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Mr. Daniel Bullets
Kaibab Band of Paiute Indians of the Kaibab Indian Reservation
Cultural Preservation Office
HC65, Box 2
Fredonia, Arizona 86022

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

Dear Mr. Bullets,

The NRCS is continuing Section 106 consultation for the proposed Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (aka Cove Reservoir Project), in Kane County, Utah. Included in this submission are a literature review cultural resources memo titled *Kane County Water Conservancy District's Cove Reservoir Project—Cultural Resources Review Memo, Indirect/Visual Areas of Potential Effect (APEs)*. The United States Department of Agriculture's Natural Resources Conservation Service (NRCS), with the and Kane County Water Conservancy District (KCWCD) are proposing to construct the new Cove Reservoir within the existing Glendale, Mt. Carmel, and Orderville irrigation systems. This proposed reservoir would be located immediately southwest of Orderville, Utah, off Cove Road. Additional improvements would include the construction of approximately 1.5 miles of new pipeline, the Glendale hydroelectric power plant, and 0.2 mile of new power line and 0.7 acre of utility corridor along U.S. Highway 89 (US-89) and Cove Road; these improvements would be located west of US-89 and the East Fork of the Virgin River in Glendale, Utah. The Project also proposes the potential use of three previously disturbed borrow pits—Lambs Pit, Tait Pit, and Esplin Pit—for Project-related construction needs. These proposed actions constitute an undertaking under Section 106.

The NRCS is serving as the lead federal agency pursuant to 36 CFR 800.2. The Bureau of Land Management-Kanab Field Office (BLM), U.S. Army Corps of Engineers, Sacramento District (Corps), Environmental Protection Agency (EPA), National Park Service (NPS), and Utah Trust Land Administration (TLA) have been identified as cooperating agencies. The NRCS shall act on behalf of all agencies in fulfilling our collective responsibilities under Section 106, including delineation of the APE, identification of historic properties, and finding of effect. The NRCS will inform all cooperating agencies of Section 106 consultation. This consultation will also cover TLA's responsibilities under Utah Annotated Code Section 9-8-404.

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Emily Fife

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Enclosure

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Vice Chairman Chris Spotted Eagle
Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony
One Paiute Drive
Las Vegas, Nevada 89106

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

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Chairman Benny Tso
Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony
One Paiute Drive
Las Vegas, Nevada 89106

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

Dear Chairman Tso,

The NRCS is continuing Section 106 consultation for the proposed Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (aka Cove Reservoir Project), in Kane County, Utah. Included in this submission are a literature review cultural resources memo titled *Kane County Water Conservancy District's Cove Reservoir Project—Cultural Resources Review Memo, Indirect/Visual Areas of Potential Effect (APEs)*. The United States Department of Agriculture's Natural Resources Conservation Service (NRCS), with the and Kane County Water Conservancy District (KCWCD) are proposing to construct the new Cove Reservoir within the existing Glendale, Mt. Carmel, and Orderville irrigation systems. This proposed reservoir would be located immediately southwest of Orderville, Utah, off Cove Road. Additional improvements would include the construction of approximately 1.5 miles of new pipeline, the Glendale hydroelectric power plant, and 0.2 mile of new power line and 0.7 acre of utility corridor along U.S. Highway 89 (US-89) and Cove Road; these improvements would be located west of US-89 and the East Fork of the Virgin River in Glendale, Utah. The Project also proposes the potential use of three previously disturbed borrow pits—Lambs Pit, Tait Pit, and Esplin Pit—for Project-related construction needs. These proposed actions constitute an undertaking under Section 106.

The NRCS is serving as the lead federal agency pursuant to 36 CFR 800.2. The Bureau of Land Management-Kanab Field Office (BLM), U.S. Army Corps of Engineers, Sacramento District (Corps), Environmental Protection Agency (EPA), National Park Service (NPS), and Utah Trust Land Administration (TLA) have been identified as cooperating agencies. The NRCS shall act on behalf of all agencies in fulfilling our collective responsibilities under Section 106, including delineation of the APE, identification of historic properties, and finding of effect. The NRCS will inform all cooperating agencies of Section 106 consultation. This consultation will also cover TLA's responsibilities under Utah Annotated Code Section 9-8-404.

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Salt Lake City, Utah 84138
Phone: 801-524-4550

Area of Potential Effects (APE) (36 CFR 800.4)

Table 1 summarizes the Direct, Visual, and Indirect APEs.

TABLE 1
TOTAL Area of Potential Effects (APE)

Area of Potential Effect	BLM	State	Private	Total
Indirect APE Acreage (Inundation Areas)	17.05	0.51	990.41	**1,007.97**
Visual APE Acreage (1 Mile Buffer of Cove Reservoir and Facilities)	245.00	1,698.01	3,009.28	**4,952.29**
Direct (Physical) APE Acreage (Cove Reservoir, Pipes, Canals, Esplin Pit, Tait Pit, Lamb's Pit)	0.23	70.33	641.9	**712.46**

- **Direct (Physical) APE**: Includes all potential physical ground disturbance, including construction, staging, access roads, borrow sources, and necessary buffers. It has been refined to a total of 712.46 acres.
- **Visual APE**: A radius of 1 mile around the periphery of the proposed Cove Reservoir was evaluated for potential visual resources that could be impacted by the current construction of the reservoir. GIS viewshed analysis was used to refine the final boundaries of the Visual APE, and areas without potential visibility of the project were removed from the Visual APE.
- **Indirect APE:** Includes the breach inundation zones (Sunny-Day and Rainy-Day) in the unlikely event of a dam breach.

Identification of Historic Properties (36 CFR 800.4)

To identify historic properties within the APEs, a literature review was completed by Eocene Environmental. Personnel meet or exceed the Secretary of the Interior Standards in Archeology. The literature review identified 26 cultural resources, 14 of which are eligible for the National Register of Historic Place (NRHP), and one unevaluated, but treated as eligible, within the partially overlapping Direct, Indirect, and Visual APEs. Of the 15 historic properties, only one historic property 42KA7537 (prehistoric cave and artifact scatter) meets the site type criteria for inclusion in the visual impact assessment and therefore do not require a formal visual effects assessment. Site 42KA7537 is only located in the Direct APE and will be avoided (see Case No. 24-1261).

Within the overlapping APEs, there are nine historic buildings/structures of which five are eligible for the NRHP, two are undetermined (treated as eligible), one has been demolished, and the final is ineligible/non-contributing. Within the Visual APE there are three eligible buildings/structures (Property ID Nos., 32819, 50442, and 33219). These historic properties are in Orderville, and the proposed Cove Reservoir would be obstructed from view by means of several ridges southwest of Gardner Hollow.

Within the Indirect APE breach inundation zone, there are three historic properties: Mt. Carmel School and Church (Property ID No. 37252); Dixon, Maynard, House and Studio (Property ID No. 40479); and Steven's Barn

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(Property ID No. 31786). Steven's Barn (Property ID NO. 31786) has likely been demolished. Due to distance, elevation, and the proposed reservoir safety features, these historic properties are unlikely to be adversely affected by the highly improbable failure of the proposed Cove Reservoir dam.

Finding of Effect (36 CFR 800.5)

The implementation of the undertaking will not alter the character-defining characteristics of the aforementioned historic properties that allow them to convey their significance since visual component is not the character-defining feature that makes the sites eligible. Therefore, the NRCS finding of effect for the Visual and Indirect APEs is No Adverse Effect. This results in no change to the finding of effect for the entirety of the undertaking, where the NRCS retains our previous determination of ***Adverse Effect to Historic Properties*** (Case No. 20-0121).

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Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)

Anders Fillerup, NRCS, ASTC-Water Resources, Salt Lake City, Utah
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Chairman Mario Monroe
Moapa Band of Paiute Indians of the Moapa River Indian Reservation
P.O. Box 340
Moapa, Nevada 89025

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

Dear Chairman Monroe,

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Cultural Manager
Moapa Band of Paiute Indians of the Moapa River Indian Reservation
P.O. Box 340
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Councilman Malcolm Lehi
White Mesa, Ute Council
P.O. Box 7096
White Mesa, Utah 84511

June 4, 2025

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(Property ID No. 31786). Steven's Barn (Property ID NO. 31786) has likely been demolished. Due to distance, elevation, and the proposed reservoir safety features, these historic properties are unlikely to be adversely affected by the highly improbable failure of the proposed Cove Reservoir dam.

Finding of Effect (36 CFR 800.5)

The implementation of the undertaking will not alter the character-defining characteristics of the aforementioned historic properties that allow them to convey their significance since visual component is not the character-defining feature that makes the sites eligible. Therefore, the NRCS finding of effect for the Visual and Indirect APEs is No Adverse Effect. This results in no change to the finding of effect for the entirety of the undertaking, where the NRCS retains our previous determination of ***Adverse Effect to Historic Properties*** (Case No. 20-0121).

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Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)

Anders Fillerup, NRCS, ASTC-Water Resources, Salt Lake City, Utah
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, Utah
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Brandon Todd, NRCS, ASTC-Field Operations, Richfield, Utah
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Mr. Richard M. Begay
THPO and Department Manager
Navajo Nation Historic Preservation Department
P.O. Box 4950
Window Rock, Arizona 86515

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

Dear Mr. Begay,

The NRCS is continuing Section 106 consultation for the proposed Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (aka Cove Reservoir Project), in Kane County, Utah. Included in this submission are a literature review cultural resources memo titled *Kane County Water Conservancy District's Cove Reservoir Project—Cultural Resources Review Memo, Indirect/Visual Areas of Potential Effect (APEs)*. The United States Department of Agriculture's Natural Resources Conservation Service (NRCS), with the and Kane County Water Conservancy District (KCWCD) are proposing to construct the new Cove Reservoir within the existing Glendale, Mt. Carmel, and Orderville irrigation systems. This proposed reservoir would be located immediately southwest of Orderville, Utah, off Cove Road. Additional improvements would include the construction of approximately 1.5 miles of new pipeline, the Glendale hydroelectric power plant, and 0.2 mile of new power line and 0.7 acre of utility corridor along U.S. Highway 89 (US-89) and Cove Road; these improvements would be located west of US-89 and the East Fork of the Virgin River in Glendale, Utah. The Project also proposes the potential use of three previously disturbed borrow pits—Lambs Pit, Tait Pit, and Esplin Pit—for Project-related construction needs. These proposed actions constitute an undertaking under Section 106.

The NRCS is serving as the lead federal agency pursuant to 36 CFR 800.2. The Bureau of Land Management-Kanab Field Office (BLM), U.S. Army Corps of Engineers, Sacramento District (Corps), Environmental Protection Agency (EPA), National Park Service (NPS), and Utah Trust Land Administration (TLA) have been identified as cooperating agencies. The NRCS shall act on behalf of all agencies in fulfilling our collective responsibilities under Section 106, including delineation of the APE, identification of historic properties, and finding of effect. The NRCS will inform all cooperating agencies of Section 106 consultation. This consultation will also cover TLA's responsibilities under Utah Annotated Code Section 9-8-404.

NRCS initially consulted with your office in letters sent January 9, 2020 (U18TN0844), and again on January 23, 2023 (U21TN0840). Concurrence on site eligibility and a determination of ***adverse effect to historic properties*** for the undertaking was received on January 17, 2020, and February 6, 2023, respectively (Case Nos. 20-0121 and 23-0280). Additional consultation occurred for an expansion of the APE for a borrow source in a letter dated May 20, 2024 (U23TN0682). Concurrence was received on May 20, 2024 (Case No. 24-1261). Following these consultations, the NRCS has revised the Area of Potential Effects (APE) to include the Direct (Physical), Visual, and Indirect APEs.

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Area of Potential Effects (APE) (36 CFR 800.4)

Table 1 summarizes the Direct, Visual, and Indirect APEs.

TABLE 1
TOTAL Area of Potential Effects (APE)

Area of Potential Effect	BLM	State	Private	Total
Indirect APE Acreage (Inundation Areas)	17.05	0.51	990.41	**1,007.97**
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- **Direct (Physical) APE**: Includes all potential physical ground disturbance, including construction, staging, access roads, borrow sources, and necessary buffers. It has been refined to a total of 712.46 acres.
- **Visual APE**: A radius of 1 mile around the periphery of the proposed Cove Reservoir was evaluated for potential visual resources that could be impacted by the current construction of the reservoir. GIS viewshed analysis was used to refine the final boundaries of the Visual APE, and areas without potential visibility of the project were removed from the Visual APE.
- **Indirect APE:** Includes the breach inundation zones (Sunny-Day and Rainy-Day) in the unlikely event of a dam breach.

Identification of Historic Properties (36 CFR 800.4)

To identify historic properties within the APEs, a literature review was completed by Eocene Environmental. Personnel meet or exceed the Secretary of the Interior Standards in Archeology. The literature review identified 26 cultural resources, 14 of which are eligible for the National Register of Historic Place (NRHP), and one unevaluated, but treated as eligible, within the partially overlapping Direct, Indirect, and Visual APEs. Of the 15 historic properties, only one historic property 42KA7537 (prehistoric cave and artifact scatter) meets the site type criteria for inclusion in the visual impact assessment and therefore do not require a formal visual effects assessment. Site 42KA7537 is only located in the Direct APE and will be avoided (see Case No. 24-1261).

Within the overlapping APEs, there are nine historic buildings/structures of which five are eligible for the NRHP, two are undetermined (treated as eligible), one has been demolished, and the final is ineligible/non-contributing. Within the Visual APE there are three eligible buildings/structures (Property ID Nos., 32819, 50442, and 33219). These historic properties are in Orderville, and the proposed Cove Reservoir would be obstructed from view by means of several ridges southwest of Gardner Hollow.

Within the Indirect APE breach inundation zone, there are three historic properties: Mt. Carmel School and Church (Property ID No. 37252); Dixon, Maynard, House and Studio (Property ID No. 40479); and Steven's Barn

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Finding of Effect (36 CFR 800.5)

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Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)

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President Buu Nygren
Navajo Nation Office of the President
P.O Box 7440
Window Rock, Arizona 86515

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

Dear President Nygren,

The NRCS is continuing Section 106 consultation for the proposed Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (aka Cove Reservoir Project), in Kane County, Utah. Included in this submission are a literature review cultural resources memo titled *Kane County Water Conservancy District's Cove Reservoir Project—Cultural Resources Review Memo, Indirect/Visual Areas of Potential Effect (APEs)*. The United States Department of Agriculture's Natural Resources Conservation Service (NRCS), with the and Kane County Water Conservancy District (KCWCD) are proposing to construct the new Cove Reservoir within the existing Glendale, Mt. Carmel, and Orderville irrigation systems. This proposed reservoir would be located immediately southwest of Orderville, Utah, off Cove Road. Additional improvements would include the construction of approximately 1.5 miles of new pipeline, the Glendale hydroelectric power plant, and 0.2 mile of new power line and 0.7 acre of utility corridor along U.S. Highway 89 (US-89) and Cove Road; these improvements would be located west of US-89 and the East Fork of the Virgin River in Glendale, Utah. The Project also proposes the potential use of three previously disturbed borrow pits—Lambs Pit, Tait Pit, and Esplin Pit—for Project-related construction needs. These proposed actions constitute an undertaking under Section 106.

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Area of Potential Effects (APE) (36 CFR 800.4)

Table 1 summarizes the Direct, Visual, and Indirect APEs.

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TOTAL Area of Potential Effects (APE)

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Within the overlapping APEs, there are nine historic buildings/structures of which five are eligible for the NRHP, two are undetermined (treated as eligible), one has been demolished, and the final is ineligible/non-contributing. Within the Visual APE there are three eligible buildings/structures (Property ID Nos., 32819, 50442, and 33219). These historic properties are in Orderville, and the proposed Cove Reservoir would be obstructed from view by means of several ridges southwest of Gardner Hollow.

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Sincerely,

Emily Fife

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State Conservationist

Enclosure

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Mr. Clarence Rockwell
Executive Director
Navajo Utah Commission
P.O. Box 570
Montezuma Creek, Utah 84534

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

Dear Mr. Rockwell,

The NRCS is continuing Section 106 consultation for the proposed Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (aka Cove Reservoir Project), in Kane County, Utah. Included in this submission are a literature review cultural resources memo titled *Kane County Water Conservancy District's Cove Reservoir Project—Cultural Resources Review Memo, Indirect/Visual Areas of Potential Effect (APEs)*. The United States Department of Agriculture's Natural Resources Conservation Service (NRCS), with the and Kane County Water Conservancy District (KCWCD) are proposing to construct the new Cove Reservoir within the existing Glendale, Mt. Carmel, and Orderville irrigation systems. This proposed reservoir would be located immediately southwest of Orderville, Utah, off Cove Road. Additional improvements would include the construction of approximately 1.5 miles of new pipeline, the Glendale hydroelectric power plant, and 0.2 mile of new power line and 0.7 acre of utility corridor along U.S. Highway 89 (US-89) and Cove Road; these improvements would be located west of US-89 and the East Fork of the Virgin River in Glendale, Utah. The Project also proposes the potential use of three previously disturbed borrow pits—Lambs Pit, Tait Pit, and Esplin Pit—for Project-related construction needs. These proposed actions constitute an undertaking under Section 106.

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Area of Potential Effects (APE) (36 CFR 800.4)

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Ms. Stephanie Holly
Administration
Navajo Utah Commission
P.O. Box 570
Montezuma Creek, Utah 84534

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

Dear Ms. Holly,

The NRCS is continuing Section 106 consultation for the proposed Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (aka Cove Reservoir Project), in Kane County, Utah. Included in this submission are a literature review cultural resources memo titled *Kane County Water Conservancy District's Cove Reservoir Project—Cultural Resources Review Memo, Indirect/Visual Areas of Potential Effect (APEs)*. The United States Department of Agriculture's Natural Resources Conservation Service (NRCS), with the and Kane County Water Conservancy District (KCWCD) are proposing to construct the new Cove Reservoir within the existing Glendale, Mt. Carmel, and Orderville irrigation systems. This proposed reservoir would be located immediately southwest of Orderville, Utah, off Cove Road. Additional improvements would include the construction of approximately 1.5 miles of new pipeline, the Glendale hydroelectric power plant, and 0.2 mile of new power line and 0.7 acre of utility corridor along U.S. Highway 89 (US-89) and Cove Road; these improvements would be located west of US-89 and the East Fork of the Virgin River in Glendale, Utah. The Project also proposes the potential use of three previously disturbed borrow pits—Lambs Pit, Tait Pit, and Esplin Pit—for Project-related construction needs. These proposed actions constitute an undertaking under Section 106.

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Area of Potential Effects (APE) (36 CFR 800.4)

Table 1 summarizes the Direct, Visual, and Indirect APEs.

TABLE 1
TOTAL Area of Potential Effects (APE)

Area of Potential Effect	BLM	State	Private	Total
Indirect APE Acreage (Inundation Areas)	17.05	0.51	990.41	**1,007.97**
Visual APE Acreage (1 Mile Buffer of Cove Reservoir and Facilities)	245.00	1,698.01	3,009.28	**4,952.29**
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Identification of Historic Properties (36 CFR 800.4)

To identify historic properties within the APEs, a literature review was completed by Eocene Environmental. Personnel meet or exceed the Secretary of the Interior Standards in Archeology. The literature review identified 26 cultural resources, 14 of which are eligible for the National Register of Historic Place (NRHP), and one unevaluated, but treated as eligible, within the partially overlapping Direct, Indirect, and Visual APEs. Of the 15 historic properties, only one historic property 42KA7537 (prehistoric cave and artifact scatter) meets the site type criteria for inclusion in the visual impact assessment and therefore do not require a formal visual effects assessment. Site 42KA7537 is only located in the Direct APE and will be avoided (see Case No. 24-1261).

Within the overlapping APEs, there are nine historic buildings/structures of which five are eligible for the NRHP, two are undetermined (treated as eligible), one has been demolished, and the final is ineligible/non-contributing. Within the Visual APE there are three eligible buildings/structures (Property ID Nos., 32819, 50442, and 33219). These historic properties are in Orderville, and the proposed Cove Reservoir would be obstructed from view by means of several ridges southwest of Gardner Hollow.

Within the Indirect APE breach inundation zone, there are three historic properties: Mt. Carmel School and Church (Property ID No. 37252); Dixon, Maynard, House and Studio (Property ID No. 40479); and Steven's Barn

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(Property ID No. 31786). Steven's Barn (Property ID NO. 31786) has likely been demolished. Due to distance, elevation, and the proposed reservoir safety features, these historic properties are unlikely to be adversely affected by the highly improbable failure of the proposed Cove Reservoir dam.

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The implementation of the undertaking will not alter the character-defining characteristics of the aforementioned historic properties that allow them to convey their significance since visual component is not the character-defining feature that makes the sites eligible. Therefore, the NRCS finding of effect for the Visual and Indirect APEs is No Adverse Effect. This results in no change to the finding of effect for the entirety of the undertaking, where the NRCS retains our previous determination of ***Adverse Effect to Historic Properties*** (Case No. 20-0121).

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Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)

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Chairperson Laurel Yellowhorse
Paiute Indian Tribe of Utah
440 North Paiute Drive
Cedar City, Utah 84721

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

Dear Chairperson Yellowhorse,

The NRCS is continuing Section 106 consultation for the proposed Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (aka Cove Reservoir Project), in Kane County, Utah. Included in this submission are a literature review cultural resources memo titled *Kane County Water Conservancy District's Cove Reservoir Project—Cultural Resources Review Memo, Indirect/Visual Areas of Potential Effect (APEs)*. The United States Department of Agriculture's Natural Resources Conservation Service (NRCS), with the and Kane County Water Conservancy District (KCWCD) are proposing to construct the new Cove Reservoir within the existing Glendale, Mt. Carmel, and Orderville irrigation systems. This proposed reservoir would be located immediately southwest of Orderville, Utah, off Cove Road. Additional improvements would include the construction of approximately 1.5 miles of new pipeline, the Glendale hydroelectric power plant, and 0.2 mile of new power line and 0.7 acre of utility corridor along U.S. Highway 89 (US-89) and Cove Road; these improvements would be located west of US-89 and the East Fork of the Virgin River in Glendale, Utah. The Project also proposes the potential use of three previously disturbed borrow pits—Lambs Pit, Tait Pit, and Esplin Pit—for Project-related construction needs. These proposed actions constitute an undertaking under Section 106.

The NRCS is serving as the lead federal agency pursuant to 36 CFR 800.2. The Bureau of Land Management-Kanab Field Office (BLM), U.S. Army Corps of Engineers, Sacramento District (Corps), Environmental Protection Agency (EPA), National Park Service (NPS), and Utah Trust Land Administration (TLA) have been identified as cooperating agencies. The NRCS shall act on behalf of all agencies in fulfilling our collective responsibilities under Section 106, including delineation of the APE, identification of historic properties, and finding of effect. The NRCS will inform all cooperating agencies of Section 106 consultation. This consultation will also cover TLA's responsibilities under Utah Annotated Code Section 9-8-404.

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Emily Fife

EMILY FIFE
State Conservationist

Enclosure

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Ms. Autumn Gillard
Cultural Resource Director
Paiute Indian Tribe of Utah
440 North Paiute Drive
Cedar City, Utah 84721

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

Dear Ms. Gillard,

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Governor Arden Kucate
Pueblo of Zuni
P.O. Box 339
Zuni, New Mexico 87327

June 4, 2025

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Mr. Kurt Dongoske
Director and THPO
Pueblo of Zuni
P.O. Box 1149
Zuni, New Mexico 87327

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

Dear Mr. Dongoske,

The NRCS is continuing Section 106 consultation for the proposed Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (aka Cove Reservoir Project), in Kane County, Utah. Included in this submission are a literature review cultural resources memo titled *Kane County Water Conservancy District's Cove Reservoir Project—Cultural Resources Review Memo, Indirect/Visual Areas of Potential Effect (APEs)*. The United States Department of Agriculture's Natural Resources Conservation Service (NRCS), with the and Kane County Water Conservancy District (KCWCD) are proposing to construct the new Cove Reservoir within the existing Glendale, Mt. Carmel, and Orderville irrigation systems. This proposed reservoir would be located immediately southwest of Orderville, Utah, off Cove Road. Additional improvements would include the construction of approximately 1.5 miles of new pipeline, the Glendale hydroelectric power plant, and 0.2 mile of new power line and 0.7 acre of utility corridor along U.S. Highway 89 (US-89) and Cove Road; these improvements would be located west of US-89 and the East Fork of the Virgin River in Glendale, Utah. The Project also proposes the potential use of three previously disturbed borrow pits—Lambs Pit, Tait Pit, and Esplin Pit—for Project-related construction needs. These proposed actions constitute an undertaking under Section 106.

The NRCS is serving as the lead federal agency pursuant to 36 CFR 800.2. The Bureau of Land Management-Kanab Field Office (BLM), U.S. Army Corps of Engineers, Sacramento District (Corps), Environmental Protection Agency (EPA), National Park Service (NPS), and Utah Trust Land Administration (TLA) have been identified as cooperating agencies. The NRCS shall act on behalf of all agencies in fulfilling our collective responsibilities under Section 106, including delineation of the APE, identification of historic properties, and finding of effect. The NRCS will inform all cooperating agencies of Section 106 consultation. This consultation will also cover TLA's responsibilities under Utah Annotated Code Section 9-8-404.

NRCS initially consulted with your office in letters sent January 9, 2020 (U18TN0844), and again on January 23, 2023 (U21TN0840). Concurrence on site eligibility and a determination of ***adverse effect to historic properties*** for the undertaking was received on January 17, 2020, and February 6, 2023, respectively (Case Nos. 20-0121 and 23-0280). Additional consultation occurred for an expansion of the APE for a borrow source in a letter dated May 20, 2024 (U23TN0682). Concurrence was received on May 20, 2024 (Case No. 24-1261). Following these consultations, the NRCS has revised the Area of Potential Effects (APE) to include the Direct (Physical), Visual, and Indirect APEs.

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Area of Potential Effects (APE) (36 CFR 800.4)

Table 1 summarizes the Direct, Visual, and Indirect APEs.

TABLE 1
TOTAL Area of Potential Effects (APE)

Area of Potential Effect	BLM	State	Private	Total
Indirect APE Acreage (Inundation Areas)	17.05	0.51	990.41	**1,007.97**
Visual APE Acreage (1 Mile Buffer of Cove Reservoir and Facilities)	245.00	1,698.01	3,009.28	**4,952.29**
Direct (Physical) APE Acreage (Cove Reservoir, Pipes, Canals, Esplin Pit, Tait Pit, Lamb's Pit)	0.23	70.33	641.9	**712.46**

- **Direct (Physical) APE**: Includes all potential physical ground disturbance, including construction, staging, access roads, borrow sources, and necessary buffers. It has been refined to a total of 712.46 acres.
- **Visual APE**: A radius of 1 mile around the periphery of the proposed Cove Reservoir was evaluated for potential visual resources that could be impacted by the current construction of the reservoir. GIS viewshed analysis was used to refine the final boundaries of the Visual APE, and areas without potential visibility of the project were removed from the Visual APE.
- **Indirect APE:** Includes the breach inundation zones (Sunny-Day and Rainy-Day) in the unlikely event of a dam breach.

Identification of Historic Properties (36 CFR 800.4)

To identify historic properties within the APEs, a literature review was completed by Eocene Environmental. Personnel meet or exceed the Secretary of the Interior Standards in Archeology. The literature review identified 26 cultural resources, 14 of which are eligible for the National Register of Historic Place (NRHP), and one unevaluated, but treated as eligible, within the partially overlapping Direct, Indirect, and Visual APEs. Of the 15 historic properties, only one historic property 42KA7537 (prehistoric cave and artifact scatter) meets the site type criteria for inclusion in the visual impact assessment and therefore do not require a formal visual effects assessment. Site 42KA7537 is only located in the Direct APE and will be avoided (see Case No. 24-1261).

Within the overlapping APEs, there are nine historic buildings/structures of which five are eligible for the NRHP, two are undetermined (treated as eligible), one has been demolished, and the final is ineligible/non-contributing. Within the Visual APE there are three eligible buildings/structures (Property ID Nos., 32819, 50442, and 33219). These historic properties are in Orderville, and the proposed Cove Reservoir would be obstructed from view by means of several ridges southwest of Gardner Hollow.

Within the Indirect APE breach inundation zone, there are three historic properties: Mt. Carmel School and Church (Property ID No. 37252); Dixon, Maynard, House and Studio (Property ID No. 40479); and Steven's Barn

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(Property ID No. 31786). Steven's Barn (Property ID NO. 31786) has likely been demolished. Due to distance, elevation, and the proposed reservoir safety features, these historic properties are unlikely to be adversely affected by the highly improbable failure of the proposed Cove Reservoir dam.

Finding of Effect (36 CFR 800.5)

The implementation of the undertaking will not alter the character-defining characteristics of the aforementioned historic properties that allow them to convey their significance since visual component is not the character-defining feature that makes the sites eligible. Therefore, the NRCS finding of effect for the Visual and Indirect APEs is No Adverse Effect. This results in no change to the finding of effect for the entirety of the undertaking, where the NRCS retains our previous determination of ***Adverse Effect to Historic Properties*** (Case No. 20-0121).

In an electronical transmittal on March 28, 2024, the NRCS notified the Advisory Council on Historic Preservation (Council) of the adverse effect determination by providing documentation specified in 36 CFR 800.11(e). The Council declined to participate in consultation in a letter dated April 20, 2024. Per 36 CFR 800.6, the NRCS is continuing consultation with your office, the Sponsors, agencies, applicable Native American tribes, and other consulting parties, to develop mitigation stipulations that will be executed in a Memorandum of Agreement. As the lead federal agency, the NRCS is informing the BLM, Corps, NPS, TLA, and EPA of ongoing Section 106 consultations. Per 36 CFR 800.4-800.5, the NRCS requests concurrence for the delineation of the APEs, identification of historic properties, and finding of effect. If you have any questions, comments, or concerns, please contact Tara S. Hoffmann, Water and Cultural Resources Specialist, at (385)-258-1266 at your convenience.

Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)

Anders Fillerup, NRCS, ASTC-Water Resources, Salt Lake City, Utah
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, Utah
Tara Hoffmann, NRCS, Water and Cultural Resources Specialist, Salt Lake City, Utah
Brandon Todd, NRCS, ASTC-Field Operations, Richfield, Utah
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President Carlene Yellowhair
San Juan Southern Paiute Tribe of Arizona
P.O. Box 2950
Tuba City, Arizona 86045

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

Dear President Yellowhair,

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Emily Fife

EMILY FIFE
State Conservationist

Enclosure

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Vice President Johnny Lehi
San Juan Southern Paiute Tribe of Arizona
P.O. Box 2950
Tuba City, Arizona 86045

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

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Mr. Dustin Jansen
Division Director
Utah Division of Indian Affairs

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

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<u>Area of Potential Effects (APE) (36 CFR 800.4)</u>

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Finding of Effect (36 CFR 800.5)

The implementation of the undertaking will not alter the character-defining characteristics of the aforementioned historic properties that allow them to convey their significance since visual component is not the character-defining feature that makes the sites eligible. Therefore, the NRCS finding of effect for the Visual and Indirect APEs is No Adverse Effect. This results in no change to the finding of effect for the entirety of the undertaking, where the NRCS retains our previous determination of ***Adverse Effect to Historic Properties*** (Case No. 20-0121).

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Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)

Anders Fillerup, NRCS, ASTC-Water Resources, Salt Lake City, Utah
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, Utah
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Emily Paris, Eocene, Project Manager, Sparks, Nevada

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Chairman Julius Murray
Ute Indian Tribe of the Uintah & Ouray Reservation
P.O. Box 190
Fort Duchesne, Utah 84026

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

Dear Chairman Murray,

The NRCS is continuing Section 106 consultation for the proposed Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (aka Cove Reservoir Project), in Kane County, Utah. Included in this submission are a literature review cultural resources memo titled *Kane County Water Conservancy District's Cove Reservoir Project—Cultural Resources Review Memo, Indirect/Visual Areas of Potential Effect (APEs)*. The United States Department of Agriculture's Natural Resources Conservation Service (NRCS), with the and Kane County Water Conservancy District (KCWCD) are proposing to construct the new Cove Reservoir within the existing Glendale, Mt. Carmel, and Orderville irrigation systems. This proposed reservoir would be located immediately southwest of Orderville, Utah, off Cove Road. Additional improvements would include the construction of approximately 1.5 miles of new pipeline, the Glendale hydroelectric power plant, and 0.2 mile of new power line and 0.7 acre of utility corridor along U.S. Highway 89 (US-89) and Cove Road; these improvements would be located west of US-89 and the East Fork of the Virgin River in Glendale, Utah. The Project also proposes the potential use of three previously disturbed borrow pits—Lambs Pit, Tait Pit, and Esplin Pit—for Project-related construction needs. These proposed actions constitute an undertaking under Section 106.

The NRCS is serving as the lead federal agency pursuant to 36 CFR 800.2. The Bureau of Land Management-Kanab Field Office (BLM), U.S. Army Corps of Engineers, Sacramento District (Corps), Environmental Protection Agency (EPA), National Park Service (NPS), and Utah Trust Land Administration (TLA) have been identified as cooperating agencies. The NRCS shall act on behalf of all agencies in fulfilling our collective responsibilities under Section 106, including delineation of the APE, identification of historic properties, and finding of effect. The NRCS will inform all cooperating agencies of Section 106 consultation. This consultation will also cover TLA's responsibilities under Utah Annotated Code Section 9-8-404.

NRCS initially consulted with your office in letters sent January 9, 2020 (U18TN0844), and again on January 23, 2023 (U21TN0840). Concurrence on site eligibility and a determination of ***adverse effect to historic properties*** for the undertaking was received on January 17, 2020, and February 6, 2023, respectively (Case Nos. 20-0121 and 23-0280). Additional consultation occurred for an expansion of the APE for a borrow source in a letter dated May 20, 2024 (U23TN0682). Concurrence was received on May 20, 2024 (Case No. 24-1261). Following these consultations, the NRCS has revised the Area of Potential Effects (APE) to include the Direct (Physical), Visual, and Indirect APEs.

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Area of Potential Effects (APE) (36 CFR 800.4)

Table 1 summarizes the Direct, Visual, and Indirect APEs.

TABLE 1
TOTAL Area of Potential Effects (APE)

Area of Potential Effect	BLM	State	Private	Total
Indirect APE Acreage (Inundation Areas)	17.05	0.51	990.41	**1,007.97**
Visual APE Acreage (1 Mile Buffer of Cove Reservoir and Facilities)	245.00	1,698.01	3,009.28	**4,952.29**
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- **Indirect APE:** Includes the breach inundation zones (Sunny-Day and Rainy-Day) in the unlikely event of a dam breach.

Identification of Historic Properties (36 CFR 800.4)

To identify historic properties within the APEs, a literature review was completed by Eocene Environmental. Personnel meet or exceed the Secretary of the Interior Standards in Archeology. The literature review identified 26 cultural resources, 14 of which are eligible for the National Register of Historic Place (NRHP), and one unevaluated, but treated as eligible, within the partially overlapping Direct, Indirect, and Visual APEs. Of the 15 historic properties, only one historic property 42KA7537 (prehistoric cave and artifact scatter) meets the site type criteria for inclusion in the visual impact assessment and therefore do not require a formal visual effects assessment. Site 42KA7537 is only located in the Direct APE and will be avoided (see Case No. 24-1261).

Within the overlapping APEs, there are nine historic buildings/structures of which five are eligible for the NRHP, two are undetermined (treated as eligible), one has been demolished, and the final is ineligible/non-contributing. Within the Visual APE there are three eligible buildings/structures (Property ID Nos., 32819, 50442, and 33219). These historic properties are in Orderville, and the proposed Cove Reservoir would be obstructed from view by means of several ridges southwest of Gardner Hollow.

Within the Indirect APE breach inundation zone, there are three historic properties: Mt. Carmel School and Church (Property ID No. 37252); Dixon, Maynard, House and Studio (Property ID No. 40479); and Steven's Barn

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(Property ID No. 31786). Steven's Barn (Property ID NO. 31786) has likely been demolished. Due to distance, elevation, and the proposed reservoir safety features, these historic properties are unlikely to be adversely affected by the highly improbable failure of the proposed Cove Reservoir dam.

Finding of Effect (36 CFR 800.5)

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Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)

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Ms. Betsy Chapoose
THPO
Ute Indian Tribe of the Uintah & Ouray Reservation
P.O. Box 190
Fort Duchesne, Utah 84026

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

Dear Ms. Chapoose,

The NRCS is continuing Section 106 consultation for the proposed Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (aka Cove Reservoir Project), in Kane County, Utah. Included in this submission are a literature review cultural resources memo titled *Kane County Water Conservancy District's Cove Reservoir Project—Cultural Resources Review Memo, Indirect/Visual Areas of Potential Effect (APEs)*. The United States Department of Agriculture's Natural Resources Conservation Service (NRCS), with the and Kane County Water Conservancy District (KCWCD) are proposing to construct the new Cove Reservoir within the existing Glendale, Mt. Carmel, and Orderville irrigation systems. This proposed reservoir would be located immediately southwest of Orderville, Utah, off Cove Road. Additional improvements would include the construction of approximately 1.5 miles of new pipeline, the Glendale hydroelectric power plant, and 0.2 mile of new power line and 0.7 acre of utility corridor along U.S. Highway 89 (US-89) and Cove Road; these improvements would be located west of US-89 and the East Fork of the Virgin River in Glendale, Utah. The Project also proposes the potential use of three previously disturbed borrow pits—Lambs Pit, Tait Pit, and Esplin Pit—for Project-related construction needs. These proposed actions constitute an undertaking under Section 106.

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Area of Potential Effects (APE) (36 CFR 800.4)

Table 1 summarizes the Direct, Visual, and Indirect APEs.

TABLE 1
TOTAL Area of Potential Effects (APE)

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Within the overlapping APEs, there are nine historic buildings/structures of which five are eligible for the NRHP, two are undetermined (treated as eligible), one has been demolished, and the final is ineligible/non-contributing. Within the Visual APE there are three eligible buildings/structures (Property ID Nos., 32819, 50442, and 33219). These historic properties are in Orderville, and the proposed Cove Reservoir would be obstructed from view by means of several ridges southwest of Gardner Hollow.

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Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)

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Ms. Luana Thompson
Natural Resources Director
Ute Indian Tribe of the Uintah & Ouray Reservation
P.O. Box 190
Fort Duchesne, Utah 84026

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

Dear Ms. Thompson,

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Area of Potential Effects (APE) (36 CFR 800.4)

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Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)

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Ms. Jacinthe "J" Messier
Tribal Archaeologist
Ute Mountain Ute Tribe
P.O. Box 468
Towaoc, Colorado 81334

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

Dear Ms. Messier,

The NRCS is continuing Section 106 consultation for the proposed Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (aka Cove Reservoir Project), in Kane County, Utah. Included in this submission are a literature review cultural resources memo titled *Kane County Water Conservancy District's Cove Reservoir Project—Cultural Resources Review Memo, Indirect/Visual Areas of Potential Effect (APEs)*. The United States Department of Agriculture's Natural Resources Conservation Service (NRCS), with the and Kane County Water Conservancy District (KCWCD) are proposing to construct the new Cove Reservoir within the existing Glendale, Mt. Carmel, and Orderville irrigation systems. This proposed reservoir would be located immediately southwest of Orderville, Utah, off Cove Road. Additional improvements would include the construction of approximately 1.5 miles of new pipeline, the Glendale hydroelectric power plant, and 0.2 mile of new power line and 0.7 acre of utility corridor along U.S. Highway 89 (US-89) and Cove Road; these improvements would be located west of US-89 and the East Fork of the Virgin River in Glendale, Utah. The Project also proposes the potential use of three previously disturbed borrow pits—Lambs Pit, Tait Pit, and Esplin Pit—for Project-related construction needs. These proposed actions constitute an undertaking under Section 106.

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Area of Potential Effects (APE) (36 CFR 800.4)

Table 1 summarizes the Direct, Visual, and Indirect APEs.

TABLE 1
TOTAL Area of Potential Effects (APE)

Area of Potential Effect	BLM	State	Private	Total
Indirect APE Acreage (Inundation Areas)	17.05	0.51	990.41	**1,007.97**
Visual APE Acreage (1 Mile Buffer of Cove Reservoir and Facilities)	245.00	1,698.01	3,009.28	**4,952.29**
Direct (Physical) APE Acreage (Cove Reservoir, Pipes, Canals, Esplin Pit, Tait Pit, Lamb's Pit)	0.23	70.33	641.9	**712.46**

- **Direct (Physical) APE**: Includes all potential physical ground disturbance, including construction, staging, access roads, borrow sources, and necessary buffers. It has been refined to a total of 712.46 acres.
- **Visual APE**: A radius of 1 mile around the periphery of the proposed Cove Reservoir was evaluated for potential visual resources that could be impacted by the current construction of the reservoir. GIS viewshed analysis was used to refine the final boundaries of the Visual APE, and areas without potential visibility of the project were removed from the Visual APE.
- **Indirect APE:** Includes the breach inundation zones (Sunny-Day and Rainy-Day) in the unlikely event of a dam breach.

Identification of Historic Properties (36 CFR 800.4)

To identify historic properties within the APEs, a literature review was completed by Eocene Environmental. Personnel meet or exceed the Secretary of the Interior Standards in Archeology. The literature review identified 26 cultural resources, 14 of which are eligible for the National Register of Historic Place (NRHP), and one unevaluated, but treated as eligible, within the partially overlapping Direct, Indirect, and Visual APEs. Of the 15 historic properties, only one historic property 42KA7537 (prehistoric cave and artifact scatter) meets the site type criteria for inclusion in the visual impact assessment and therefore do not require a formal visual effects assessment. Site 42KA7537 is only located in the Direct APE and will be avoided (see Case No. 24-1261).

Within the overlapping APEs, there are nine historic buildings/structures of which five are eligible for the NRHP, two are undetermined (treated as eligible), one has been demolished, and the final is ineligible/non-contributing. Within the Visual APE there are three eligible buildings/structures (Property ID Nos., 32819, 50442, and 33219). These historic properties are in Orderville, and the proposed Cove Reservoir would be obstructed from view by means of several ridges southwest of Gardner Hollow.

Within the Indirect APE breach inundation zone, there are three historic properties: Mt. Carmel School and Church (Property ID No. 37252); Dixon, Maynard, House and Studio (Property ID No. 40479); and Steven's Barn

State Office Natural Resources Conservation Service
125 South State Street, Room 6416
Salt Lake City, Utah 84138
Phone: 801-524-4550

(Property ID No. 31786). Steven's Barn (Property ID NO. 31786) has likely been demolished. Due to distance, elevation, and the proposed reservoir safety features, these historic properties are unlikely to be adversely affected by the highly improbable failure of the proposed Cove Reservoir dam.

Finding of Effect (36 CFR 800.5)

The implementation of the undertaking will not alter the character-defining characteristics of the aforementioned historic properties that allow them to convey their significance since visual component is not the character-defining feature that makes the sites eligible. Therefore, the NRCS finding of effect for the Visual and Indirect APEs is No Adverse Effect. This results in no change to the finding of effect for the entirety of the undertaking, where the NRCS retains our previous determination of ***Adverse Effect to Historic Properties*** (Case No. 20-0121).

In an electronical transmittal on March 28, 2024, the NRCS notified the Advisory Council on Historic Preservation (Council) of the adverse effect determination by providing documentation specified in 36 CFR 800.11(e). The Council declined to participate in consultation in a letter dated April 20, 2024. Per 36 CFR 800.6, the NRCS is continuing consultation with your office, the Sponsors, agencies, applicable Native American tribes, and other consulting parties, to develop mitigation stipulations that will be executed in a Memorandum of Agreement. As the lead federal agency, the NRCS is informing the BLM, Corps, NPS, TLA, and EPA of ongoing Section 106 consultations. Per 36 CFR 800.4-800.5, the NRCS requests concurrence for the delineation of the APEs, identification of historic properties, and finding of effect. If you have any questions, comments, or concerns, please contact Tara S. Hoffmann, Water and Cultural Resources Specialist, at (385)-258-1266 at your convenience.

Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)

Anders Fillerup, NRCS, ASTC-Water Resources, Salt Lake City, Utah
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, Utah
Tara Hoffmann, NRCS, Water and Cultural Resources Specialist, Salt Lake City, Utah
Brandon Todd, NRCS, ASTC-Field Operations, Richfield, Utah
Kristi Westwood, NRCS, District Conservationist, Panguitch, Utah
Brian Storm, BLM, Archaeologist, Kanab, Utah
Kristine Curry, TLA, Archaeologist, Salt Lake City, Utah
Jason Gipson, Corps, Chief, Bountiful, Utah
Courtney Mackay, NPS, Archeologist, Springdale, Utah
Region 8, EPA, Denver, Colorado
Emily Paris, Eocene, Project Manager, Sparks, Nevada

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U.S. DEPARTMENT OF AGRICULTURE

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125 South State Street, Room 6416
Salt Lake City, Utah 84138
Phone: 801-524-4550

Chairman Manuel Heart
Ute Mountain Ute Tribe
125 Mikewash Road
Towaoc, Colorado 81334

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

Dear Chairman Heart,

The NRCS is continuing Section 106 consultation for the proposed Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (aka Cove Reservoir Project), in Kane County, Utah. Included in this submission are a literature review cultural resources memo titled *Kane County Water Conservancy District's Cove Reservoir Project—Cultural Resources Review Memo, Indirect/Visual Areas of Potential Effect (APEs)*. The United States Department of Agriculture's Natural Resources Conservation Service (NRCS), with the and Kane County Water Conservancy District (KCWCD) are proposing to construct the new Cove Reservoir within the existing Glendale, Mt. Carmel, and Orderville irrigation systems. This proposed reservoir would be located immediately southwest of Orderville, Utah, off Cove Road. Additional improvements would include the construction of approximately 1.5 miles of new pipeline, the Glendale hydroelectric power plant, and 0.2 mile of new power line and 0.7 acre of utility corridor along U.S. Highway 89 (US-89) and Cove Road; these improvements would be located west of US-89 and the East Fork of the Virgin River in Glendale, Utah. The Project also proposes the potential use of three previously disturbed borrow pits—Lambs Pit, Tait Pit, and Esplin Pit—for Project-related construction needs. These proposed actions constitute an undertaking under Section 106.

The NRCS is serving as the lead federal agency pursuant to 36 CFR 800.2. The Bureau of Land Management-Kanab Field Office (BLM), U.S. Army Corps of Engineers, Sacramento District (Corps), Environmental Protection Agency (EPA), National Park Service (NPS), and Utah Trust Land Administration (TLA) have been identified as cooperating agencies. The NRCS shall act on behalf of all agencies in fulfilling our collective responsibilities under Section 106, including delineation of the APE, identification of historic properties, and finding of effect. The NRCS will inform all cooperating agencies of Section 106 consultation. This consultation will also cover TLA's responsibilities under Utah Annotated Code Section 9-8-404.

NRCS initially consulted with your office in letters sent January 9, 2020 (U18TN0844), and again on January 23, 2023 (U21TN0840). Concurrence on site eligibility and a determination of ***adverse effect to historic properties*** for the undertaking was received on January 17, 2020, and February 6, 2023, respectively (Case Nos. 20-0121 and 23-0280). Additional consultation occurred for an expansion of the APE for a borrow source in a letter dated May 20, 2024 (U23TN0682). Concurrence was received on May 20, 2024 (Case No. 24-1261). Following these consultations, the NRCS has revised the Area of Potential Effects (APE) to include the Direct (Physical), Visual, and Indirect APEs.

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Phone: 801-524-4550

Area of Potential Effects (APE) (36 CFR 800.4)

Table 1 summarizes the Direct, Visual, and Indirect APEs.

TABLE 1
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- **Direct (Physical) APE**: Includes all potential physical ground disturbance, including construction, staging, access roads, borrow sources, and necessary buffers. It has been refined to a total of 712.46 acres.
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Within the overlapping APEs, there are nine historic buildings/structures of which five are eligible for the NRHP, two are undetermined (treated as eligible), one has been demolished, and the final is ineligible/non-contributing. Within the Visual APE there are three eligible buildings/structures (Property ID Nos., 32819, 50442, and 33219). These historic properties are in Orderville, and the proposed Cove Reservoir would be obstructed from view by means of several ridges southwest of Gardner Hollow.

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Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)

Anders Fillerup, NRCS, ASTC-Water Resources, Salt Lake City, Utah
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, Utah
Tara Hoffmann, NRCS, Water and Cultural Resources Specialist, Salt Lake City, Utah
Brandon Todd, NRCS, ASTC-Field Operations, Richfield, Utah
Kristi Westwood, NRCS, District Conservationist, Panguitch, Utah
Brian Storm, BLM, Archaeologist, Kanab, Utah
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Region 8, EPA, Denver, Colorado
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Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)

Anders Fillerup, NRCS, ASTC-Water Resources, Salt Lake City, Utah
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Kristi Westwood, NRCS, District Conservationist, Panguitch, Utah
Jason Gipson, Corps, Chief, Bountiful, Utah
Region 8, EPA, Denver, Colorado
Emily Paris, Eocene, Project Manager, Sparks, Nevada

From:	Hoffmann, Tara - FPAC-NRCS, UT
To:	Richard M. Begay
Cc:	Kieon S. Halona
Subject:	RE: NRCS Cove Reservoir Project, updated APE Sec. 106 consultation
Date:	Thursday, June 5, 2025 8:44:00 AM
Attachments:	image001.png

Richard,

We thank you for your prompt response. Will include this in our consultation record.

Many thanks,
Tara

Tara S. Hoffmann
Water & Cultural Resources Specialist
NRCS Utah | Water Resources

U.S. DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service
125 S State St Rm 6416, Salt Lake City, UT, 84138
p: (801) 524-4556 | c: (385) 258-1266
e: tara.hoffmann@usda.gov | w: www.nrcs.usda.gov/ut

From: Richard M. Begay <r.begay@navajo-nsn.gov>
Sent: Thursday, June 5, 2025 8:39 AM
To: Hoffmann, Tara - FPAC-NRCS, UT <tara.hoffmann@usda.gov>
Cc: Kieon S. Halona <kieon.halona@navajo-nsn.gov>
Subject: RE: NRCS Cove Reservoir Project, updated APE Sec. 106 consultation

Tara,
I have no questions or concerns at this time. Please proceed with the project without further consultation with the Navajo Nation.
Richard M. Begay, THPO
Navajo Nation

From: Hoffmann, Tara - FPAC-NRCS, UT <tara.hoffmann@usda.gov>
Sent: Wednesday, June 4, 2025 3:37 PM
To: Dr. Buu V. Nygren <presidentnygren@navajo-nsn.gov>; Richard M. Begay <r.begay@navajo-nsn.gov>
Subject: NRCS Cove Reservoir Project, updated APE Sec. 106 consultation

President Nygren and Mr. Begay,

See attached formal Section 106 consultation letter with an updated Direct (Physical), Indirect,

and Visual APE, identification of historic properties, and finding of effect, for the proposed Cove Reservoir Watershed Plan-EIS near Orderville, Utah. Let me know if you have any questions.

Sincerely,
Tara

Tara S. Hoffmann
Water & Cultural Resources Specialist
NRCS Utah | Water Resources

U.S. DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service
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From:	Hoffmann, Tara - FPAC-NRCS, UT
To:	"Darren Daboda THPO"
Subject:	RE: NRCS Utah Cove Reservoir Project, auditory effects
Date:	Monday, August 24, 2026 1:55:00 PM
Attachments:	THPOcommentNRCSKCWCDCoveReservoirProject.2025.docx image001.png image002.png image003.png 2025_SPPA_Executed.pdf image004.png
Importance:	High

Mr. Daboda,

In follow-up to my voicemail earlier today, I'm also sending an email for more information. NRCS is following up to ensure we have considered the Moapa Band of Paiutes comments on the proposed Cove Reservoir Watershed Plan-EIS under Section 106 of the NHPA. One of the comments was in regards acoustic effect concerns at Site 42KA7537, . In response to those concerns, the NRCS has extended the avoidance area around the site to ensure that acoustic noise from machinery is minimal. We have extended the avoidance area to the north and east, around a natural rock outcropping, which would block noise from extending towards the site. See image below. In addition, the rock quarry will only be used during construction and then reclaimed afterwards, so effects would be temporary. For a little background on this site and previous NRCS involvement,

, back in 2012, the entire area in front and to the north was accidentally quarried for rock, but it was stopped . When the rock quarry area was reclaimed, we placed geotextile fabric down along a cutbank and then backfilled along it to ensure any archaeological deposits remaining were kept undisturbed. The acoustics also remained intact. At that time, I worked closely with Charley Bullets and elders from the Kaibab Paiute, all of whom visited the site. Please let us know if this will quell concerns regarding acoustic effects.

The avoidance area shown below would be fenced off on the eastern boundary, connecting to existing fencelines, so it is clear where construction crews cannot go.

I did want to discuss the recommendation for a tribal monitor. We will take this under consideration, and on Private land NRCS will follow our inadvertent discovery plan, as outline in our Prototype Programmatic Agreement with the Utah SHPO (see attached).

Once construction starts, in approximately two years, we will keep the Moapa Band informed of any findings of cultural significance, following NRCS protocols per our PPA, and of any unforeseen adverse effects.

Thank you again, for your active participation in NRCSs' watershed program Section 106 consultation process.

Best,
Tara

Tara S. Hoffmann
Water & Cultural Resources Specialist
NRCS Utah | Water Resources

USDA U.S. DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service
125 S State St Rm 6416, Salt Lake City, UT, 84138
c: (385) 258-1266

tara.hoffmann@usda.gov | www.nrcs.usda.gov/ut

From: Hoffmann, Tara - FPAC-NRCS, UT
Sent: Tuesday, July 15, 2025 9:26 AM
To: Darren Daboda THPO <moapathpo@moapabandofpaiutes.org>
Subject: NRCS Utah Cove Reservoir Project, auditory effects
Importance: High

Mr. Daboda,

Following up to see if the Moapa Band of Paiutes have additional comments regarding NRCSs proposal described in the emails below to minimize auditory effects . Feel free to call if you'd like to discuss more- I can be reached at 385-258-1266.

Many thanks,
Tara

Tara S. Hoffmann
Water & Cultural Resources Specialist
NRCS Utah | Water Resources

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Natural Resources Conservation Service
125 S State St Rm 6416, Salt Lake City, UT, 84138
c: (385) 258-1266
e: tara.hoffmann@usda.gov | w: www.nrcs.usda.gov/ut

From: Hoffmann, Tara - FPAC-NRCS, UT
Sent: Wednesday, June 18, 2025 8:43 AM
To: Darren Daboda <moapathpo@moapabandofpaiutes.org>
Subject: RE: NRCS Utah Cove Reservoir Project, updated APE Sec. 106 consultation
Importance: High

Mr. Daboda,

Thank you for comments on the proposed Cove Reservoir Project. NRCS and KCWCD are currently working on the Draft Watershed Plan and Environmental Impact Statement and if funding for construction is obtained, construction would likely occur in 2027 at the earliest.

For acoustic effects related to Site 42KA7537, is there mitigation/minimization you would recommend? There are no trees to leave as a buffer to sound,
I first visited this site with Charley Bullets and an elder from the Kaibab Paiute many years ago.

I am open to any ideas and can also reach out to Daniel

Bullets to see if he has recommendations.

We are planning to physically avoid the larger area , and heavy equipment would only operate in the borrow source to the east (see attached "Cove_Prev_Surveys" map and screenshot below). We could increase that avoidance area to be located where the outcropping protrudes out

I will also reach out to local tribes to see if they have monitors that could be present during construction.

Let me know your thoughts and feel free to call if you would like to discuss more.

Thanks again,
Tara

Tara S. Hoffmann
Water & Cultural Resources Specialist
NRCS Utah | Water Resources

U.S. DEPARTMENT OF AGRICULTURE
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p: (801) 524-4556 | c: (385) 258-1266
e: tara.hoffmann@usda.gov | w: www.nrcs.usda.gov/ut

From: Darren Daboda THPO <moapathpo@moapabandofpaiutes.org>
Sent: Thursday, June 5, 2025 10:10 AM
To: Hoffmann, Tara - FPAC-NRCS, UT <tara.hoffmann@usda.gov>
Subject: RE: NRCS Utah Cove Reservoir Project, updated APE Sec. 106 consultation

Good morning,

Enclosed for your information, is a copy of "THPO's comments about NRCS KCWCD Cove Reservoir Project."

Thanks,

DARREN DABODA
Tribal Historic Preservation Office
Moapa Band of Paiutes

1 Lincoln St
P.O. Box 340
Moapa, NV 89025

Telephone : 702 865 2787 ext. 92
Cell: 702 277 4977
Fax: 702 865 2875
Email: moapathpo@moapabandofpaiutes.org

From: Hoffmann, Tara - FPAC-NRCS, UT <tara.hoffmann@usda.gov>
Sent: Wednesday, June 4, 2025 2:47 PM
To: Darren Daboda THPO <moapathpo@moapabandofpaiutes.org>; Mario Monroe <chair.mbop@moapabandofpaiutes.org>; Moapa Cultural <moapacultural@moapabandofpaiutes.org>
Subject: NRCS Utah Cove Reservoir Project, updated APE Sec. 106 consultation

Mr. Daboda, Chairman Monroe, and Cultural Manager,

See attached formal Section 106 consultation letter with an updated Direct (Physical), Indirect, and

Visual APE, identification of historic properties, and finding of effect, for the proposed Cove Reservoir Watershed Plan-EIS near Orderville, Utah. Let me know if you have any questions.

Sincerely,
Tara

Tara S. Hoffmann
Water & Cultural Resources Specialist
NRCS Utah | Water Resources

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From:	Hoffmann, Tara - FPAC-NRCS, UT
To:	shaunc@utetribe.com; Betsy Chapoose (betsyc@utetribe.com); Luana Thompson; schapoose@pitu.gov; lyellowhorse@utahpaiutes.org; Daniel Bulletts; R Maldonado; Darren Daboda THPO; Mario Monroe chair.mbop@moapabandofpaiutes.org; cspottedeagle@lvpaiute.com; btso@lvpaiute.com; r.begay@navajo-nsn.gov; alray.nelson@navajo-nsn.gov; Heart, Manuel; Jacinthe Messier; malcolm.lehi@utemountain.org; Johnny Lehi, Jr. J.lehijr@sanjuanpaiute-nsn.gov; Carlene Yellowhair; Kurt Dongoske; Arden Kucate; Stewart Koyiyumptewa; lakeevama@hopi.nsn.us
Subject:	NRCS Utah Cove EFVR Plan-EIS, updated Indirect APE Sec. 106 Consultation
Date:	Wednesday, September 9, 2026 9:44:00 AM
Attachments:	Cove Indirect APE_CR-Memo.pdf image001.png CoveAPE_106Emails20250604.pdf

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See attached continuation of formal Section 106 consultation letter with an updated Indirect Area of Potential Effects (APE) memo, identification of historic properties, and finding of no adverse effect, for the proposed Cove-East Fork of the Virgin River Draft Watershed Plan-EIS near Orderville, Utah (Memo attached). We initially consulted with your offices regarding the Indirect APE in emails dated June 4, 2025 (see attached). This updated memo discusses the revised Sunny Day and Rainy Day Breach Inundation Zones in the improbable event of a dam breach. The likelihood of a dam breach occurring is not a reasonably foreseeable effect given the adherence to Utah and NRCS Dam Safety Standards. However, in a good faith effort to consider all potential effects, the NRCS is including the breach inundation zones as part of the Indirect APE, and this analysis has been incorporated into the Draft Plan-EIS.

The updated memo retains our previous finding of No Adverse Effect for the Indirect APE.

Please let us know if you concur with the updated Indirect APE, identification of historic properties and finding of effect within 15 days of receipt. Feel free to reach out with any questions, comments, or concerns.

Best,
Tara

Tara S. Hoffmann
Water & Cultural Resources Specialist
NRCS Utah | Water Resources

U.S. DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service
125 S State St Rm 6416, Salt Lake City, UT, 84138
c: (385) 258-1266
tara.hoffmann@usda.gov | www.nrcs.usda.gov/ut

Agency Consultation

From:	Hoffmann, Tara - FPAC-NRCS, UT
To:	Jencks, Hollis G CIV USARMY CESPK (USA)
Cc:	jason.a.gipson
Subject:	NRCS Cove Reservoir Project, updated APE consultation
Date:	Wednesday, June 4, 2025 3:25:00 PM
Attachments:	Cove Indirect APE_CR-Memo.pdf CoveAPE_106Ltr_Corps.pdf image001.png

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Hollis,

See attached formal Section 106 consultation letter with an updated Direct (Physical), Indirect, and Visual APE, identification of historic properties, and finding of effect, for the proposed Cove Reservoir Watershed Plan-EIS near Orderville. Let me know if you have any questions.

Thanks,
Tara

Tara S. Hoffmann
Water & Cultural Resources Specialist
NRCS Utah | Water Resources

U.S. DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service
125 S State St Rm 6416, Salt Lake City, UT, 84138
p: (801) 524-4556 | c: (385) 258-1266
e: tara.hoffmann@usda.gov | w: www.nrcs.usda.gov/ut

From:	Hoffmann, Tara - FPAC-NRCS, UT
To:	Hubner, Matt
Cc:	EPA-R8-NEPA
Subject:	NRCS Cove Reservoir Project, updated APE consultation
Date:	Wednesday, June 4, 2025 3:27:00 PM
Attachments:	Cove Indirect APE_CR-Memo.pdf image001.png CoveAPE_106Ltr_EPA.pdf
Importance:	High

Matt,

See attached formal Section 106 consultation letter with an updated Direct (Physical), Indirect, and Visual APE, identification of historic properties, and finding of effect, for the proposed Cove Reservoir Watershed Plan-EIS near Orderville. Let me know if you have any questions.

Thanks,
Tara

Tara S. Hoffmann
Water & Cultural Resources Specialist
NRCS Utah | Water Resources

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Natural Resources Conservation Service
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e: tara.hoffmann@usda.gov | w: www.nrcs.usda.gov/ut

From: Hoffmann, Tara - FPAC-NRCS, UT
To: Mackay, Courtney E
Subject: NRCS Cove Reservoir Project, updated APE consultation
Date: Wednesday, June 4, 2025 3:24:00 PM
Attachments: CoveAPE_106Ltr_NPS.pdf
Cove Indirect APE_CR-Memo.pdf
image001.png

Courtney,

See attached formal Section 106 consultation letter with an updated Direct (Physical), Indirect, and Visual APE, identification of historic properties, and finding of effect, for the proposed Cove Reservoir Watershed Plan-EIS near Orderville. Let me know if you have any questions.

Thanks,
Tara

Tara S. Hoffmann
Water & Cultural Resources Specialist
NRCS Utah | Water Resources

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Natural Resources Conservation Service
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e: tara.hoffmann@usda.gov | w: www.nrcs.usda.gov/ut

From:	Hoffmann, Tara - FPAC-NRCS, UT
To:	Storm, Brian P
Subject:	NRCS Cove Reservoir Project, updated APE consultation
Date:	Wednesday, June 4, 2025 3:23:00 PM
Attachments:	CoveAPE_106Ltr_BLM.pdf Cove Indirect APE_CR-Memo.pdf image001.png
Importance:	High

Brian,

See attached formal Section 106 consultation letter with an updated Direct (Physical), Indirect, and Visual APE, identification of historic properties, and finding of effect, for the proposed Cove Reservoir Watershed Plan-EIS near Orderville. Let me know if you have any questions.

Thanks,
Tara

Tara S. Hoffmann
Water & Cultural Resources Specialist
NRCS Utah | Water Resources

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Mr. Hollis Jencks
Project Manager
Bountiful Regulatory Office
U.S. Army Corps of Engineers
533 West 3600 South, Suite 150
Bountiful, UT 84010-7744

June 4, 2025

Reference: SPK-2020-00507 Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

Dear Mr. Jencks:

The NRCS is continuing Section 106 consultation for the proposed Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (aka Cove Reservoir Project), in Kane County, Utah. Included in this submission are a literature review cultural resources memo titled *Kane County Water Conservancy District's Cove Reservoir Project—Cultural Resources Review Memo*, *Indirect/Visual Areas of Potential Effect (APEs)*. The United States Department of Agriculture's Natural Resources Conservation Service (NRCS), with the and Kane County Water Conservancy District (KCWCD) are proposing to construct the new Cove Reservoir within the existing Glendale, Mt. Carmel, and Orderville irrigation systems. This proposed reservoir would be located immediately southwest of Orderville, Utah, off Cove Road. Additional improvements would include the construction of approximately 1.5 miles of new pipeline, the Glendale hydroelectric power plant, and 0.2 mile of new power line and 0.7 acre of utility corridor along U.S. Highway 89 (US-89) and Cove Road; these improvements would be located west of US-89 and the East Fork of the Virgin River in Glendale, Utah. The Project also proposes the potential use of three previously disturbed borrow pits—Lambs Pit, Tait Pit, and Esplin Pit—for Project-related construction needs. These proposed actions constitute an undertaking under Section 106.

The NRCS is serving as the lead federal agency pursuant to 36 CFR 800.2. The Bureau of Land Management-Kanab Field Office (BLM), U.S. Army Corps of Engineers, Sacramento District (Corps), Environmental Protection Agency (EPA), National Park Service (NPS), and Utah Trust Land Administration (TLA) have been identified as cooperating agencies. The NRCS shall act on behalf of all agencies in fulfilling our collective responsibilities under Section 106, including delineation of the APE, identification of historic properties, and finding of effect. The NRCS will inform all cooperating agencies of Section 106 consultation. This consultation will also cover TLA's responsibilities under Utah Annotated Code Section 9-8-404.

NRCS initially consulted with your office in letters sent January 9, 2020 (U18TN0844), and again on January 23, 2023 (U21TN0840). Concurrence on site eligibility and a determination of ***adverse effect to historic properties*** for the undertaking was received on January 17, 2020, and February 6, 2023, respectively (Case Nos. 20-0121 and 23-0280). Additional consultation occurred for an expansion of the APE for a borrow source in a letter dated May 20, 2024 (U23TN0682). Concurrence was received on May 20, 2024 (Case No. 24-1261). Following these consultations, the NRCS has revised the Area of Potential Effects (APE) to include the Direct (Physical), Visual, and Indirect APEs.

Area of Potential Effects (APE) (36 CFR 800.4)

Table 1 summarizes the Direct, Visual, and Indirect APEs.

TABLE 1 TOTAL Area of Potential Effects (APE)				
Area of Potential Effect	**BLM**	**State**	**Private**	**Total**
Indirect APE Acreage (Inundation Areas)	17.05	0.51	990.41	**1,007.97**
Visual APE Acreage (1 Mile Buffer of Cove Reservoir and Facilities)	245.00	1,698.01	3,009.28	**4,952.29**
Direct (Physical) APE Acreage (Cove Reservoir, Pipes, Canals, Esplin Pit, Tait Pit, Lamb's Pit)	0.23	70.33	641.9	**712.46**

- **Direct (Physical) APE**: Includes all potential physical ground disturbance, including construction, staging, access roads, borrow sources, and necessary buffers. It has been refined to a total of 712.46 acres.
- **Visual APE**: A radius of 1 mile around the periphery of the proposed Cove Reservoir was evaluated for potential visual resources that could be impacted by the current construction of the reservoir. GIS viewshed analysis was used to refine the final boundaries of the Visual APE, and areas without potential visibility of the project were removed from the Visual APE.
- **Indirect APE:** Includes the breach inundation zones (Sunny-Day and Rainy-Day) in the unlikely event of a dam breach.

Identification of Historic Properties (36 CFR 800.4)

To identify historic properties within the APEs, a literature review was completed by Eocene Environmental. Personnel meet or exceed the Secretary of the Interior Standards in Archeology. The literature review identified 26 cultural resources, 14 of which are eligible for the National Register of Historic Place (NRHP), and one unevaluated, but treated as eligible, within the partially overlapping Direct, Indirect, and Visual APEs. Of the 15 historic properties, only one historic property 42KA7537 (prehistoric cave and artifact scatter) meets the site type criteria for inclusion in the visual impact assessment and therefore do not require a formal visual effects assessment. Site 42KA7537 is only located in the Direct APE and will be avoided (see Case No. 24-1261).

Within the overlapping APEs, there are nine historic buildings/structures of which five are eligible for the NRHP, two are undetermined (treated as eligible), one has been demolished, and the final is ineligible/non-contributing. Within the Visual APE there are three eligible buildings/structures (Property ID Nos., 32819, 50442, and 33219). These historic properties are in Orderville, and the proposed Cove Reservoir would be obstructed from view by means of several ridges southwest of Gardner Hollow.

Within the Indirect APE breach inundation zone, there are three historic properties: Mt. Carmel School and Church (Property ID No. 37252); Dixon, Maynard, House and Studio (Property ID No. 40479); and Steven's Barn

(Property ID No. 31786). Steven's Barn (Property ID NO. 31786) has likely been demolished. Due to distance, elevation, and the proposed reservoir safety features, these historic properties are unlikely to be adversely affected by the highly improbable failure of the proposed Cove Reservoir dam.

Finding of Effect (36 CFR 800.5)

The implementation of the undertaking will not alter the character-defining characteristics of the aforementioned historic properties that allow them to convey their significance since visual component is not the character-defining feature that makes the sites eligible. Therefore, the NRCS finding of effect for the Visual and Indirect APEs is No Adverse Effect. This results in no change to the finding of effect for the entirety of the undertaking, where the NRCS retains our previous determination of ***Adverse Effect to Historic Properties*** (Case No. 20-0121).

In an electronical transmittal on March 28, 2024, the NRCS notified the Advisory Council on Historic Preservation (Council) of the adverse effect determination by providing documentation specified in 36 CFR 800.11(e). The Council declined to participate in consultation in a letter dated April 20, 2024. Per 36 CFR 800.6, the NRCS is continuing consultation with your office, the Sponsors, agencies, applicable Native American tribes, and other consulting parties, to develop mitigation stipulations that will be executed in a Memorandum of Agreement. As the lead federal agency, the NRCS is informing the BLM, Corps, NPS, TLA, and EPA of ongoing Section 106 consultations. Per 36 CFR 800.4-800.5, the NRCS requests concurrence for the delineation of the APEs, identification of historic properties, and finding of effect. If you have any questions, comments, or concerns, please contact Tara S. Hoffmann, Water and Cultural Resources Specialist, at (385)-258-1266 at your convenience.

Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)

Anders Fillerup, NRCS, ASTC-Water Resources, Salt Lake City, Utah
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, Utah
Tara Hoffmann, NRCS, Water and Cultural Resources Specialist, Salt Lake City, Utah
Brandon Todd, NRCS, ASTC-Field Operations, Richfield, Utah
Kristi Westwood, NRCS, District Conservationist, Panguitch, Utah
Jason Gipson, Corps, Chief, Bountiful, Utah
Region 8, EPA, Denver, Colorado
Emily Paris, Eocene, Project Manager, Sparks, Nevada

Mr. Matt Hubner
NEPA Branch
U.S. EPA, Region 8, 8EJC-NE
1595 Wynkoop Street
Denver, CO 80202-1129

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

Dear Ms. Hubner:

The NRCS is continuing Section 106 consultation for the proposed Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (aka Cove Reservoir Project), in Kane County, Utah. Included in this submission are a literature review cultural resources memo titled *Kane County Water Conservancy District's Cove Reservoir Project—Cultural Resources Review Memo, Indirect/Visual Areas of Potential Effect (APEs)*. The United States Department of Agriculture's Natural Resources Conservation Service (NRCS), with the and Kane County Water Conservancy District (KCWCD) are proposing to construct the new Cove Reservoir within the existing Glendale, Mt. Carmel, and Orderville irrigation systems. This proposed reservoir would be located immediately southwest of Orderville, Utah, off Cove Road. Additional improvements would include the construction of approximately 1.5 miles of new pipeline, the Glendale hydroelectric power plant, and 0.2 mile of new power line and 0.7 acre of utility corridor along U.S. Highway 89 (US-89) and Cove Road; these improvements would be located west of US-89 and the East Fork of the Virgin River in Glendale, Utah. The Project also proposes the potential use of three previously disturbed borrow pits—Lambs Pit, Tait Pit, and Esplin Pit—for Project-related construction needs. These proposed actions constitute an undertaking under Section 106.

The NRCS is serving as the lead federal agency pursuant to 36 CFR 800.2. The Bureau of Land Management-Kanab Field Office (BLM), U.S. Army Corps of Engineers, Sacramento District (Corps), Environmental Protection Agency (EPA), National Park Service (NPS), and Utah Trust Land Administration (TLA) have been identified as cooperating agencies. The NRCS shall act on behalf of all agencies in fulfilling our collective responsibilities under Section 106, including delineation of the APE, identification of historic properties, and finding of effect. The NRCS will inform all cooperating agencies of Section 106 consultation. This consultation will also cover TLA's responsibilities under Utah Annotated Code Section 9-8-404.

NRCS initially consulted with your office in letters sent January 9, 2020 (U18TN0844), and again on January 23, 2023 (U21TN0840). Concurrence on site eligibility and a determination of ***adverse effect to historic properties*** for the undertaking was received on January 17, 2020, and February 6, 2023, respectively (Case Nos. 20-0121 and 23-0280). Additional consultation occurred for an expansion of the APE for a borrow source in a letter dated May 20, 2024 (U23TN0682). Concurrence was received on May 20, 2024 (Case No. 24-1261). Following these consultations, the NRCS has revised the Area of Potential Effects (APE) to include the Direct (Physical), Visual, and Indirect APEs.

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- **Direct (Physical) APE**: Includes all potential physical ground disturbance, including construction, staging, access roads, borrow sources, and necessary buffers. It has been refined to a total of 712.46 acres.
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To identify historic properties within the APEs, a literature review was completed by Eocene Environmental. Personnel meet or exceed the Secretary of the Interior Standards in Archeology. The literature review identified 26 cultural resources, 14 of which are eligible for the National Register of Historic Place (NRHP), and one unevaluated, but treated as eligible, within the partially overlapping Direct, Indirect, and Visual APEs. Of the 15 historic properties, only one historic property 42KA7537 (prehistoric cave and artifact scatter) meets the site type criteria for inclusion in the visual impact assessment and therefore do not require a formal visual effects assessment. Site 42KA7537 is only located in the Direct APE and will be avoided (see Case No. 24-1261).

Within the overlapping APEs, there are nine historic buildings/structures of which five are eligible for the NRHP, two are undetermined (treated as eligible), one has been demolished, and the final is ineligible/non-contributing. Within the Visual APE there are three eligible buildings/structures (Property ID Nos., 32819, 50442, and 33219). These historic properties are in Orderville, and the proposed Cove Reservoir would be obstructed from view by means of several ridges southwest of Gardner Hollow.

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(Property ID No. 31786). Steven's Barn (Property ID NO. 31786) has likely been demolished. Due to distance, elevation, and the proposed reservoir safety features, these historic properties are unlikely to be adversely affected by the highly improbable failure of the proposed Cove Reservoir dam.

Finding of Effect (36 CFR 800.5)

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In an electronical transmittal on March 28, 2024, the NRCS notified the Advisory Council on Historic Preservation (Council) of the adverse effect determination by providing documentation specified in 36 CFR 800.11(e). The Council declined to participate in consultation in a letter dated April 20, 2024. Per 36 CFR 800.6, the NRCS is continuing consultation with your office, the Sponsors, agencies, applicable Native American tribes, and other consulting parties, to develop mitigation stipulations that will be executed in a Memorandum of Agreement. As the lead federal agency, the NRCS is informing the BLM, Corps, NPS, TLA, and EPA of ongoing Section 106 consultations. Per 36 CFR 800.4-800.5, the NRCS requests concurrence for the delineation of the APEs, identification of historic properties, and finding of effect. If you have any questions, comments, or concerns, please contact Tara S. Hoffmann, Water and Cultural Resources Specialist, at (385)-258-1266 at your convenience.

Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)

Anders Fillerup, NRCS, ASTC-Water Resources, Salt Lake City, Utah
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, Utah
Tara Hoffmann, NRCS, Water and Cultural Resources Specialist, Salt Lake City, Utah
Brandon Todd, NRCS, ASTC-Field Operations, Richfield, Utah
Kristi Westwood, NRCS, District Conservationist, Panguitch, Utah
Jason Gipson, Corps, Chief, Bountiful, Utah
Region 8, EPA, Denver, Colorado
Emily Paris, Eocene, Project Manager, Sparks, Nevada

Ms. Courtney Mackay
Cultural Resource Program Manager
Zion National Park
1 Zion Park Blvd.
Springdale, UT 84767

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

Dear Ms. Mackay:

The NRCS is continuing Section 106 consultation for the proposed Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (aka Cove Reservoir Project), in Kane County, Utah. Included in this submission are a literature review cultural resources memo titled *Kane County Water Conservancy District's Cove Reservoir Project—Cultural Resources Review Memo, Indirect/Visual Areas of Potential Effect (APEs).* The United States Department of Agriculture's Natural Resources Conservation Service (NRCS), with the and Kane County Water Conservancy District (KCWCD) are proposing to construct the new Cove Reservoir within the existing Glendale, Mt. Carmel, and Orderville irrigation systems. This proposed reservoir would be located immediately southwest of Orderville, Utah, off Cove Road. Additional improvements would include the construction of approximately 1.5 miles of new pipeline, the Glendale hydroelectric power plant, and 0.2 mile of new power line and 0.7 acre of utility corridor along U.S. Highway 89 (US-89) and Cove Road; these improvements would be located west of US-89 and the East Fork of the Virgin River in Glendale, Utah. The Project also proposes the potential use of three previously disturbed borrow pits—Lambs Pit, Tait Pit, and Esplin Pit—for Project-related construction needs. These proposed actions constitute an undertaking under Section 106.

The NRCS is serving as the lead federal agency pursuant to 36 CFR 800.2. The Bureau of Land Management-Kanab Field Office (BLM), U.S. Army Corps of Engineers, Sacramento District (Corps), Environmental Protection Agency (EPA), National Park Service (NPS), and Utah Trust Land Administration (TLA) have been identified as cooperating agencies. The NRCS shall act on behalf of all agencies in fulfilling our collective responsibilities under Section 106, including delineation of the APE, identification of historic properties, and finding of effect. The NRCS will inform all cooperating agencies of Section 106 consultation. This consultation will also cover TLA's responsibilities under Utah Annotated Code Section 9-8-404.

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Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)

Anders Fillerup, NRCS, ASTC-Water Resources, Salt Lake City, Utah
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, Utah
Tara Hoffmann, NRCS, Water and Cultural Resources Specialist, Salt Lake City, Utah
Brandon Todd, NRCS, ASTC-Field Operations, Richfield, Utah
Kristi Westwood, NRCS, District Conservationist, Panguitch, Utah
Brian Storm, BLM, Archaeologist, Kanab, Utah
Kristine Curry, TLA, Archaeologist, Salt Lake City, Utah
Jason Gipson, Corps, Chief, Bountiful, Utah
Courtney Mackay, NPS, Archeologist, Springdale, Utah
Region 8, EPA, Denver, Colorado
Emily Paris, Eocene, Project Manager, Sparks, Nevada

Dr. Christopher Merritt
State Historic Preservation Officer
Department of Cultural and Community Engagement
3760 Highland Drive
Millcreek, Utah 84106

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

Dear Dr. Merritt:

The NRCS is continuing Section 106 consultation for the proposed Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (aka Cove Reservoir Project), in Kane County, Utah. Included in this submission are a literature review cultural resources memo titled *Kane County Water Conservancy District's Cove Reservoir Project—Cultural Resources Review Memo, Indirect/Visual Areas of Potential Effect (APEs)*. The United States Department of Agriculture's Natural Resources Conservation Service (NRCS), with the and Kane County Water Conservancy District (KCWCD) are proposing to construct the new Cove Reservoir within the existing Glendale, Mt. Carmel, and Orderville irrigation systems. This proposed reservoir would be located immediately southwest of Orderville, Utah, off Cove Road. Additional improvements would include the construction of approximately 1.5 miles of new pipeline, the Glendale hydroelectric power plant, and 0.2 mile of new power line and 0.7 acre of utility corridor along U.S. Highway 89 (US-89) and Cove Road; these improvements would be located west of US-89 and the East Fork of the Virgin River in Glendale, Utah. The Project also proposes the potential use of three previously disturbed borrow pits—Lambs Pit, Tait Pit, and Esplin Pit—for Project-related construction needs. These proposed actions constitute an undertaking under Section 106.

The NRCS is serving as the lead federal agency pursuant to 36 CFR 800.2. The Bureau of Land Management-Kanab Field Office (BLM), U.S. Army Corps of Engineers, Sacramento District (Corps), Environmental Protection Agency (EPA), National Park Service (NPS), and Utah Trust Land Administration (TLA) have been identified as cooperating agencies. The NRCS shall act on behalf of all agencies in fulfilling our collective responsibilities under Section 106, including delineation of the APE, identification of historic properties, and finding of effect. The NRCS will inform all cooperating agencies of Section 106 consultation. This consultation will also cover TLA's responsibilities under Utah Annotated Code Section 9-8-404.

NRCS initially consulted with your office in letters sent January 9, 2020 (U18TN0844), and again on January 23, 2023 (U21TN0840). Concurrence on site eligibility and a determination of ***adverse effect to historic properties*** for the undertaking was received on January 17, 2020, and February 6, 2023, respectively (Case Nos. 20-0121 and 23-0280). Additional consultation occurred for an expansion of the APE for a borrow source in a letter dated May 20, 2024 (U23TN0682). Concurrence was received on May 20, 2024 (Case No. 24-1261). Following these consultations, the NRCS has revised the Area of Potential Effects (APE) to include the Direct (Physical), Visual, and Indirect APEs.

Area of Potential Effects (APE) (36 CFR 800.4)

Table 1 summarizes the Direct, Visual, and Indirect APEs.

TABLE 1 TOTAL Area of Potential Effects (APE)				
Area of Potential Effect	**BLM**	**State**	**Private**	**Total**
Indirect APE Acreage (Inundation Areas)	17.05	0.51	990.41	**1,007.97**
Visual APE Acreage (1 Mile Buffer of Cove Reservoir and Facilities)	245.00	1,698.01	3,009.28	**4,952.29**
Direct (Physical) APE Acreage (Cove Reservoir, Pipes, Canals, Esplin Pit, Tait Pit, Lamb's Pit)	0.23	70.33	641.9	**712.46**

- **Direct (Physical) APE**: Includes all potential physical ground disturbance, including construction, staging, access roads, borrow sources, and necessary buffers. It has been refined to a total of 712.46 acres.
- **Visual APE**: A radius of 1 mile around the periphery of the proposed Cove Reservoir was evaluated for potential visual resources that could be impacted by the current construction of the reservoir. GIS viewshed analysis was used to refine the final boundaries of the Visual APE, and areas without potential visibility of the project were removed from the Visual APE.
- **Indirect APE:** Includes the breach inundation zones (Sunny-Day and Rainy-Day) in the unlikely event of a dam breach.

Identification of Historic Properties (36 CFR 800.4)

To identify historic properties within the APEs, a literature review was completed by Eocene Environmental. Personnel meet or exceed the Secretary of the Interior Standards in Archeology. The literature review identified 26 cultural resources, 14 of which are eligible for the National Register of Historic Place (NRHP), and one unevaluated, but treated as eligible, within the partially overlapping Direct, Indirect, and Visual APEs. Of the 15 historic properties, only one historic property 42KA7537 (prehistoric cave and artifact scatter) meets the site type criteria for inclusion in the visual impact assessment and therefore do not require a formal visual effects assessment. Site 42KA7537 is only located in the Direct APE and will be avoided (see Case No. 24-1261).

Within the overlapping APEs, there are nine historic buildings/structures of which five are eligible for the NRHP, two are undetermined (treated as eligible), one has been demolished, and the final is ineligible/non-contributing. Within the Visual APE there are three eligible buildings/structures (Property ID Nos., 32819, 50442, and 33219). These historic properties are in Orderville, and the proposed Cove Reservoir would be obstructed from view by means of several ridges southwest of Gardner Hollow.

Within the Indirect APE breach inundation zone, there are three historic properties: Mt. Carmel School and Church (Property ID No. 37252); Dixon, Maynard, House and Studio (Property ID No. 40479); and Steven's Barn

(Property ID No. 31786). Steven's Barn (Property ID NO. 31786) has likely been demolished. Due to distance, elevation, and the proposed reservoir safety features, these historic properties are unlikely to be adversely affected by the highly improbable failure of the proposed Cove Reservoir dam.

Finding of Effect (36 CFR 800.5)

The implementation of the undertaking will not alter the character-defining characteristics of the aforementioned historic properties that allow them to convey their significance since visual component is not the character-defining feature that makes the sites eligible. Therefore, the NRCS finding of effect for the Visual and Indirect APEs is No Adverse Effect. This results in no change to the finding of effect for the entirety of the undertaking, where the NRCS retains our previous determination of ***Adverse Effect to Historic Properties*** (Case No. 20-0121).

In an electronical transmittal on March 28, 2024, the NRCS notified the Advisory Council on Historic Preservation (Council) of the adverse effect determination by providing documentation specified in 36 CFR 800.11(e). The Council declined to participate in consultation in a letter dated April 20, 2024. Per 36 CFR 800.6, the NRCS is continuing consultation with your office, the Sponsors, agencies, applicable Native American tribes, and other consulting parties, to develop mitigation stipulations that will be executed in a Memorandum of Agreement. As the lead federal agency, the NRCS is informing the BLM, Corps, NPS, TLA, and EPA of ongoing Section 106 consultations. Per 36 CFR 800.4-800.5, the NRCS requests concurrence for the delineation of the APEs, identification of historic properties, and finding of effect. If you have any questions, comments, or concerns, please contact Tara S. Hoffmann, Water and Cultural Resources Specialist, at (385)-258-1266 at your convenience.

Sincerely,

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)

Anders Fillerup, NRCS, ASTC-Water Resources, Salt Lake City, Utah
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, Utah
Tara Hoffmann, NRCS, Water and Cultural Resources Specialist, Salt Lake City, Utah
Brandon Todd, NRCS, ASTC-Field Operations, Richfield, Utah
Kristi Westwood, NRCS, District Conservationist, Panguitch, Utah
Brian Storm, BLM, Archaeologist, Kanab, Utah
Kristine Curry, TLA, Archaeologist, Salt Lake City, Utah
Jason Gipson, Corps, Chief, Bountiful, Utah
Courtney Mackay, NPS, Archeologist, Springdale, Utah
Region 8, EPA, Denver, Colorado
Emily Paris, Eocene, Project Manager, Sparks, Nevada

Ms. Kristine Curry
Archaeologist
Trust Lands Administration
102 South 200 East, #600
Salt Lake City, Utah 84111

June 4, 2025

Reference: Continuation of Consultation for the Kane County Water Conservancy District's Cove Reservoir Project— Direct/Indirect/Visual Areas of Potential Effect

Dear Ms. Curry:

The NRCS is continuing Section 106 consultation for the proposed Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (aka Cove Reservoir Project), in Kane County, Utah. Included in this submission are a literature review cultural resources memo titled *Kane County Water Conservancy District's Cove Reservoir Project—Cultural Resources Review Memo, Indirect/Visual Areas of Potential Effect (APEs)*. The United States Department of Agriculture's Natural Resources Conservation Service (NRCS), with the and Kane County Water Conservancy District (KCWCD) are proposing to construct the new Cove Reservoir within the existing Glendale, Mt. Carmel, and Orderville irrigation systems. This proposed reservoir would be located immediately southwest of Orderville, Utah, off Cove Road. Additional improvements would include the construction of approximately 1.5 miles of new pipeline, the Glendale hydroelectric power plant, and 0.2 mile of new power line and 0.7 acre of utility corridor along U.S. Highway 89 (US-89) and Cove Road; these improvements would be located west of US-89 and the East Fork of the Virgin River in Glendale, Utah. The Project also proposes the potential use of three previously disturbed borrow pits—Lambs Pit, Tait Pit, and Esplin Pit—for Project-related construction needs. These proposed actions constitute an undertaking under Section 106.

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NRCS initially consulted with your office in letters sent January 9, 2020 (U18TN0844), and again on January 23, 2023 (U21TN0840). Concurrence on site eligibility and a determination of ***adverse effect to historic properties*** for the undertaking was received on January 17, 2020, and February 6, 2023, respectively (Case Nos. 20-0121 and 23-0280). Additional consultation occurred for an expansion of the APE for a borrow source in a letter dated May 20, 2024 (U23TN0682). Concurrence was received on May 20, 2024 (Case No. 24-1261). Following these consultations, the NRCS has revised the Area of Potential Effects (APE) to include the Direct (Physical), Visual, and Indirect APEs.

Area of Potential Effects (APE) (36 CFR 800.4)

Table 1 summarizes the Direct, Visual, and Indirect APEs.

TABLE 1 TOTAL Area of Potential Effects (APE)				
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- **Indirect APE:** Includes the breach inundation zones (Sunny-Day and Rainy-Day) in the unlikely event of a dam breach.

Identification of Historic Properties (36 CFR 800.4)

To identify historic properties within the APEs, a literature review was completed by Eocene Environmental. Personnel meet or exceed the Secretary of the Interior Standards in Archeology. The literature review identified 26 cultural resources, 14 of which are eligible for the National Register of Historic Place (NRHP), and one unevaluated, but treated as eligible, within the partially overlapping Direct, Indirect, and Visual APEs. Of the 15 historic properties, only one historic property 42KA7537 (prehistoric cave and artifact scatter) meets the site type criteria for inclusion in the visual impact assessment and therefore do not require a formal visual effects assessment. Site 42KA7537 is only located in the Direct APE and will be avoided (see Case No. 24-1261).

Within the overlapping APEs, there are nine historic buildings/structures of which five are eligible for the NRHP, two are undetermined (treated as eligible), one has been demolished, and the final is ineligible/non-contributing. Within the Visual APE there are three eligible buildings/structures (Property ID Nos., 32819, 50442, and 33219). These historic properties are in Orderville, and the proposed Cove Reservoir would be obstructed from view by means of several ridges southwest of Gardner Hollow.

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(Property ID No. 31786). Steven's Barn (Property ID NO. 31786) has likely been demolished. Due to distance, elevation, and the proposed reservoir safety features, these historic properties are unlikely to be adversely affected by the highly improbable failure of the proposed Cove Reservoir dam.

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Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure

cc: (w/o encl)

Anders Fillerup, NRCS, ASTC-Water Resources, Salt Lake City, Utah
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, Utah
Tara Hoffmann, NRCS, Water and Cultural Resources Specialist, Salt Lake City, Utah
Brandon Todd, NRCS, ASTC-Field Operations, Richfield, Utah
Kristi Westwood, NRCS, District Conservationist, Panguitch, Utah
Brian Storm, BLM, Archaeologist, Kanab, Utah
Kristine Curry, TLA, Archaeologist, Salt Lake City, Utah
Jason Gipson, Corps, Chief, Bountiful, Utah
Courtney Mackay, NPS, Archeologist, Springdale, Utah
Region 8, EPA, Denver, Colorado
Emily Paris, Eocene, Project Manager, Sparks, Nevada

From: Hoffmann, Tara - FPAC-NRCS, UT
To: "Hubner, Matt"; Gipson, Jason A CIV USARMY CESPK (USA)
Cc: Zack, Winston S CIV USARMY CESPA (USA); Storm, Brian P
Subject: RE: [External Email]RE: NRCS Cove East Fork Virgin River Draft Plan-EIS, updated Indirect APE Consultation
Date: Thursday, September 10, 2026 8:11:00 AM
Attachments: image002.png
image003.png

Thank you, Matt and Jason for your prompt replies. We will continue on with our planning process and keep you informed of any updates.

Best,
Tara

Tara S. Hoffmann
Water & Cultural Resources Specialist
NRCS Utah | Water Resources

U.S. DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service
125 S State St Rm 6416, Salt Lake City, UT, 84138
c: (385) 258-1266
tara.hoffmann@usda.gov | www.nrcs.usda.gov/ut

From: Hubner, Matt <hubner.matt@epa.gov>
Sent: Thursday, September 10, 2026 7:24 AM
To: Hoffmann, Tara - FPAC-NRCS, UT <tara.hoffmann@usda.gov>
Cc: Zack, Winston S CIV USARMY CESPA (USA) <Winston.S.Zack@usace.army.mil>; Storm, Brian P <bstorm@blm.gov>; Gipson, Jason A CIV USARMY CESPK (USA) <Jason.A.Gipson@usace.army.mil>
Subject: [External Email]RE: NRCS Cove East Fork Virgin River Draft Plan-EIS, updated Indirect APE Consultation

[External Email]
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Hi Tara,

Thank you for sending over the updated information and memo regarding the Indirect APE and the recent revisions to the breach inundation zones. After reviewing the materials, I wanted to let you know that we do not have a specific action to take regarding Section 106 at this time, and we don't have particular feedback on the APE. Please keep us informed of any further updates or if additional input is needed down the line.

Thanks again for sharing these details and for your continued coordination.

Best regards,

Matt

Matt Hubner
NEPA Branch
U.S. EPA, Region 8, 8EJC-NE
1595 Wynkoop Street
Denver, CO 80202-1129
Call me on Teams
p: (303) 312-6500 / f: (303) 312-7203

From: Gipson, Jason A CIV USARMY CESPK (USA) <Jason.A.Gipson@usace.army.mil>
Sent: Wednesday, September 9, 2026 3:28 PM
To: Hoffmann, Tara - FPAC-NRCS, UT <tara.hoffmann@usda.gov>
Cc: Hubner, Matt <hubner.matt@epa.gov>; Zack, Winston S CIV USARMY CESPA (USA) <Winston.S.Zack@usace.army.mil>; Storm, Brian P <bstorm@blm.gov>
Subject: RE: NRCS Cove East Fork Virgin River Draft Plan-EIS, updated Indirect APE Consultation

Caution: This email originated from outside EPA, please exercise additional caution when deciding whether to open attachments or click on provided links.

Tara,

Given the Corps very limited involvement/jurisdiction over the project elements, such as a few pipeline crossings of streams, I will defer to NRCS and have no objections to the updated indirect APE.

Jason Gipson
Chief, Utah Regulatory Section
US Army Corps of Engineers, Sacramento District
523 Heritage Park Blvd, Suite 1
Layton, Utah 84041-5611

Office: 385-303-9452
Mobile: 801-725-1275

How am I doing? Let my supervisor know at michael.g.nepstad@usace.army.mil



From: Hoffmann, Tara - FPAC-NRCS, UT <tara.hoffmann@usda.gov>
Sent: Wednesday, September 9, 2026 10:08 AM
To: Hubner, Matt <hubner.matt@epa.gov>; Zack, Winston S CIV USARMY CESPA (USA) <Winston.S.Zack@usace.army.mil>; Storm, Brian P <bstorm@blm.gov>
Cc: Gipson, Jason A CIV USARMY CESPK (USA) <Jason.A.Gipson@usace.army.mil>
Subject: [Non-DoD Source] NRCS Cove East Fork Virgin River Draft Plan-EIS, updated Indirect APE Consultation

Matt, Winston, and Brian,

The NRCS is continuing Section 106 consultation for the proposed Cove - East Fork of the Virgin River Draft Watershed Plan-EIS near Orderville, Utah (SPK-2020-00507). As part of the proposed project, the Cove Reservoir and dam would be constructed off channel near Orderville. The likelihood of a dam breach occurring is not a reasonably foreseeable effect given the adherence to Utah and NRCS Dam Safety Standards. However, in a good faith effort to consider all potential effects, the NRCS is including both breach inundation zones as part of the Indirect APE, and this analysis has been incorporated into the Draft Plan-EIS.

During the watershed planning process, the Sunny Day and Rainy-Day Breach Inundation Zones have recently been updated, and as such, NRCS has revised the Indirect APE, and identification of historic properties. See attached Memo. We initially consulted with your offices and 11 federally-recognized tribes regarding the original Indirect APE in emails dated June 4, 2025 (see attached). This updated Memo describes the revised Sunny Day and Rainy-Day Breach Inundation Zones in the improbable event of a dam breach, and the identification of historic properties. All other APEs remain unchanged. I have attached shapefiles of the breach inundation zones.

The NRCS retains our previous finding of No Adverse Effect for the Indirect APE given that the likelihood of a breach is not reasonably foreseeable and the historic properties present within the Indirect APE are far enough in distance from the dam that the depth and velocity of water is within the limits of a current 100-year flood event. Of note, we are also in consultation with Zion National Park regarding the updated Indirect APE.

Please let us know if you concur with the updated Indirect APE, identification of historic properties and finding of effect within 15 days of receipt. Feel free to reach out with any questions, comments, or concerns.

Thanks,
Tara

Tara S. Hoffmann
Water & Cultural Resources Specialist
NRCS Utah | Water Resources

U.S. DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service
125 S State St Rm 6416, Salt Lake City, UT, 84138
c: (385) 258-1266
tara.hoffmann@usda.gov | www.nrcs.usda.gov/ut

From: Dempsey, Erin C.
To: Hoffmann, Tara - FPAC-NRCS, UT
Cc: Mackay, Courtney E; Jeff_Bradybaugh@nps.gov
Subject: Re: [EXTERNAL] RE: Cove Reservoir EIS-Parunuweap Canyon Archaeological District GIS layer
Date: Tuesday, September 1, 2026 12:32:14 PM
Attachments: image001.png
image002.png

Thank you, Tara! Courtney and her team are working on a response for you. We'll be in touch soon.

Erin

—
Erin Dempsey, PhD
Division Lead, Resource Management and Research
Division Lead, Interpretation and Visitor Services (Acting)
Zion National Park
Office: 435-772-0188
Cell: 347-215-4789

From: Hoffmann, Tara - FPAC-NRCS, UT <tara.hoffmann@usda.gov>
Sent: Tuesday, September 1, 2026 12:06 PM
To: Dempsey, Erin C. <Erin_Dempsey@nps.gov>
Cc: Mackay, Courtney E <Courtney_Mackay@nps.gov>; Bradybaugh, Jeffrey S <Jeff_Bradybaugh@nps.gov>
Subject: RE: [EXTERNAL] RE: Cove Reservoir EIS-Parunuweap Canyon Archaeological District GIS layer

Erin,

Answer to your question regarding the data used for the models, it was USGS 10M obtained from UGRC.

Thanks,
Tara

Tara S. Hoffmann
Water & Cultural Resources Specialist
NRCS Utah | Water Resources

U.S. DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service
125 S State St Rm 6416, Salt Lake City, UT, 84138
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tara.hoffmann@usda.gov | www.nrcs.usda.gov/ut

From: Hoffmann, Tara - FPAC-NRCS, UT

Sent: Thursday, August 27, 2026 10:26 AM
To: 'Dempsey, Erin C.' <Erin_Dempsey@nps.gov>
Cc: Mackay, Courtney E <Courtney_Mackay@nps.gov>; Jeff_Bradybaugh@nps.gov
Subject: RE: [EXTERNAL] RE: Cove Reservoir EIS-Parunuweap Canyon Archaeological District GIS layer

Hi Erin,

Attached is a depth and velocity raster file- this should have all the data. Let me know if you have any additional questions.

Thanks!
Tara

Tara S. Hoffmann
Water & Cultural Resources Specialist
NRCS Utah | Water Resources

U.S. DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service
125 S State St Rm 6416, Salt Lake City, UT, 84138
c: (385) 258-1266
tara.hoffmann@usda.gov | www.nrcs.usda.gov/ut

From: Dempsey, Erin C. <Erin_Dempsey@nps.gov>
Sent: Wednesday, August 26, 2026 2:52 PM
To: Hoffmann, Tara - FPAC-NRCS, UT <tara.hoffmann@usda.gov>
Cc: Mackay, Courtney E <Courtney_Mackay@nps.gov>; Jeff_Bradybaugh@nps.gov
Subject: Re: [EXTERNAL] RE: Cove Reservoir EIS-Parunuweap Canyon Archaeological District GIS layer

Hi Tara,

Thanks for following up on our questions so quickly. We like to take you up on the offer of depth and velocity GIS data. That will help us with one of our questions about discharge calculations throughout the East Fork corridor in Zion. Also, could you tell us what data was used to create the base layers in the model? (3DEP, USGS topos, etc.).

Thanks again,
Erin

—
Erin Dempsey, PhD
Division Lead, Resource Management and Research
Division Lead, Interpretation and Visitor Services (Acting)
Zion National Park

Office: 435-772-0188
Cell: 347-215-4789

From: Hoffmann, Tara - FPAC-NRCS, UT <tara.hoffmann@usda.gov>
Sent: Wednesday, August 26, 2026 9:17 AM
To: Bradybaugh, Jeffrey S <Jeff_Bradybaugh@nps.gov>
Cc: Dempsey, Erin C. <Erin_Dempsey@nps.gov>; Mackay, Courtney E <Courtney_Mackay@nps.gov>
Subject: [EXTERNAL] RE: Cove Reservoir EIS-Parunuweap Canyon Archaeological District GIS layer

This email has been received from outside of DOI - Use caution before clicking on links, opening attachments, or responding.

Jeff,

In follow-up to my previous email, both the rainy day and sunny day inundation boundaries are at or below the typical 100-year floodplain boundary, and the likelihood of a dam breach is not a reasonably foresee. I've re-attached the rainy day boundary in case you have issues with the previous attachment.

If you'd like more detail in terms of depth/velocity, the engineers said they can pull together a shapefile with that information by the end of the week. Let me know ASAP and we can gather that data.

Best,
Tara

Tara S. Hoffmann
Water & Cultural Resources Specialist
NRCS Utah | Water Resources

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Natural Resources Conservation Service
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tara.hoffmann@usda.gov | www.nrcs.usda.gov/ut

From: Hoffmann, Tara - FPAC-NRCS, UT
Sent: Tuesday, August 25, 2026 2:28 PM
To: 'Bradybaugh, Jeffrey S' <Jeff_Bradybaugh@nps.gov>
Cc: Dempsey, Erin C. <Erin_Dempsey@nps.gov>; Mackay, Courtney E <Courtney_Mackay@nps.gov>
Subject: RE: Cove Reservoir EIS-Parunuweap Canyon Archaeological District GIS layer

Hi Jeff,

The public wouldn't have any access to a map of the Parunuweap Archeological District. The memo will be included in Appendix E of the Draft Plan-EIS but without any sensitive locational information. We really only need the GIS data for analysis purposes, and no map would be added to the memo. We'd share the GIS data with Jennifer Bannick at Eocene, she'd add a brief discussion of the district to the memo, and then the GIS data can be deleted.

I've reached out to the engineers to get the water depths within Parunuweap Canyon in the unlikely event of a dam failure. I'm also attaching shapefiles that show the inundation areas on a sunny-day and rainy-day breach. Let me know if you have any issues opening these. Maps of these inundation areas are also located in Appendix E of the updated Preliminary Draft Plan-EIS, though less informative given the scale. I'd recommend starting on page E-51.

Best,
Tara

Tara S. Hoffmann
Water & Cultural Resources Specialist
NRCS Utah | Water Resources

USDA U.S. DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service
125 S State St Rm 6416, Salt Lake City, UT, 84138
c: (385) 258-1266
tara.hoffmann@usda.gov | www.nrcs.usda.gov/ut

From: Bradybaugh, Jeffrey S <Jeff_Bradybaugh@nps.gov>
Sent: Tuesday, August 25, 2026 1:19 PM
To: Hoffmann, Tara - FPAC-NRCS, UT <tara.hoffmann@usda.gov>
Cc: Dempsey, Erin C. <Erin_Dempsey@nps.gov>; Mackay, Courtney E <Courtney_Mackay@nps.gov>
Subject: Re: Cove Reservoir EIS-Parunuweap Canyon Archaeological District GIS layer

Hello Tara,

Thank you for sharing the Cove Reservoir Cultural Resources Review Memo with us. We appreciate that the analysis takes into account potential impact to NPS resources.

Could you tell us what level of public access, if at all, the Parunuweap Archeological District map would have? For example, would this memo be included as an appendix to the EIS that is released for public comment? We are open to sharing a GIS shapefile for NRCS analysis purposes, but archeological site data is protected on Federal lands, and we have concerns with it becoming public information.

Also, to concur with NRCS's finding of No Adverse Effect, we need to understand the potential impacts on our resources from a dam failure. Do you have documentation/mapping showing potential water levels in Parunuweap Canyon?

Jeff Bradybaugh (he/him)
Superintendent
Zion National Park
State Highway Route 9
Springdale, UT 84767
phone: 435-772-0140
e-mail: jeff_bradybaugh@nps.gov

"Optimism is true moral courage"
Sir Ernest Shackleton, 1874-1922
shipwrecked Antarctic Explorer

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From: Hoffmann, Tara - FPAC-NRCS, UT <tara.hoffmann@usda.gov>
Sent: Monday, August 24, 2026 12:43 PM
To: Mackay, Courtney E <Courtney_Mackay@nps.gov>
Subject: [EXTERNAL] Cove Reservoir EIS-Parunuweap Canyon Archaeological District GIS layer

This email has been received from outside of DOI - Use caution before clicking on links, opening attachments, or responding.

Hello Courtney,

The NRCS, in partnership with the Kane County Water Conservancy District is has drafted the Cove Reservoir East Fork of the Virgin River Watershed Plan-EIS in Kane and Washington Counties. As part of this Watershed Plan-EIS, a recently updated Cultural Resources desktop review (see attached memo, with comments) of the Rainy/Sunny Day breach analyses of the proposed earthen dam have been completed, and the indirect breach inundation zones pass through Zion National Park. The dam itself would be in Orderville, and the likelihood of a dam breach is extremely low; given the distance from the dam to the park, the increase water levels and water velocity through Parunuweap Canyon would have dissipated drastically.

As a result of the desktop review, Eocene identified 9 historic properties (42WS1158, 1160, 1793, 2795, 2796, 2799, 2809, 3344, 6242 (in progress recording)) within the Sunny and/or Rainy Day breach inundation APEs that are within the park. I have attached the draft cultural report memo. Of these, 1158, 1160, and 1793 are within the Parunuweap Canyon Archaeological District.

After reviewing the memo, I realized it failed to mention the Archaeological District since it isn't in Sego- do you have a GIS shapefile of it that I can share with Eocene?

NRCS, as lead federal agency, has conducted previous consultations, but this is the first instance the indirect APE crosses the park. Given the distance of the dam to the historic properties in the park, the high unlikelihood of a breach due to NRCS and Utah Dam Safety Requirements, we are proposing a *No Adverse Effect determination*. Please let me know if the NPS concurs with this determination for the Indirect Breach Inundation Zone APEs **by August 31, 2026.** Eocene also sent the complete updated Preliminary Draft Watershed Plan-EIS to Jeff Bradybaugh, Robyn Henderek, and Erin Dempsey (minus this cultural resources memo) on 8/18/2026.

Thank you!
Tara

Tara S. Hoffmann
Water & Cultural Resources Specialist
NRCS Utah | Water Resources

U.S. DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service
125 S State St Rm 6416, Salt Lake City, UT, 84138
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From: Hoffmann, Tara - FPAC-NRCS, UT
To: Hubner, Matt; Winston.S.Zack@usace.army.mil; Storm, Brian P
Cc: jason.a.gipson
Subject: NRCS Cove East Fork Virgin River Draft Plan-EIS, updated Indirect APE Consultation
Date: Wednesday, September 9, 2026 10:07:00 AM
Attachments: image001.png
Cove Indirect APE_CR-Memo.pdf
CoveAPE_106Emails20250604.pdf
357-24 Rainy Day Inundation Boundary.zip
357-24 Sunny Day Inundation Boundary.zip

Matt, Winston, and Brian,

The NRCS is continuing Section 106 consultation for the proposed Cove - East Fork of the Virgin River Draft Watershed Plan-EIS near Orderville, Utah (SPK-2020-00507). As part of the proposed project, the Cove Reservoir and dam would be constructed off channel near Orderville. The likelihood of a dam breach occurring is not a reasonably foreseeable effect given the adherence to Utah and NRCS Dam Safety Standards. However, in a good faith effort to consider all potential effects, the NRCS is including both breach inundation zones as part of the Indirect APE, and this analysis has been incorporated into the Draft Plan-EIS.

During the watershed planning process, the Sunny Day and Rainy-Day Breach Inundation Zones have recently been updated, and as such, NRCS has revised the Indirect APE, and identification of historic properties. See attached Memo. We initially consulted with your offices and 11 federally-recognized tribes regarding the original Indirect APE in emails dated June 4, 2025 (see attached). This updated Memo describes the revised Sunny Day and Rainy-Day Breach Inundation Zones in the improbable event of a dam breach, and the identification of historic properties. All other APEs remain unchanged. I have attached shapefiles of the breach inundation zones.

The NRCS retains our previous finding of No Adverse Effect for the Indirect APE given that the likelihood of a breach is not reasonably foreseeable and the historic properties present within the Indirect APE are far enough in distance from the dam that the depth and velocity of water is within the limits of a current 100-year flood event. Of note, we are also in consultation with Zion National Park regarding the updated Indirect APE.

Please let us know if you concur with the updated Indirect APE, identification of historic properties and finding of effect within 15 days of receipt. Feel free to reach out with any questions, comments, or concerns.

Thanks,
Tara

Tara S. Hoffmann
Water & Cultural Resources Specialist
NRCS Utah | Water Resources

U.S. DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service
125 S State St Rm 6416, Salt Lake City, UT, 84138
c: (385) 258-1266
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Tribal Correspondence Table

Federally Recognized Tribe	Contact Name *(Job Title)*	Address	Plan EA Scoping Letter Date	Plan EA Response	Plan EA First CRIR	Plan EA Response *(Date)*	Plan-EA NOA	Plan EA Response	Plan-EIS Scoping Letter Date	Plan-EIS Response	Plan-EIS NOI	Plan-EIS Response	Plan-EIS Second CRIR	Plan-EIS Response	Plan-EIS Third CRIR	Plan-EIS Response	Follow Up (Date)	Response
Hopi Tribe	Timothy L. Nuvangyoma *(current Chairman)*	P.O. Box 123 Kykotsmovi, AZ 86039	May 23, 2018	No Response	Jan 9, 2020	No Response	Nov 20, 2020	No Response	Jan 14, 2022	No Response	May 3, 2022	No Response	Jan 23, 2023	No Response	May 22, 2024	No Response	Email June 4, 2025	None.
	Leigh Kuwanwisiwma *(former Director)*	P.O. Box 123 Kykotsmovi, AZ 86039	May 23, 2018	No Response	Jan 9, 2020	Response via THPO.	Nov 20, 2020	No Response	-	-	-	-	-	-	-	-	-	-
	Stewart B. Koyiyumptewa *(current Director/THPO)*	P.O. Box 123 Kykotsmovi, Arizona 86039	-	-	-	Concur with determinations of eligibility *(Jan 28, 2020)*-	Nov 20, 2020	Request for copies of CRIRs, draft EAs, and copies of proposed treatment plans. Request to withdraw EA application and prepare EIS instead *(Dec 7, 2020)*; Acknowledgement of receival of copies of the CRIR and SHPO concurrence and request to conduct full EIS *(Jan 4, 2021)*	Jan 14, 2022	Request for hard copies of all CRIRs and proposed treatment plans *(Feb 7, 2022)*	May 3, 2022	No Response	Jan 23, 2023	No Response	May 22, 2024	No Response	Email June 4, 2025	None.
Hualapai Tribe*	Damon R. Clarke *(former Chairman)*	P.O. Box 179 941 Hualapai Way Peach Springs, AZ 86434	May 23, 2018	No Response	Jan 9, 2020	No Response	Nov 20, 2020	No Response	-	-	-	-	-	-	-	-	-	-

Federally Recognized Tribe	Contact Name *(Job Title)*	Address	Plan EA Scoping Letter Date	Plan EA Response	Plan EA First CRIR	Plan EA Response *(Date)*	Plan-EA NOA	Plan EA Response	Plan-EIS Scoping Letter Date	Plan-EIS Response	Plan-EIS NOI	Plan-EIS Response	Plan-EIS Second CRIR	Plan-EIS Response	Plan-EIS Third CRIR	Plan-EIS Response	Follow Up (Date)	Response
	Dawn Hubbs *(former Program Manager)*	P.O. Box 310 941 Hualapai Way Peach Springs, AZ 86434	May 23, 2018	No Response	Jan 9, 2020	No Response	Nov 20, 2020	No Response	-	-	-	-	-	-	-	-	-	-
Kaibab Band of Paiute Indians of the Kaibab Indian Reservation	Ona Segundo *(former Chairwoman)*	HC65, Box 2 Fredonia, AZ 86022	May 23, 2018	No Response	Jan 9, 2020	No Response	Nov 20, 2020	No Response	Jan 14, 2022	No Response	May 3, 2022	No Response	Jan 23, 2023	No Response	-	-	-	-
	Charley Bullets *(former Cultural Resources Director)*	HC65, Box 3 Fredonia, AZ 86022	May 23, 2018	No Response	Jan 9, 2020	No comments *(Jan 16, 2019)*	-	-	-	-	-	-	-	-	-	-	-	-
	Daniel Bullets *(current Cultural Resources Director)*	HC65, Box 2 Fredonia, Arizona 86022	-	-	-	-	Nov 20, 2020	Phone conversation with NRCS *(Dec 7, 2020)*	Jan 14, 2022	No Response	May 3, 2022	No Response	Jan 23, 2023	No Response	May 22, 2024	Statement of no questions or comments about the project *(May 24, 2024)*	Email June 4, 2025	None.
	Roland Maldonado *(current Chairman)*	HC65, Box 2 Fredonia, Arizona 86022	-	-	-	-	-	-	-	-	-	-	-	-	May 22, 2024	No Response	Email June 4, 2025	None.
Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony	Benny Tso *(current Chairman)*	One Paiute Drive Las Vegas, NV 89106	May 23, 2018	No Response	Jan 9, 2020	No Response	Nov 20, 2020	No Response	-	-	-	-	Jan 23, 2023	No Response	-	-	Email June 4, 2025	None.
	Curtis Anderson *(former Chairman)*	One Paiute Drive Las Vegas, Nevada 89106	-	-	-	-	-	-	Jan 14, 2022	No Response	May 3, 2022	No Response	-	-	-	-	-	-

Federally Recognized Tribe	Contact Name *(Job Title)*	Address	Plan EA Scoping Letter Date	Plan EA Response	Plan EA First CRIR	Plan EA Response *(Date)*	Plan-EA NOA	Plan EA Response	Plan-EIS Scoping Letter Date	Plan-EIS Response	Plan-EIS NOI	Plan-EIS Response	Plan-EIS Second CRIR	Plan-EIS Response	Plan-EIS Third CRIR	Plan-EIS Response	Follow Up (Date)	Response
	Deryn Pete *(former Chairwoman)*	One Paiute Drive Las Vegas, Nevada 89106	-	-	-	-	-	-	-	-	-	-	-	-	May 22, 2024	No Response	-	-
	Ila Yazzie *(former Vice Chairwoman)*	One Paiute Drive Las Vegas, Nevada 89106	-	-	-	-	-	-	-	-	-	-	-	-	May 22, 2024	No Response	Email June 4, 2025	None.
Moapa Band of Paiute Indians of the Moapa River Indian	Greg Anderson *(former Chairman)*	P.O. Box 340 Moapa, NV 89025-0340	May 23, 2018	No Response	Jan 9, 2020	No Response	Nov 20, 2020	No Response	-	-	-	-	-	-	-	-	-	-
	Darren Daboda *(current THPO)*	P.O. Box 341 Moapa, NV 89025-0340	May 23, 2018	No Response	-	-	Nov 20, 2020	No Response	-	-	May 3, 2022	No Response	Jan 23, 2023	No Response	May 22, 2024	No Response	Emails June 4, 5 &18 , 2025; Phone June 5, 2025	June 5, 2025 email regarding potential auditory effects. NRCS left voicemails on June 10 and 20, 2025 and February 12 and August 24, 2026. NRCS left emails on June 18 and July 15, 2025, and August 24, 2026. No responses received.
	Mario Monroe (*current Chairman)*	P.O. Box 341 Moapa, NV 89025-0340															Email June 4, 2025	None.

Federally Recognized Tribe	Contact Name *(Job Title)*	Address	Plan EA Scoping Letter Date	Plan EA Response	Plan EA First CRIR	Plan EA Response *(Date)*	Plan-EA NOA	Plan EA Response	Plan-EIS Scoping Letter Date	Plan-EIS Response	Plan-EIS NOI	Plan-EIS Response	Plan-EIS Second CRIR	Plan-EIS Response	Plan-EIS Third CRIR	Plan-EIS Response	Follow Up (Date)	Response
	Laura Parry *(former Chairwoman)*	P.O. Box 340 Moapa, Nevada 89025-0340	-	-	-	-	-	-	Jan 14, 2022	No Response	May 3, 2022	No Response	Jan 23, 2023	-	-	-	-	-
	Shanandoah Anderson *(former Cultural Manager)*	P.O. Box 340 Moapa, Nevada 89025-0340	-	-	-	-	-	-	Jan 14, 2022	Statement of no questions or comments concerning the project *(March 31, 2022)*	May 3, 2022	No Response	Jan 23, 2023	No Response	-	-	-	-
	Vickie Simmons *(current Council Secretary)*	P.O. Box 340 Moapa, Nevada 89025-0340	-	-	-	-	-	-	-	-	-	-	-	-	May 22, 2024	No Response	-	-
Navajo Nation	Russell Begaye *(former President)*	100 parkway P.O. Box 7440 Window Rock, AZ 86515	May 23, 2018	No Response	Jan 9, 2020	No Response	-	-	-	-	-	-	-	-	-	-	-	-
	Richard M. Begay *(current THPO/ Department Manager)*	P.O. Box 4950 Window Rock, AZ 86515	May 23, 2018	No Response	-	-	Nov 20, 2020	No Response	-	-	-	-	Jan 23, 2023	No Response	May 22, 2024	No Response	June 5, 2025	None.
	Jonathan Nez *(former President)*	P.O. Box 7440 Window Rock, Arizona 86515	-	-	-	-	Nov 20, 2020	No Response	Jan 14, 2022	No Response	May 3, 2022	No Response	-	-	-	-	-	-

Federally Recognized Tribe	Contact Name *(Job Title)*	Address	Plan EA Scoping Letter Date	Plan EA Response	Plan EA First CRIR	Plan EA Response *(Date)*	Plan-EA NOA	Plan EA Response	Plan-EIS Scoping Letter Date	Plan-EIS Response	Plan-EIS NOI	Plan-EIS Response	Plan-EIS Second CRIR	Plan-EIS Response	Plan-EIS Third CRIR	Plan-EIS Response	Follow Up (Date)	Response
	Timothy C. Begay *(Cultural Specialist)*	P.O. Box 4950 Window Rock, AZ 86515	-	-	-	-	-	Determination of no Navajo TCPs within the project area and no concerns with the project *(Dec 4, 2020)*	-	-	-	-	-	-	-	-	-	-
	Buu Nygren *(current President)*	P.O. Box 7440 Window Rock, Arizona 86515	-	-	-	-	-	-	-	-	-	-	Jan 23, 2023	No Response	May 22, 2024	No Response	June 5, 2025	None.
Paiute Indian Tribe of Utah	Tamra Borchardt-Slayton *(former Chairperson)*	440 North Paiute Drive Cedar City, UT 84720	May 23, 2018	No Response	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Laurel Yellowhorse (*current Chairperson)*	440 North Paiute Drive Cedar City, UT 84720	-	-	-	-											Email June 4, 2025	None.
	Dorena Martineau *(former Cultural Resources Manager)*	440 North Paiute Drive Cedar City, UT 84720	May 23, 2018	No Response	Jan 9, 2020	Concur with determination of eligibility and effort for the project *(Jan 21, 2020)*	Nov 20, 2020	No Response	Jan 14, 2022	No Response	May 3, 2022	No Response	Jan 23, 2023	No Response	-	-	-	-
	Autumn Gillard *(current Cultural Resources Manager)*	440 North Paiute Drive Cedar City, UT 84720	-	-	-	-	-	-	-	-	-	-	-	-	May 22, 2024	No Response	Email June 4, 2025	None.

Federally Recognized Tribe	Contact Name *(Job Title)*	Address	Plan EA Scoping Letter Date	Plan EA Response	Plan EA First CRIR	Plan EA Response *(Date)*	Plan-EA NOA	Plan EA Response	Plan-EIS Scoping Letter Date	Plan-EIS Response	Plan-EIS NOI	Plan-EIS Response	Plan-EIS Second CRIR	Plan-EIS Response	Plan-EIS Third CRIR	Plan-EIS Response	Follow Up (Date)	Response
Pueblo of Zuni	Val Panteah Sr. *(former Governor)*	P.O. Box 339 Zuni, NM 87327	May 23, 2018	No Response	Jan 9, 2020	No Response	Nov 20, 2020	No Response	Jan 14, 2022	No Response	May 3, 2022	No Response	Jan 23, 2023	No Response	-	-	-	-
	Kurt Dongaske *(current Director/THPO)*	P.O. Box 1149 Zuni, New Mexico 87327	-	-	Jan 9, 2020	No Response	Nov 20, 2020	No Response	Jan 14, 2022	No Response	May 3, 2022	No Response	Jan 23, 2023	No Response	May 22, 2024	No Response	Email June 4, 2025	None.
	Arden Kucate *(current Governor)*	P.O. Box 339 Zuni, New Mexico 87327	-	-	-	-	-	-	-	-	-	-	-	-	May 22, 2024	No Response	Email June 4, 2025	None.
San Juan Southern Paiute Tribe of Arizona	Carlene Yellowhair *(current President)*	50 South Main Street, Suite 201 P.O. Box 2950 Tuba City, AZ 86045	May 23, 2018	No Response	Jan 9, 2020	No Response	Nov 20, 2020	No Response	Jan 14, 2022	No Response	May 3, 2022	No Response	-	-	-	-	Email June 4, 2025	None.
	Johnny Lehi, Jr. *(current Vice President)*	50 South Main Street, Suite 201 P.O. Box 2950 Tuba City, AZ 86045	-	-	-	-	-	-	-	-	-	-	Jan 23, 2023	No Response	-	-	Email June 4, 2025	None.
	Robbin Preston, Jr. *(former President)*	50 South Main Street, Suite 201 P.O. Box 2950 Tuba City, AZ 86045	-	-	-	-	-	-	-	-	-	-	-	-	May 22, 2024	No Response	-	-
Ute Indian Tribe of the Uintah & Ouray	Luke Duncan *(former Chairman)*	P.O Box 190 Fort Duchesne, UT 84026	May 23, 2018	No Response	Jan 9, 2020	No Response	Nov 20, 2020	No Response	Jan 14, 2022	No Response	May 3, 2022	No Response	Jan 23, 2023	No Response	-	-	-	-

Federally Recognized Tribe	Contact Name *(Job Title)*	Address	Plan EA Scoping Letter Date	Plan EA Response	Plan EA First CRIR	Plan EA Response *(Date)*	Plan-EA NOA	Plan EA Response	Plan-EIS Scoping Letter Date	Plan-EIS Response	Plan-EIS NOI	Plan-EIS Response	Plan-EIS Second CRIR	Plan-EIS Response	Plan-EIS Third CRIR	Plan-EIS Response	Follow Up (Date)	Response
Reservation	Betsy Chapoose *(current THPO)*	P.O Box 190 Fort Duchesne, UT 84026	May 23, 2018	No Response	Jan 9, 2020	No Response	Nov 20, 2020	No Response	Jan 14, 2022	No Response	May 3, 2022	No Response	Jan 23, 2023	No Response	May 22, 2024	No Response	Email June 4, 2025	None.
	Julius Murray *(current Chairman)*	P.O Box 190 Fort Duchesne, UT 84026	-	-	-	-	-	-	-	-	-	-	-	-	May 22, 2024	No Response	Email June 4, 2025	None.
	Luana Thompson *(current Natural Resource Director)*	P.O Box 190 Fort Duchesne, UT 84026	-	-	-	-	-	-	-	-	-	-	-	-	May 22, 2024	No Response	Email June 4, 2025	None.
Ute Mountain Ute Tribe	Harold Cuthair *(former Chairman)*	P.O. Box JJ 125 Mikewash Road Towac, CO 81334	May 23, 2018	No Response	Jan 9, 2020	No Response	Nov 20, 2020	No Response	-	-	-	-	-	-	-	-	-	-
	Terry Knight *(former THPO)*	P.O. Box 468 Towac, CO 81334	May 23, 2018	No Response	Jan 9, 2020	No Response	Nov 20, 2020	No Response	Jan 14, 2022	No Response	May 3, 2022	No Response	Jan 23, 2023	No Response	May 22, 2024	No Response	-	-
	Nichol Shurack *(former Assistant THPO)*	P.O. Box 468 Towac, CO 81334	May 23, 2018	No Response	-	-	Nov 20, 2020	No Response	-	-	-	-	Jan 23, 2023	No Response	-	-	-	-
	Manuel Heart *(current Chairman)*	P.O. Box JJ 125 Mikewash Road Towac, Colorado 81334	-	-	-	-	-	-	Jan 14, 2022	No Response	May 3, 2022	No Response	Jan 23, 2023	No Response	May 22, 2024	No Response	Email June 4, 2025	None.

Federally Recognized Tribe	Contact Name *(Job Title)*	Address	Plan EA Scoping Letter Date	Plan EA Response	Plan EA First CRIR	Plan EA Response *(Date)*	Plan-EA NOA	Plan EA Response	Plan-EIS Scoping Letter Date	Plan-EIS Response	Plan-EIS NOI	Plan-EIS Response	Plan-EIS Second CRIR	Plan-EIS Response	Plan-EIS Third CRIR	Plan-EIS Response	Follow Up (Date)	Response
	Jacinthe Messier *(current THPO)*	P.O. Box 468 131 West Mikewash Road Towac, Colorado 81334	-	-	-	-	-	-	-	-	-	-	-	-	May 22, 2024	No Response	Email June 4, 2025	None.
White Mesa, Ute Council	Elaine Cantsee *(former Council Representative)*	P.O. Box 7096 White Mesa, UT 84511	May 23, 2018	No Response	Jan 9, 2020	No Response	Nov 20, 2020	No Response	-	-	-	-	-	-	-	-	-	-
	Malcolm Lehi *(current Council Representative)*	P.O. Box 7096 White Mesa, Utah 84511	-	-	-	-	-	-	Jan 14, 2022	No Response	May 3, 2022	No Response	Jan 23, 2023	No Response	May 22, 2024	No Response	Email June 4, 2025	None.

- Hualapai Tribe notified the NRCS via phone on March 1, 2021, that they no longer want to be consulted on undertakings in southern Utah.

ACHP Correspondence

From:	Hoffmann, Tara - FPAC-NRCS, UT
To:	e106
Cc:	Seibert, Erika - FPAC-NRCS, DC; Carrig, Charles - FPAC-NRCS, AR; Alexis Clark
Subject:	Utah NRCS Notification of Adverse Effects- Cove Reservoir
Date:	Thursday, March 28, 2024 12:08:00 PM
Attachments:	e106_CoveReservoir_Utah.docx CoveReservoir_Consultation.pdf U18TN0544.pdf U21TN0840.pdf U23TN0682.pdf

Good Afternoon,

Per 36 CFR 800.6(a)(1), attached is notification of adverse effects to two historic properties as a result of the proposed Cove-East Fork Virgin River Supplemental Watershed Plan-EIS, Kane County, Utah. Also included is current Section 106 consultation between NRCS, SHPO, cooperating agencies, and applicable tribes, and cultural resources reports.

Thank you,
Tara

Tara S. Hoffmann, MA
State Watershed Cultural Resources Specialist/Tribal Liaison
Natural Resources Conservation Service
Salt Lake City, UT
O: 801-524-4556 C: 385-258-1266

Advisory Council on Historic Preservation
Electronic Section 106 Documentation Submittal System (e106) Form
MS Word format

Send to: *e106@achp.gov*

Please review the instructions at www.achp.gov/e106-email-form prior to completing this form. Questions about whether to use the e106 form should be directed to the assigned ACHP staff member in the Office of Federal Agency Programs.

I. Basic information

1. **Purpose of notification.** Indicate whether this documentation is to:
   - ☒ Notify the ACHP of a finding that an undertaking may adversely affect historic properties
   - ☐ Invite the ACHP to participate in a Section 106 consultation
   - ☐ Propose to develop a project Programmatic Agreement (project PA) for complex or multiple undertakings in accordance with 36 C.F.R. 800.14(b)(3)
   - ☐ Supply additional documentation for a case already entered into the ACHP record system
   - ☐ File an executed MOA or PA with the ACHP in accordance with 800.6(b)(iv) (where the ACHP did not participate in consultation)
   - ☐ Other, please describe
     Click here to enter text.

2. ACHP Project Number (If the ACHP was previously notified of the undertaking and an ACHP Project Number has been provided, enter project number here and skip to Item 7 below): Click here to enter text.

3. **Name of federal agency** (If multiple agencies, list them all and indicate whether one is the lead agency):

   Natural Resources Conservation Service (NRCS) is the lead agency. The Bureau of Land Management (BLM), Kanab Field Office is a cooperating agency.

4. **Name of undertaking/project** (Include project/permit/application number if applicable):

   Cove-East Fork Virgin River Supplemental Watershed Plan-EIS, Kane County, UT

5. **Location of undertaking** (Indicate city(s), county(s), state(s), land ownership, and whether it would occur on or affect historic properties located on tribal lands):

   Near Orderville in Kane County, Utah. Located on private lands and public lands administered by the, Bureau of Land Management (BLM), Kanab Field Office, the Utah School and Institutional Trust Lands Administration (SITLA), and Utah Department of Transportation. No tribal land is involved.

6. **Name and title of federal agency official and contact person for this undertaking**, including email address and phone number:

Tara Hoffmann, MA
State Watershed Cultural Resources Specialist
Salt Lake City, Utah
Tara.hoffmann@usda.gov
385-258-1266

II. Information on the Undertaking*

7. Describe the undertaking and nature of federal involvement (if multiple federal agencies are involved, specify involvement of each):

The Natural Resources Conservation Service (NRCS) is providing technical and financial assistance through the Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566 Stat. 666 as amended [16 U.S.C. Section 1001 et. Seq.]) 1954, as amended, to the Kane County Water Conservancy District (KCWCD), as the Project Sponsor, to is to increase and maintain a reliable supply of water for local agricultural use and existing storage needs, increase water conservation, and improve water delivery efficiency in the Upper Virgin Watershed in Kane County, Utah, and for existing and future water demands in Washington County, Utah. As part of the NEPA process, project alternatives are currently being analyzed. Proposed improvements within the two action alternatives include constructing a reservoir, installation of a pipeline to carry water, the Glendale, Utah hydroelectric plant the piping of the Mt. Carmel irrigation ditches to increase efficiency, and seven borrow sources.

To evaluate the potential project alternatives and assess the environmental impacts of the project, a Watershed Plan and Environmental Impact Statement (EIS) is being prepared by Jones and DeMille Engineering, on behalf of the NRCS, in cooperation with KCWCD and the BLM.

8. Describe the Area of Potential Effects (APE):

Per 36 CFR 800.16(d), the APE encompasses a total of 868.98, which includes multiple discontiguous parcels. The APE includes all proposed construction locations, staging, access roads, borrow sources, and necessary buffers around each element. The parcels occur on public lands administered by the BLM (152.29 acres) and SITLA (70.34 acres). The remaining 646.35 acres of the project area occurs on private land.

9. Describe steps taken to identify historic properties:

Per 36 CFR 800.4, three intensive cultural resources inventoried were conducted by Transcon Environmental to identify historic properties that could be affected by the undertaking (U18TH0544, U21TN0840, and U23TN0682). Please refer to the attached reports for detailed information on these inventories. Survey methodology accepted by the Utah State Historic Preservation Officer (SHPO), the BLM and NRCS was followed. The surveys were completed between 2018 and 2023 under the auspices of State of Utah Public Lands Policy Archaeological Survey Permit No. 167, and State of Utah Antiquities Permit (Survey) Nos. U18TN0544, U21TN0840, and U23TN0682. The APE was surveyed by the archaeologists walking parallel transects spaced no more than 15 m (49 ft) apart.

10. Describe the historic property (or properties) and any National Historic Landmarks within the APE (or attach documentation or provide specific link to this information):

See attached cultural resources reports for detailed historic property information. Summary is below.

As part of the cultural resources inventory for U18TN0544, Table 1 summarizes the historic properties identified.

TABLE 1
U18TN0544 Historic Properties

Site Number	Site Description	Eligibility	Effects
42KA6331	Prehistoric lithic scatter	Eligible—D	*No Adverse Effect to Historic Properties* if the site is avoided. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.
42KA8785	Prehistoric artifact scatter	Eligible – D	*No Adverse Effect to Historic Properties* if the site is avoided. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.
42KA8904	Prehistoric ceramic, lithic, and FCR scatter	Eligible—D	*No Adverse Effect to Historic Properties* if the site is avoided. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.
42KA8974	Prehistoric artifact scatter	Eligible—D	*No Adverse Effect to Historic Properties* if the site is avoided. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.

Table 2 summarizes the historic properties identified during the U21TN0840 inventory.

TABLE 2
U21TN0840 Historic Properties

Site No.	Site Description	Eligibility	Effects	Project Design Impacts	Site Protective or Avoidance Measures
42KA1157	Prehistoric artifact scatter	Eligible—D	*No Adverse Effect*	Installation of new buried pipe along the northeast portion of the site.	None; the portion of the site within the Project APE is heavily disturbed by previous road construction/maintenance, plowing, livestock and a sewer line, it has also been previously tested and is non-contributing to the overall eligibility of the site.
42KA9490 (FS-01)	Historic ditch (*Mount Carmel Irrigation Ditch– West Ditch*)	Eligible—A, C, D	***Adverse Effect***	The open ditch will be converted to buried pipe.	An inadvertent discovery plan will be prepared, as well as a MOA with associated Historic Properties Treatment Plan to mitigate the adverse effects to the site.
42KA9491 (FS-02)	Historic ditch (*Mount Carmel Irrigation Ditch– East Ditch*)	Eligible—A, D	***Adverse Effect***	The open ditch will be converted to buried pipe.	An inadvertent discovery plan will be prepared, as well as a MOA with associated Historic Properties Treatment Plan to mitigate the adverse effects to the site.

Continued.

Table 3 summarizes the historic properties identified as a result of the U23TN0682 inventory.

TABLE 3
U23TN0682 Historic Properties

Site Number	Site Description	Eligibility	Protective Measures
42KA7537	Prehistoric cave and artifact scatter (*Kanab Creek Cave*)	Eligible—D	Avoid all ground disturbing activities within 15 meters of the site boundary; a cultural monitor must be present during all ground disturbance within 15 meters of the site boundary, and avoidance flagging must be placed 15 meters from the site boundary prior to any construction activities near the site area.
42KA9789	Prehistoric artifact scatter	Eligible—D	Avoid all ground disturbing activities within 15 meters of the site boundary; a cultural monitor must be present during all ground disturbance within 15 meters of the site boundary, and avoidance flagging must be placed 15 meters from the site boundary prior to any construction activities near the site area.

11. Describe the undertaking's effects on historic properties:

Per Table 2, the Mt. Carmel East and West Irrigation Ditches (Sites 42KA9490 and 9491) will be converted from open ditch to pipe as part of the proposed undertaking. The NRCS, in consultation with the Utah SHPO and consulting tribes, determined that this would result in an Adverse Effect, per 36CFR800.5. All other project components will result in No Adverse Effect to Historic Properties. Refer to attached consultation letters and cultural resources reports for detailed information.

12. Explain how this undertaking would adversely affect historic properties (include information on any conditions or future actions known to date to avoid, minimize, or mitigate adverse effects):

Per Table 2, Mt. Carmel East and West Irrigation Ditches (Sites 42KA9490 and 9491) will be converted from open ditch to pipe as part of the proposed undertaking. The piping of the ditches will result in direct damage to those aspects of integrity that contribute to each site's NRHP eligibility. As such, the NRCS, in consultation with the Utah SHPO and consulting tribes, determined that this would result in an Adverse Effect, per 36CFR800.5.

The NRCS is currently developing mitigation stipulations and is in consultation with the Utah SHPO, the project Sponsor, and other consulting parties in drafting mitigation strategies and developing a Memorandum of Agreement (MOA).

13. Provide copies or summaries of the views provided to date by any consulting parties, Indian tribes or Native Hawai'ian organizations, or the public, including any correspondence from the SHPO and/or THPO.

See attached consultation correspondence between the NRCS, SHPO, BLM, and Tribes, documenting all consultation to date. Due to tribal and public feedback, the project was elevated from a Supplemental Plan-EA to a Plan-EIS in 2022. Consultation for U23TN0682 is forthcoming. The Plan-EIS is still in development.

III. Additional Information

14. Please indicate the status of any consultation that has occurred to date, including whether there are any unresolved concerns or issues the ACHP should know about in deciding whether to

participate in consultation. Providing a list of consulting parties, including email addresses and phone numbers if known, can facilitate the ACHP's review response.

Concurrent with the National Environmental Policy Act scoping period for the Supplemental Plan-EA, and as part of Section 106 of the NHPA, Executive Order 13007, 13175, and the AIRFA, the NRCS reached out to the Ute Tribe of the Uintah and Ouray Reservation, Paiute Indian Tribe of Utah, Kaibab Band of Paiute Indians, Moapa Band of Paiute Indians of the Moapa River Indian Nation, the Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony, the Hopi Tribe, Navajo Nation, Pueblo of Zuni, San Juan Southern Paiute Tribe of Arizona, White Mesa, Ute Council, Hualapai Tribe, and the Ute Mountain Ute. The tribal scoping letters were sent in letters dated May 23, 2018. No responses were received.

Tribal consultation was also conducted to announce the Notice of Availability of the Draft Supplemental Plan-EA in letters dated November 20, 2020. The Navajo Nation responded in an email on December 4, 2020 indicating no presence of TCPs and that NRCS may proceed without further consultation. The Hopi Tribe responded in a letter dated December 8, 2020 with concerns regarding preparation of an EA, and a request to conduct a full EIS. The NRCS spoke off-the-record with the Hopi Tribe on December 14, 2020 via telephone regarding the project. The NRCS formally responded to the Hopi Tribe in a letter dated December 15, 2020 indicating that if deemed necessary after additional environmental review, an EIS would be prepared in accordance with the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) at 40 CFR Part 1501.3. The Hopi Tribe responded to the NRCS in a letter dated January 4, 2021 acknowledging receipt of cultural resources report U18TN0544, and reiterating the necessity of an EIS analysis.

Consultation letters for U18TN0544, with a determination of No Adverse Effect, were sent on January 9, 2020 to the Utah SHPO, the BLM, the US Army Corps of Engineers, and the aforementioned tribes. Concurrence on site eligibility and project effects was received from the Paiute Tribe on January 28, 2020, and from the Hopi Tribe on February 3, 2020. The Utah SHPO concurred on project effects and site eligibility in a letter dated January 17, 2020. The Hopi Tribe concurred with the determination of effect in a letter dated January 4, 2021.

Based on tribal and other public controversy, the NRCS determined that an EIS was necessary in 2022. A Notice of Intent (NOI) for the preparation of the Plan-EIS was sent to the same tribes in a letter dated January 11, 2022. The NOI letter requested any information tribes would like to share with NRCS regarding historic properties or places of traditional religious and cultural importance near the proposed project area that we should consider as part of our analysis. The Hopi Tribe responded in a letter dated February 7, 2022 with no objection to the Plan-EIS, and requesting hard copies of cultural resources report and draft-EIS for review and comment.

The NRCS consulted with the Utah SHPO and the aforementioned tribes on U21TN0840 in a letter dated January 23, 2023. U21TN0840 resulted in a determination of Adverse Effects to Historic Properties, as a result of the proposed conversion from open ditch to pipe for historic properties 42KA9490 and 9491. The Utah SHPO concurred with the Adverse Effect determination and site eligibility in a letter dated February 6, 2023. No tribal responses were received.

U23TN0682 covered a supplemental survey area for an additional borrow source. Consultation for that report is forthcoming.

To resolve the adverse effects to 42KA9490 and 42KA9491, the NRCS is currently drafting mitigation stipulations and is in active consultation with the Utah SHPO. Draft mitigation stipulations proposed include drone flyovers, aerial photographs, a Story Map, and interpretive brochure. There are no unresolved concerns in relation to the proposed undertaking.

15. Does your agency have a website or website link where the interested public can find out about this project and/or provide comments? Please provide relevant links:

This is the general project information website. We are currently not in a public comment period. The draft Plan-EIS is scheduled to be available for public comment in winter 2024.

Cove-East Fork Virgin River Watershed

16. Is this undertaking considered a "major" or "covered" project listed on the Federal Infrastructure Projects Permitting Dashboard? If so, please provide the link:

No.

The following are attached to this form (check all that apply):

☒ Section 106 consultation correspondence

☐ Maps, photographs, drawings, and/or plans

☐ Additional historic property information

☐ Consulting party list with known contact information

☒ Other: Cultural Resources Reports with maps

From:	Office of Federal Agency Programs
To:	Hoffmann, Tara - FPAC-NRCS, UT
Cc:	Maxwell Sickler; bstorm@blm.gov; cmerritt@utah.gov; hollis.g.jencks@usace.army.mil; Stewart Koyiyumptewa
Subject:	[External Email]Cove-East Fork Virgin River Supplemental Watershed Plan, Orderville, Kane County, Utah, ACHP Project Number: 020755
Date:	Friday, April 12, 2024 8:51:53 AM
Attachments:	Cove-East Fork Virgin River Supplemental Watershed Plan.20240412.np.pdf

You don't often get email from ofap@achp.gov. Learn why this is important

[External Email]
If this message comes from an **unexpected sender** or references a **vague/unexpected topic;**
Use caution before clicking links or opening attachments.
Please send any concerns or suspicious messages to: Spam.Abuse@usda.gov

From: Office of Federal Agency Programs

Advisory Council on Historic Preservation

Attached is our letter on the subject undertaking (in Adobe Acrobat PDF format)

If you have any questions concerning our letter, please contact

Max Sickler
202-517-0220
msickler@achp.gov
Case # 020755
***e*106**-online section 106 documentation submittal system
now available to all federal agencies
http://www.achp.gov/work106.html

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MEMORANDUM OF AGREEMENT
AMONG
THE UTAH NATURAL RESOURCES CONSERVATION SERVICE,
UTAH STATE HISTORIC PRESERVATION OFFICER,
THE KANE COUNTY WATER CONSERVANCY DISTRICT,
MOUNT PLEASANT IRRIGATION COMPANY,
AND U.S. ARMY CORPS OF ENGINEERS, SACRAMENTO DISTRICT
REGARDING
MITIGATION OF ADVERSE EFFECTS TO
THE MOUNT CARMEL IRRIGATION COMPANY- WEST AND EAST DITCHES
(42KA9490 and 42KA9491)
KANE COUNTY, UTAH

WHEREAS, the Utah Natural Resources Conservation Service (NRCS) is providing technical and financial assistance to the Kane County Water Conservancy District (Sponsor) through the Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566 Stat. 666 as amended [16 U.S.C. Section 1001 et. Seq.]) 1954 to construct a new dam and improve water management infrastructure within the East Fork Virgin River Watershed, located north of Orderville, Utah (hereafter referred to as the "Project"); and

WHEREAS, the NRCS has determined that the Project is an undertaking subject to review under Section 106 of the National Historic Preservation Act (NHPA), 54 U.S.C. §305108, and its implementing regulations, 36 C.F.R. 800; and

WHEREAS, the Sponsor will apply for, and the United States Army Corps of Engineers, Sacramento District (Corps), proposes to issue a permit pursuant to Section 404 of the Clean Water Act (33 U.S.C. § 1344) for the Project; and

WHEREAS, the NRCS, as the lead Federal agency under Section 106 of the National Historic Preservation Act, as amended (54 U.S.C. § 306108) will consult on the Corps behalf; and

WHEREAS, the Sponsor is supporting the Mount Carmel Irrigation Company in their efforts to manage agricultural water; and

WHEREAS, the NRCS has defined the Project's Direct Area of Potential Effects (APE) as 375.1-acres, consisting of 0.23 acres of lands administered by the Bureau of Land Management (BLM)-Kanab Field Office, 0.67 acres of Utah Trust Lands Administration (TLA) lands, and 374.2 acres of private land composed of multiple polygons, which encompasses all potential ground disturbance including construction areas, access roads, staging areas, borrow sources, and necessary buffers; and

WHEREAS, three intensive cultural resources inventories to identify historic properties within the APE have been completed, as required by 36 C.F.R. 800, by Eocene Environmental Group (Utah Division of State Historic Project Nos U18TN0554, U21TN0840, and U23TN0682); and

WHEREAS, the NRCS and the Utah State Historic Preservation Office (SHPO) agree that the historic Mt. Carmel Irrigation Company- West Ditch (42KA9490), and the Mt. Carmel Irrigation Company- East Ditch (42KA9491), located on private land, are eligible for inclusion in the National Register of Historic Places (NRHP) under Criteria A,C, and D (42KA9490 and Criteria A and D (42KA9491) ; and

WHEREAS, the NRCS has determined that the Project will result in adverse effects to the two historic ditches due to the conversion from open earthen ditch to enclosed pressurized pipe; and

WHEREAS, the NRCS has consulted with the Utah State Historic Preservation Office (SHPO), BLM, TLA, the Corps, Utah Department of Transportation, Kaibab Band of Paiute Indians, Moapa Band of Paiute Indians, Las Vegas Tribe of Paiute Indians, Navajo Nation, Paiute Indian Tribe of Utah, Pueblo of Zuni, San Juan Southern Paiute Tribe, Hopi Tribe, Ute Mountain Ute Tribe, Ute Indian Tribe of the Uintah and Ouray Reservation, regarding the effects of the Project on historic properties; and

WHEREAS, the BLM, TLA, the Corps, Kaibab Band of Paiute Indians, Moapa Band of Paiute Indians, Las Vegas Tribe of Paiute Indians, Navajo Nation, Paiute Indian Tribe of Utah, Pueblo of Zuni, San Juan Southern Paiute Tribe, Hopi Tribe, Ute Mountain Ute Tribe, Ute Indian Tribe of the Uintah and Ouray Reservation declined or failed to respond to further participation in the development of this MOA; and

WHEREAS, the SHPO, Corps, the Sponsor, and the Mount Carmel Irrigation Company have agreed to participate in the development of the MOA; and

WHEREAS, in accordance with 36 CFR § 800.6(a)(1), the NRCS notified the Advisory Council on Historic Preservation (ACHP) of its adverse effect determination, with specified documentation, in a letter dated March 28, 2024, and the ACHP responded in a letter dated April 12, 2024, stating they have chosen not to participate in the consultation pursuant to 36 CFR § 800.6(a)(1)(iii; and

WHEREAS, "Signatories" hereafter collectively refers to the required (NRCS and SHPO), invited (Mount Carmel Irrigation Company), and concurring party (Corps); and

WHEREAS, other parties may be invited to become signatories to this MOA if such a party agrees to these terms; and

NOW, THEREFORE, the Signatories agree that upon NRCS's decision to proceed with the Project, the NRCS shall ensure that the following stipulations are implemented in order to resolve the adverse effects of the Project on historic properties, and that these stipulations shall govern the Project and all of its parts until this MOA expires or is terminated.

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STIPULATIONS

The NRCS shall ensure that the following measures are carried out:

I. PROFESSIONAL QUALIFICATIONS

A. All tasks will be completed by personnel meeting the Secretary of the Interior's Standards and Guidelines for Archeology and Architectural History as stated in 36 C.F.R. 61.

B. All tasks will be completed according to specifications consistent with the Secretary of Interior's *Standards and Guidelines for Archeological and Historical Documentation* and, where appropriate, guidelines required by the SHPO and NRCS.

II. MITIGATION OF ARCHAEOLOGICAL RESOURCES

A. The NRCS shall ensure the mitigation measures outlined below are completed. Draft and final documentation shall be submitted to the NRCS for review and approval.

1. Historical context of the East and West Mount Carmel Irrigation Ditches in relation to their involvement in the early settlement of the region; and

2. Prior to Project construction, an aerial video recording of the entire length of the canals, where permitted, including aerial photos at select structures; and

3. Updated Utah Archaeology Site Forms, including re-evaluation of the canals' eligibility to the NRHP after completion of Project construction, submitted to SHPO with formal determinations; and

4. ArcGIS Story Map website to be hosted by the SHPO.

B. When all required pre-construction mitigation measures are complete and approved by the NRCS and SHPO, the NRCS shall notify the Sponsor in writing that the Project may be implemented.

III. DURATION

This MOA will expire if its terms are not carried out within five (5) years from the date of its execution. Prior to such time, the NRCS may consult with the other signatories to reconsider the terms of the MOA and amend it in accordance with Stipulation VI below.

IV. UNANTICIPATED DISCOVERIES

A. In the event of an unanticipated archaeological discovery during construction, the NRCS shall follow procedures outlined in the Prototype Programmatic Agreement with the Utah SHPO. If significant discoveries requiring longer-term work stoppage for consultation and mitigation are encountered, the NRCS will consult per 36 C.F.R.

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800.6 to develop a plan to further mitigate the adverse effect.

B. If human remains are discovered on private land, the remains will be treated in accordance with Utah Code Title 9 Chapter 8a Part 3, Section 309 (UT Code 9-8a-309). All activity shall cease in the area, immediately notify local law enforcement and the landowner. If human remains are discovered on BLM-administered land, they will be treated in accordance with the requirements of the Native American Graves Protection and Repatriation Act (NAGPRA) (25 U.S.C. 3001 et seq.) and its implementing regulations (43 C.F.R. 10 All construction activities within 100 feet of the remains shall cease immediately and the NRCS shall consult pursuant to 43 C.F.R. 10.5, to develop a written plan of action to manage the discovery. Construction in the area of the remains may need to be halted throughout the review process. Continuation of work following a discovery will be contingent upon approval by the NRCS in consultation with the SHPO, applicable tribes, and other consulting parties that the approved plan has been satisfactorily completed.

V. DISPUTE RESOLUTION

A. Should any Signatory or concurring party to this MOA object at any time to any actions proposed or the manner in which the terms of this MOA are implemented, the NRCS shall consult with such party to resolve the objection. If the NRCS determines that such objection cannot be resolved, the NRCS will:

1. Forward all documentation relevant to the dispute, including the NRCS's proposed resolution, to the ACHP. The ACHP shall provide the NRCS with its advice on the resolution of the objection within thirty (30) days of receiving adequate documentation. Prior to reaching a final decision on the dispute, the NRCS shall prepare a written response that takes into account any timely advice or comments regarding the dispute from the ACHP and the Signatories and provide them with a copy of this written response. The NRCS will then proceed according to its final decision.

2. If the ACHP does not provide its advice regarding the dispute within the thirty (30) day-time-period, the NRCS may make a final decision on the dispute and proceed accordingly. Prior to reaching such a final decision, the NRCS shall prepare a written response that takes into account any timely comments regarding the dispute from the Signatories to the MOA and provide them and the ACHP with a copy of such written response.

3. It will be the responsibility of the NRCS to carry out all other actions subject to the terms of this MOA that are not the subject of the dispute.

VI. AMENDMENTS

This MOA may be amended when such an amendment is agreed to in writing by all Signatories. The amendment will be effective on the date a copy signed by all of the Signatories is filed with the ACHP.

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VII. COORDINATION WITH OTHER ACTIONS

Other state or federal agencies that provide permitting or financial assistance to an undertaking covered by this MOA may satisfy their own compliance responsibilities under Section 106 of the NHPA by accepting and complying with the terms of this MOA. Other parties may have their actions covered by this MOA if they agree to its terms. Agencies shall notify the NRCS and the Utah SHPO in writing of the intent to adhere to this MOA.

VIII. TERMINATION

A. If any signatory to this MOA determines that its terms will not or cannot be carried out, that party shall immediately consult with the other signatories to attempt to develop an amendment per Stipulation VIII, above. If within thirty (30) days (or another time period agreed to by all signatories) an amendment cannot be reached, any signatory may terminate the MOA upon written notification to the other signatories.

B. Once the MOA is terminated, and prior to work continuing on the undertaking, NRCS must either (a) execute an MOA pursuant to 36 CFR § 800.6 or (b) request, take into account, and respond to the comments of the ACHP under 36 CFR § 800.7. The NRCS shall notify the signatories as to the course of action it will pursue.

VIII. USDA STIPULATIONS

A. The signatories to this agreement and their respective agencies will handle their own activities and utilize their own resources, including the expenditure of their own funds, in pursuing these objectives. Each party will carry out its separate activities in a coordinated and mutually beneficial manner.

B. Any transfer of funds from one party to another shall be done via a separate instrument as appropriate. Specific work projects or activities that involve the transfer of funds, services, or property among the signatories, and their respective agencies will require execution of separate agreements and be contingent upon the availability of appropriated funds. Negotiation, execution, and administration of each such agreement must comply with all applicable statutes and regulations.

Execution of this MOA by the NRCS and Signatories, and its submission to the ACHP in accordance with 36 C.F.R. 800.6(b)(1)(iv), shall, pursuant to 36 C.F.R. 800.6(c), be considered to be an agreement with the ACHP for the purposes of Section 110(l) of the NHPA. Execution and submission of this MOA, and implementation of its terms, evidence that the NRCS has afforded the ACHP an opportunity to comment on the Project and its effects on historic properties, and that the NRCS has taken into account the effects of the Project on historic properties.

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SIGNATORY PAGE

MEMORANDUM OF AGREEMENT
AMONG
THE UTAH NATURAL RESOURCES CONSERVATION SERVICE,
UTAH STATE HISTORIC PRESERVATION OFFICER,
THE KANE COUNTY WATER CONSERVANCY DISTRICT,
MOUNT PLEASANT IRRIGATION COMPANY,
AND U.S. ARMY CORPS OF ENGINEERS, SACRAMENTO DISTRICT
REGARDING
MITIGATION OF ADVERSE EFFECTS TO
THE MOUNT CARMEL IRRIGATION COMPANY- WEST AND EAST DITCHES
(42KA9490 and 42KA9491)
KANE COUNTY, UTAH

NATURAL RESOURCES CONSERVATION SERVICE

_____ Date:_____
Arelys Ortiz, Acting Utah State Conservationist

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SIGNATORY PAGE

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THE MOUNT CARMEL IRRIGATION COMPANY- WEST AND EAST DITCHES
(42KA9490 and 42KA9491)
KANE COUNTY, UTAH

UTAH STATE HISTORIC PRESERVATION OFFICE

_____ Date:_____
Dr. Chris Merritt, State Historic Preservation Officer

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INVITED SIGNATORY PAGE

MEMORANDUM OF AGREEMENT
AMONG
THE UTAH NATURAL RESOURCES CONSERVATION SERVICE,
UTAH STATE HISTORIC PRESERVATION OFFICER,
THE KANE COUNTY WATER CONSERVANCY DISTRICT,
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REGARDING
MITIGATION OF ADVERSE EFFECTS TO
THE MOUNT CARMEL IRRIGATION COMPANY- WEST AND EAST DITCHES
(42KA9490 and 42KA9491)
KANE COUNTY, UTAH

KANE COUNTY WATER CONSERVANCY DISTRICT

_____ Date:_____
Mike Noel, Executive Director

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CONCURRING PARTY SIGNATORY PAGE

MEMORANDUM OF AGREEMENT
AMONG
THE UTAH NATURAL RESOURCES CONSERVATION SERVICE,
UTAH STATE HISTORIC PRESERVATION OFFICER,
THE KANE COUNTY WATER CONSERVANCY DISTRICT,
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MITIGATION OF ADVERSE EFFECTS TO
THE MOUNT CARMEL IRRIGATION COMPANY- WEST AND EAST DITCHES
(42KA9490 and 42KA9491)
KANE COUNTY, UTAH

MOUNT CARMEL IRRIGATION COMPANY

_____ Date:_____
John Reese, President

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CONCURRING PARTY SIGNATORY PAGE

MEMORANDUM OF AGREEMENT
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THE UTAH NATURAL RESOURCES CONSERVATION SERVICE,
UTAH STATE HISTORIC PRESERVATION OFFICER,
THE KANE COUNTY WATER CONSERVANCY DISTRICT,
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MITIGATION OF ADVERSE EFFECTS TO
THE MOUNT CARMEL IRRIGATION COMPANY- WEST AND EAST DITCHES
(42KA9490 and 42KA9491)
KANE COUNTY, UTAH

U.S. ARMY CORPS OF ENGINEERS, SACRAMENTO DISTRICT

_____ Date:_____
Jason Gipson, Chief, Utah Regulatory Section

DRAFT

NEPA Tribal Consultation

Draft Plan-EA Tribal Scoping

May 23, 2018

Luke Duncan
Chairman
Ute Indian Tribe of the Uintah & Ouray Reservation, Utah
P.O. Box 190
Fort Duchesne, UT 84026

RE: Cove Reservoir Watershed Plan-EA Project

Dear Mr. / Ms. Luke Duncan:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with the Kane County Water Conservancy District (KCWCD) as the project sponsor, is considering proposed improvements within the East Fork Virgin River Watershed in Kane County, Utah. Improvements under consideration will address water conservation concerns, agricultural and municipal demands, public safety risks, and will enhance aquatic species habitat and increase opportunities for public recreation. See the enclosed Project Fact Sheet for information about project features.

In cooperation with KCWCD, USDA-NRCS is in the very early planning stages of preparing an Environmental Assessment (EA) under the National Environmental Policy Act (NEPA) to consider and analyze potential impacts from the action. For the purposes of compliance with NEPA and Section 106 of the NHPA, USDA-NRCS is the designated lead agency. Pursuant to Section 106 of the National Historic Preservation Act (NHPA), Executive Order 13007, the American Indian Religious Freedom Act, we write to you at this time regarding the project and we welcome any information you would like to share with us regarding historic properties or places of traditional religious and cultural importance near the proposed project area that we should consider as part of our analysis. We would also appreciate your assistance in identifying any other tribes with whom we should consult on this project.

We look forward to hearing from and working with you on this important project. We welcome your call if you have questions on the proposed project or if you wish to arrange a meeting or initiate government-to-government consultation regarding this project. Please respond to our request within 30 days of receipt of this letter.

If you have any questions, comments, or concerns please contact Tara S. Hoffmann, Acting State Cultural Resources Specialist at 720-591-8051 or email at tara.hoffmann@co.usda.gov or Shelley A. Szeghi, Area Cultural Resources Specialist, at 801-629-0575 ext. 104 or email at shelley.szeghi@ut.usda.gov.

We look forward to receiving your comments and discussing this project further.

Sincerely,

TIMOTHY WILSON
NRCS State Conservationist

Encl: Project Fact Sheet, including map

cc:

Tara S. Hoffmann, Acting State Cultural Resources Specialist, Salt Lake City, UT
Shelley A. Szeghi, NRCS, Area Cultural Resources Specialist, Ogden, UT
Norm Evenstad, NRCS, Water Resources Coordinator, Salt Lake City, UT
Nicle Dunlap, Transcon Environmental, Project Manager, Berkeley, CA
Brian Parker, Transcon Environmental, Project Manager, Mesa, AZ

May 23, 2018

Betsy Chapoose
Director
Cultural Rights Protection Department
Ute Indian Tribe of the Uintah & Ouray Reservation, Utah
P.O. Box 190
Fort Duchesne, UT 84026

RE: Cove Reservoir Watershed Plan-EA Project

Dear Mr. / Ms. Betsy Chapoose:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with the Kane County Water Conservancy District (KCWCD) as the project sponsor, is considering proposed improvements within the East Fork Virgin River Watershed in Kane County, Utah. Improvements under consideration will address water conservation concerns, agricultural and municipal demands, public safety risks, and will enhance aquatic species habitat and increase opportunities for public recreation. See the enclosed Project Fact Sheet for information about project features.

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We look forward to hearing from and working with you on this important project. We welcome your call if you have questions on the proposed project or if you wish to arrange a meeting or initiate government-to-government consultation regarding this project. Please respond to our request within 30 days of receipt of this letter.

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We look forward to receiving your comments and discussing this project further.

Sincerely,

TIMOTHY WILSON
NRCS State Conservationist

Encl: Project Fact Sheet, including map

cc:

Tara S. Hoffmann, Acting State Cultural Resources Specialist, Salt Lake City, UT
Shelley A. Szeghi, NRCS, Area Cultural Resources Specialist, Ogden, UT
Norm Evenstad, NRCS, Water Resources Coordinator, Salt Lake City, UT
Nicle Dunlap, Transcon Environmental, Project Manager, Berkeley, CA
Brian Parker, Transcon Environmental, Project Manager, Mesa, AZ

May 23, 2018

Tamra Borchardt-Slayton
Chairperson
Paiute Indian Tribe of Utah
440 North Paiute Drive
Cedar City, UT 84720-2613

RE: Cove Reservoir Watershed Plan-EA Project

Dear Mr. / Ms. Tamra Borchardt-Slayton:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with the Kane County Water Conservancy District (KCWCD) as the project sponsor, is considering proposed improvements within the East Fork Virgin River Watershed in Kane County, Utah. Improvements under consideration will address water conservation concerns, agricultural and municipal demands, public safety risks, and will enhance aquatic species habitat and increase opportunities for public recreation. See the enclosed Project Fact Sheet for information about project features.

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We look forward to receiving your comments and discussing this project further.

Sincerely,

TIMOTHY WILSON
NRCS State Conservationist

Encl: Project Fact Sheet, including map

cc:

Tara S. Hoffmann, Acting State Cultural Resources Specialist, Salt Lake City, UT
Shelley A. Szeghi, NRCS, Area Cultural Resources Specialist, Ogden, UT
Norm Evenstad, NRCS, Water Resources Coordinator, Salt Lake City, UT
Nicle Dunlap, Transcon Environmental, Project Manager, Berkeley, CA
Brian Parker, Transcon Environmental, Project Manager, Mesa, AZ

May 23, 2018

Dorena Martineau
Paiute Indian Tribe of Utah
440 North Paiute Drive
Cedar City, UT 84720

RE: Cove Reservoir Watershed Plan-EA Project

Dear Mr. / Ms. Dorena Martineau:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with the Kane County Water Conservancy District (KCWCD) as the project sponsor, is considering proposed improvements within the East Fork Virgin River Watershed in Kane County, Utah. Improvements under consideration will address water conservation concerns, agricultural and municipal demands, public safety risks, and will enhance aquatic species habitat and increase opportunities for public recreation. See the enclosed Project Fact Sheet for information about project features.

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NRCS State Conservationist

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Nicle Dunlap, Transcon Environmental, Project Manager, Berkeley, CA
Brian Parker, Transcon Environmental, Project Manager, Mesa, AZ

May 23, 2018

Ona Segundo
Chairwoman
Tribal Affairs Building
Kaibab Band of Paiute Indians of the Kaibab Indian Reservation
HC65, Box 2
Fredonia, AZ 86022

RE: Cove Reservoir Watershed Plan-EA Project

Dear Mr. / Ms. Ona Segundo:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with the Kane County Water Conservancy District (KCWCD) as the project sponsor, is considering proposed improvements within the East Fork Virgin River Watershed in Kane County, Utah. Improvements under consideration will address water conservation concerns, agricultural and municipal demands, public safety risks, and will enhance aquatic species habitat and increase opportunities for public recreation. See the enclosed Project Fact Sheet for information about project features.

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NRCS State Conservationist

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Nicle Dunlap, Transcon Environmental, Project Manager, Berkeley, CA
Brian Parker, Transcon Environmental, Project Manager, Mesa, AZ

May 23, 2018

Charley Bullets
Southern Paiute Consortium
Cultural Preservation Office
Kaibab Band of Paiute Indians of the Kaibab Indian Reservation
HC65, Box 3
Fredonia, AZ 86022

RE: Cove Reservoir Watershed Plan-EA Project

Dear Mr. / Ms. Charley Bullets:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with the Kane County Water Conservancy District (KCWCD) as the project sponsor, is considering proposed improvements within the East Fork Virgin River Watershed in Kane County, Utah. Improvements under consideration will address water conservation concerns, agricultural and municipal demands, public safety risks, and will enhance aquatic species habitat and increase opportunities for public recreation. See the enclosed Project Fact Sheet for information about project features.

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We look forward to receiving your comments and discussing this project further.

Sincerely,

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NRCS State Conservationist

Encl: Project Fact Sheet, including map

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Brian Parker, Transcon Environmental, Project Manager, Mesa, AZ

May 23, 2018

Greg Anderson
Chairman
Reservation, Nevada
Moapa Band of Paiute Indians of the Moapa River Indian
P.O. Box 340
Moapa, NV 89025-0340

RE: Cove Reservoir Watershed Plan-EA Project

Dear Mr. / Ms. Greg Anderson:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with the Kane County Water Conservancy District (KCWCD) as the project sponsor, is considering proposed improvements within the East Fork Virgin River Watershed in Kane County, Utah. Improvements under consideration will address water conservation concerns, agricultural and municipal demands, public safety risks, and will enhance aquatic species habitat and increase opportunities for public recreation. See the enclosed Project Fact Sheet for information about project features.

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Sincerely,

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NRCS State Conservationist

Encl: Project Fact Sheet, including map

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Nicle Dunlap, Transcon Environmental, Project Manager, Berkeley, CA
Brian Parker, Transcon Environmental, Project Manager, Mesa, AZ

May 23, 2018

Darren Deboda
Reservation, Nevada
Moapa Band of Paiute Indians of the Moapa River Indian
P.O. Box 341
Moapa, NV 89025-0340

RE: Cove Reservoir Watershed Plan-EA Project

Dear Mr. / Ms. Darren Deboda:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with the Kane County Water Conservancy District (KCWCD) as the project sponsor, is considering proposed improvements within the East Fork Virgin River Watershed in Kane County, Utah. Improvements under consideration will address water conservation concerns, agricultural and municipal demands, public safety risks, and will enhance aquatic species habitat and increase opportunities for public recreation. See the enclosed Project Fact Sheet for information about project features.

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We look forward to receiving your comments and discussing this project further.

Sincerely,

TIMOTHY WILSON
NRCS State Conservationist

Encl: Project Fact Sheet, including map

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Nicle Dunlap, Transcon Environmental, Project Manager, Berkeley, CA
Brian Parker, Transcon Environmental, Project Manager, Mesa, AZ

May 23, 2018

Benny Tso
Chairman
Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony
One Paiute Drive
Las Vegas, NV 89106

RE: Cove Reservoir Watershed Plan-EA Project

Dear Mr. / Ms. Benny Tso:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with the Kane County Water Conservancy District (KCWCD) as the project sponsor, is considering proposed improvements within the East Fork Virgin River Watershed in Kane County, Utah. Improvements under consideration will address water conservation concerns, agricultural and municipal demands, public safety risks, and will enhance aquatic species habitat and increase opportunities for public recreation. See the enclosed Project Fact Sheet for information about project features.

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Encl: Project Fact Sheet, including map

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Brian Parker, Transcon Environmental, Project Manager, Mesa, AZ

May 23, 2018

Russell Begaye
President
Navajo Nation Office of the President
Navajo Nation
100 Parkway
P.O. Box 7440
Window Rock, AZ 86515

RE: Cove Reservoir Watershed Plan-EA Project

Dear Mr. / Ms. Russell Begaye:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with the Kane County Water Conservancy District (KCWCD) as the project sponsor, is considering proposed improvements within the East Fork Virgin River Watershed in Kane County, Utah. Improvements under consideration will address water conservation concerns, agricultural and municipal demands, public safety risks, and will enhance aquatic species habitat and increase opportunities for public recreation. See the enclosed Project Fact Sheet for information about project features.

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NRCS State Conservationist

Encl: Project Fact Sheet, including map

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May 23, 2018

Richard M. Begaye
THPO and Department Manager
Navajo Nation Historic Preservation Department
Navajo Nation
P.O. Box 4950
Window Rock, AZ 86515

RE: Cove Reservoir Watershed Plan-EA Project

Dear Mr. / Ms. Richard M. Begaye:

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May 23, 2018

Harold Cuthair
Chairman
Ute Mountain Ute Tribe
P.O. Box JJ
125 Mikewash Road
Towaoc, CO 81334

RE: Cove Reservoir Watershed Plan-EA Project

Dear Mr. / Ms. Harold Cuthair:

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NRCS State Conservationist

Encl: Project Fact Sheet, including map

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Brian Parker, Transcon Environmental, Project Manager, Mesa, AZ

May 23, 2018

Terry Knight
Tribal Historic Preservation Officer
Ute Mountain Ute Tribe
P.O. Box 468
Towaoc, CO 81334

RE: Cove Reservoir Watershed Plan-EA Project

Dear Mr. / Ms. Terry Knight:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with the Kane County Water Conservancy District (KCWCD) as the project sponsor, is considering proposed improvements within the East Fork Virgin River Watershed in Kane County, Utah. Improvements under consideration will address water conservation concerns, agricultural and municipal demands, public safety risks, and will enhance aquatic species habitat and increase opportunities for public recreation. See the enclosed Project Fact Sheet for information about project features.

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Sincerely,

TIMOTHY WILSON
NRCS State Conservationist

Encl: Project Fact Sheet, including map

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Nicle Dunlap, Transcon Environmental, Project Manager, Berkeley, CA
Brian Parker, Transcon Environmental, Project Manager, Mesa, AZ

May 23, 2018

Nichol Shurack
Tribal Archaeologist
Ute Mountain Ute Tribe
P.O. Box 468
Towaoc, CO 81334

RE: Cove Reservoir Watershed Plan-EA Project

Dear Mr. / Ms. Nichol Shurack:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with the Kane County Water Conservancy District (KCWCD) as the project sponsor, is considering proposed improvements within the East Fork Virgin River Watershed in Kane County, Utah. Improvements under consideration will address water conservation concerns, agricultural and municipal demands, public safety risks, and will enhance aquatic species habitat and increase opportunities for public recreation. See the enclosed Project Fact Sheet for information about project features.

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Brian Parker, Transcon Environmental, Project Manager, Mesa, AZ

May 23, 2018

Elaine Cantsee
Councilwoman
White Mesa, Ute Council
P.O. Box 7096
White Mesa, UT 84511

RE: Cove Reservoir Watershed Plan-EA Project

Dear Mr. / Ms. Elaine Cantsee:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with the Kane County Water Conservancy District (KCWCD) as the project sponsor, is considering proposed improvements within the East Fork Virgin River Watershed in Kane County, Utah. Improvements under consideration will address water conservation concerns, agricultural and municipal demands, public safety risks, and will enhance aquatic species habitat and increase opportunities for public recreation. See the enclosed Project Fact Sheet for information about project features.

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If you have any questions, comments, or concerns please contact Tara S. Hoffmann, Acting State Cultural Resources Specialist at 720-591-8051 or email at tara.hoffmann@co.usda.gov or Shelley A. Szeghi, Area Cultural Resources Specialist, at 801-629-0575 ext. 104 or email at shelley.szeghi@ut.usda.gov.

We look forward to receiving your comments and discussing this project further.

Sincerely,

TIMOTHY WILSON
NRCS State Conservationist

Encl: Project Fact Sheet, including map

cc:

Tara S. Hoffmann, Acting State Cultural Resources Specialist, Salt Lake City, UT
Shelley A. Szeghi, NRCS, Area Cultural Resources Specialist, Ogden, UT
Norm Evenstad, NRCS, Water Resources Coordinator, Salt Lake City, UT
Nicle Dunlap, Transcon Environmental, Project Manager, Berkeley, CA
Brian Parker, Transcon Environmental, Project Manager, Mesa, AZ

May 23, 2018

Carlene Yellowhair
President
San Juan Southern Paiute Tribe of Arizona
50 South Main Street, Suite 201
P.O. Box 2950
Tuba City, AZ 86045

RE: Cove Reservoir Watershed Plan-EA Project

Dear Mr. / Ms. Carlene Yellowhair:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with the Kane County Water Conservancy District (KCWCD) as the project sponsor, is considering proposed improvements within the East Fork Virgin River Watershed in Kane County, Utah. Improvements under consideration will address water conservation concerns, agricultural and municipal demands, public safety risks, and will enhance aquatic species habitat and increase opportunities for public recreation. See the enclosed Project Fact Sheet for information about project features.

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Norm Evenstad, NRCS, Water Resources Coordinator, Salt Lake City, UT
Nicle Dunlap, Transcon Environmental, Project Manager, Berkeley, CA
Brian Parker, Transcon Environmental, Project Manager, Mesa, AZ

May 23, 2018

Val Panteah Sr.
Governor
Pueblo of Zuni
P.O. Box 339
Zuni, NM 87327

RE: Cove Reservoir Watershed Plan-EA Project

Dear Mr. / Ms. Val Panteah Sr.:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with the Kane County Water Conservancy District (KCWCD) as the project sponsor, is considering proposed improvements within the East Fork Virgin River Watershed in Kane County, Utah. Improvements under consideration will address water conservation concerns, agricultural and municipal demands, public safety risks, and will enhance aquatic species habitat and increase opportunities for public recreation. See the enclosed Project Fact Sheet for information about project features.

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Sincerely,

TIMOTHY WILSON
NRCS State Conservationist

Encl: Project Fact Sheet, including map

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Brian Parker, Transcon Environmental, Project Manager, Mesa, AZ

May 23, 2018

Timothy L. Nuvangyaoma
Chairman
Hopi Tribe Chairman's Office
The Hopi Tribe
P.O. Box 123
Kykotsmovi, AZ 86039

RE: Cove Reservoir Watershed Plan-EA Project

Dear Mr. / Ms. Timothy L. Nuvangyaoma:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with the Kane County Water Conservancy District (KCWCD) as the project sponsor, is considering proposed improvements within the East Fork Virgin River Watershed in Kane County, Utah. Improvements under consideration will address water conservation concerns, agricultural and municipal demands, public safety risks, and will enhance aquatic species habitat and increase opportunities for public recreation. See the enclosed Project Fact Sheet for information about project features.

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Sincerely,

TIMOTHY WILSON
NRCS State Conservationist

Encl: Project Fact Sheet, including map

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Norm Evenstad, NRCS, Water Resources Coordinator, Salt Lake City, UT
Nicle Dunlap, Transcon Environmental, Project Manager, Berkeley, CA
Brian Parker, Transcon Environmental, Project Manager, Mesa, AZ

May 23, 2018

Leigh Kuwanwisiwma
Director
Hopi Culture Preservation Office
The Hopi Tribe
P.O. Box 123
Kykotsmovi, AZ 86039

RE: Cove Reservoir Watershed Plan-EA Project

Dear Mr. / Ms. Leigh Kuwanwisiwma:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with the Kane County Water Conservancy District (KCWCD) as the project sponsor, is considering proposed improvements within the East Fork Virgin River Watershed in Kane County, Utah. Improvements under consideration will address water conservation concerns, agricultural and municipal demands, public safety risks, and will enhance aquatic species habitat and increase opportunities for public recreation. See the enclosed Project Fact Sheet for information about project features.

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We look forward to receiving your comments and discussing this project further.

Sincerely,

TIMOTHY WILSON
NRCS State Conservationist

Encl: Project Fact Sheet, including map

cc:

Tara S. Hoffmann, Acting State Cultural Resources Specialist, Salt Lake City, UT
Shelley A. Szeghi, NRCS, Area Cultural Resources Specialist, Ogden, UT
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Nicle Dunlap, Transcon Environmental, Project Manager, Berkeley, CA
Brian Parker, Transcon Environmental, Project Manager, Mesa, AZ

May 23, 2018

Damon R. Clarke
Chairman
Hualapai Tribe
P.O. Box 179
941 Hualapai Way
Peach Springs, AZ 86434

RE: Cove Reservoir Watershed Plan-EA Project

Dear Mr. / Ms. Damon R. Clarke:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with the Kane County Water Conservancy District (KCWCD) as the project sponsor, is considering proposed improvements within the East Fork Virgin River Watershed in Kane County, Utah. Improvements under consideration will address water conservation concerns, agricultural and municipal demands, public safety risks, and will enhance aquatic species habitat and increase opportunities for public recreation. See the enclosed Project Fact Sheet for information about project features.

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We look forward to receiving your comments and discussing this project further.

Sincerely,

TIMOTHY WILSON
NRCS State Conservationist

Encl: Project Fact Sheet, including map

cc:

Tara S. Hoffmann, Acting State Cultural Resources Specialist, Salt Lake City, UT
Shelley A. Szeghi, NRCS, Area Cultural Resources Specialist, Ogden, UT
Norm Evenstad, NRCS, Water Resources Coordinator, Salt Lake City, UT
Nicle Dunlap, Transcon Environmental, Project Manager, Berkeley, CA
Brian Parker, Transcon Environmental, Project Manager, Mesa, AZ

May 23, 2018

Dawn Hubbs
Tribal Historic Preservation Officer
Hualapai Tribe
P.O. Box 310
941 Hualapai Way
Peach Springs, AZ 86434

RE: Cove Reservoir Watershed Plan-EA Project

Dear Mr. / Ms. Dawn Hubbs:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with the Kane County Water Conservancy District (KCWCD) as the project sponsor, is considering proposed improvements within the East Fork Virgin River Watershed in Kane County, Utah. Improvements under consideration will address water conservation concerns, agricultural and municipal demands, public safety risks, and will enhance aquatic species habitat and increase opportunities for public recreation. See the enclosed Project Fact Sheet for information about project features.

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We look forward to receiving your comments and discussing this project further.

Sincerely,

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NRCS State Conservationist

Encl: Project Fact Sheet, including map

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Nicle Dunlap, Transcon Environmental, Project Manager, Berkeley, CA
Brian Parker, Transcon Environmental, Project Manager, Mesa, AZ

THE HOPI TRIBE

Timothy L. Nuvangyaoma
CHAIRMAN

Clark W. Tenakhongva
VICE-CHAIRMAN

June 11, 2018

Timothy Wilson, State Conservationist
Attention: Tara S. Hoffman, Shelley A. Szeghi
Natural Resources Conservation Service
125 South State Street, Room 4010
Salt Lake City, Utah 84138

Re: Cove Reservoir Watershed Plan

Dear Mr. Wilson,

Thank you for your correspondence dated May 23, 2018, regarding the National Resources Conservation Service (NRCS) and Kane County Water Conservancy District proposing improvements within the East Fork Virgin River Watershed in Kane County.

The Hopi Tribe claims cultural affiliation to prehistoric cultural groups in Utah. The Hopi Cultural Preservation Office supports the identification and avoidance of prehistoric archaeological sites and we consider the prehistoric archaeological sites of our ancestors to be "footprints" and Traditional Cultural Properties. Therefore, we appreciate the NRCS's continuing solicitation of our input and your efforts to address our concerns.

The Hopi Cultural Preservation Office requests consultation on any proposal in Utah that has the potential to effect prehistoric cultural resources. We are aware of the Jackson Flat Reservoir sponsored by the Kane County Water Conservancy District that adversely affected numerous sites and resulted in the disturbance of many human remains. We understand the project proposes improvements including the construction of a new 6,032 acre-foot reservoir, Cove Reservoir, as well as other improvements within the existing Glendale and Orderville irrigation systems.

We also understand an environmental analysis will be prepared, and therefore we look forward to being provided with copies of the cultural resources report and draft environmental assessment for review and comment. If prehistoric cultural resources are identified that will be adversely affected by the proposed project, we will request continuing consultation including being provided with a copy of any proposed treatment plans for review and comment.

If you have any questions or need additional information, please contact Terry Morgart at 928-734-3619 or tmorgart@hopi.nsn.us. Thank you for your consideration.

Respectfully,

Stewart B. Koyiyumptewa, Interim Manager
Hopi Cultural Preservation Office

xc: Utah State Historic Preservation Office

Draft Plan-EA Notice of Availability - Tribes

November 20, 2020

Mr. Greg Anderson
Chairman
Moapa Band of Paiute Indians of the Moapa Indian Reservation, Nevada
P.O. Box 340
Moapa, Nevada 89025

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Anderson:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

As designed, the project will involve the construction of a new, approximately 6,055-acre-foot reservoir east of Orderville, Utah. Project components associated with the reservoir include an earthen dam, principal and auxiliary spillways, reservoir outlet works and emergency drain, an access road around the reservoir, camping and recreation area, and a boat ramp to allow for non-motorized boating. The project would also involve the replacement of approximately 1.7-miles of pipeline in Glendale, Utah and the relocation and upgrade of the existing Glendale Hydroelectric Plant.

An electronic copy of the Draft Plan-EA can be downloaded from the NRCS Cove Reservoir Watershed planning webpage, accessed from the web address below. A hard copy of the Draft Plan-EA can also be made available to you upon request.

https://www.nrcs.usda.gov/wps/portal/nrcs/detail/ut/programs/planning/wpfp

NRCS invites you to submit comments anytime during the open comment period starting November 25, 2020 and ending on December 31, 2020. Please refer to the enclosed flyer for instructions on submitting comments. **Comments must be received by December 31, 2020 to become part of the public record.**

We look forward to hearing from and working with you on this important project. We welcome your call if you have questions on the proposed project or if you wish to arrange a meeting. If you have any questions, comments or concerns, please contact State Cultural Resources Specialist Tara S. Hoffmann at 801-524-4556 or tara.hoffmann@usda.gov, at your earliest convenience.

Sincerely,



EMILY FIFE
NRCS State Conservationist

Encl: NOA Flyer

cc:

Tara S. Hoffmann, State Cultural Resources Specialist, Salt Lake City, UT
Norm Evenstad, NRCS, Assistant State Conservationist- Water Resources, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Mr. Richard M. Begay
THPO and Department Manager
P.O. Box 4950
Window Rock, Arizona 86515

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Begay:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

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NRCS State Conservationist

Encl: NOA Flyer

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Norm Evenstad, NRCS, Assistant State Conservationist- Water Resources, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Ms. Elaine Cantsee
Councilwoman
White Mesa, Ute Council
P.O. Box 7096
White Mesa, Utah 84511

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Ms. Cantsee:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

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Tara S. Hoffmann, State Cultural Resources Specialist, Salt Lake City, UT
Norm Evenstad, NRCS, Assistant State Conservationist- Water Resources, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Ms. Betsy Chapoose
Director
Cultural Rights Protection Department
Ute Indian Tribe of the Uintah & Ouray Reservation, Utah
P.O. Box 190
Fort Duchesne, Utah 84026

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Ms. Chapoose:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

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Encl: NOA Flyer

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Tara S. Hoffmann, State Cultural Resources Specialist, Salt Lake City, UT
Norm Evenstad, NRCS, Assistant State Conservationist- Water Resources, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Dr. Damon R. Clarke
Chairman
Hualapai Tribe
941 Hualapai Way
Peach Springs, Arizona 86434

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Dr. Clarke:

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EMILY FIFE
NRCS State Conservationist

Encl: NOA Flyer

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Norm Evenstad, NRCS, Assistant State Conservationist- Water Resources, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Mr. Harold Cuthair
Chairman
Ute Mountain Ute Tribe
P.O. Box JJ
Towaoc, Colorado 81334

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Cuthair:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

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An electronic copy of the Draft Plan-EA can be downloaded from the NRCS Cove Reservoir Watershed planning webpage, accessed from the web address below. A hard copy of the Draft Plan-EA can also be made available to you upon request.

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Sincerely,



EMILY FIFE
NRCS State Conservationist

Encl: NOA Flyer

cc:

Tara S. Hoffmann, State Cultural Resources Specialist, Salt Lake City, UT
Norm Evenstad, NRCS, Assistant State Conservationist- Water Resources, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Mr. Darren Deboda
Moapa Band of Paiute Indians of the Moapa Indian Reservation, Nevada
P.O. Box 340
Moapa, Nevada 89025

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Deboda:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

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Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Dr. Kurt Dongoske
Director and Tribal Historic Preservation Officer
Pueblo of Zuni
P.O. Box 1149
Zuni, New Mexico 87327

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Dr. Dongoske:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

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Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Mr. Luke Duncan
Chairman
Ute Indian Tribe of the Uintah & Ouray Reservation, Utah
P.O. Box 190
Fort Duchesne, Utah 84026

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Duncan:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

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Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Ms. Dawn Hubbs
Tribal Historic Preservation Officer
Hualapai Tribe
941 Hualapai Way
Peach Springs, Arizona 86434

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Ms. Hubbs:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

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Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Mr. Terry Knight
Tribal Historic Preservation Officer
Ute Mountain Ute Tribe
P.O. Box 468
Towaoc, Colorado 81334

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Knight:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

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Norm Evenstad, NRCS, Assistant State Conservationist- Water Resources, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Mr. Stewart B. Koyiyumptewa
Tribal Historic Preservation Officer
Hopi Tribe of Arizona
Hopi Cultural Preservation Office
P.O. Box 123
Kykotsmovi, Arizona 86039

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Koyiyumptewa:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

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Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Mr. Leigh Kuwanwisiwma
Director
Hopi Culture Preservation Office
The Hopi Tribe
P.O. Box 123
Kykotsmovi, Arizona 86039

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Kuwanwisiwma:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

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Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Ms. Dorena Martineau
Paiute Indian Tribe of Utah
440 North Paiute Drive
Cedar City, Utah 84721

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Ms. Martineau:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

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Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Mr. Jonathan Nez
Navajo Nation Office of the President
P.O. Box 7440
Window Rock, Arizona 86515

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Nez:

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Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Mr. Timothy L. Nuvangyaoma
Chairman
Hopi Tribe Chairman's Office
P.O. Box 123
Kykotsmovi, Arizona 86039

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Nuvangyaoma:

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Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Mr. Val Panteah Sr.
Governor
Pueblo of Zuni
P.O. Box 330
Zuni, New Mexico 87327

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Panteah:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

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Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Ms. Ona Segundo
Chairwoman
Kaibab Band of Paiute Indians of the Kaibab Indian Reservation
Tribal Affairs Building
HC65, Box 2
Fredonia, Arizona 86022

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Ms. Segundo:

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We look forward to hearing from and working with you on this important project. We welcome your call if you have questions on the proposed project or if you wish to arrange a meeting. If you have any questions, comments or concerns, please contact State Cultural Resources Specialist Tara S. Hoffmann at 801-524-4556 or tara.hoffmann@usda.gov, at your earliest convenience.

Sincerely,



EMILY FIFE
NRCS State Conservationist

Encl: NOA Flyer

cc:

Tara S. Hoffmann, State Cultural Resources Specialist, Salt Lake City, UT
Norm Evenstad, NRCS, Assistant State Conservationist- Water Resources, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Ms. Nichol Shurack
Tribal Archaeologist
Ute Mountain Ute Tribe
P.O. Box 468
Towaoc, Colorado 81334

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Ms. Shurack:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

As designed, the project will involve the construction of a new, approximately 6,055-acre-foot reservoir east of Orderville, Utah. Project components associated with the reservoir include an earthen dam, principal and auxiliary spillways, reservoir outlet works and emergency drain, an access road around the reservoir, camping and recreation area, and a boat ramp to allow for non-motorized boating. The project would also involve the replacement of approximately 1.7-miles of pipeline in Glendale, Utah and the relocation and upgrade of the existing Glendale Hydroelectric Plant.

An electronic copy of the Draft Plan-EA can be downloaded from the NRCS Cove Reservoir Watershed planning webpage, accessed from the web address below. A hard copy of the Draft Plan-EA can also be made available to you upon request.

https://www.nrcs.usda.gov/wps/portal/nrcs/detail/ut/programs/planning/wpfp

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Sincerely,



EMILY FIFE
NRCS State Conservationist

Encl: NOA Flyer

cc:

Tara S. Hoffmann, State Cultural Resources Specialist, Salt Lake City, UT
Norm Evenstad, NRCS, Assistant State Conservationist- Water Resources, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Mr. Benny Tso
Chairman
Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony
One Paiute Drive
Las Vegas, Nevada 89106

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Tso:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

As designed, the project will involve the construction of a new, approximately 6,055-acre-foot reservoir east of Orderville, Utah. Project components associated with the reservoir include an earthen dam, principal and auxiliary spillways, reservoir outlet works and emergency drain, an access road around the reservoir, camping and recreation area, and a boat ramp to allow for non-motorized boating. The project would also involve the replacement of approximately 1.7-miles of pipeline in Glendale, Utah and the relocation and upgrade of the existing Glendale Hydroelectric Plant.

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Sincerely,



EMILY FIFE
NRCS State Conservationist

Encl: NOA Flyer

cc:

Tara S. Hoffmann, State Cultural Resources Specialist, Salt Lake City, UT
Norm Evenstad, NRCS, Assistant State Conservationist- Water Resources, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Mr. Clint Wagon
Chairman
Eastern Shoshone Tribe of the Wind River Reservation, Wyoming
P.O. Box 538
Fort Washakie, Wyoming 82514

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Mr. Wagon:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

As designed, the project will involve the construction of a new, approximately 6,055-acre-foot reservoir east of Orderville, Utah. Project components associated with the reservoir include an earthen dam, principal and auxiliary spillways, reservoir outlet works and emergency drain, an access road around the reservoir, camping and recreation area, and a boat ramp to allow for non-motorized boating. The project would also involve the replacement of approximately 1.7-miles of pipeline in Glendale, Utah and the relocation and upgrade of the existing Glendale Hydroelectric Plant.

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We look forward to hearing from and working with you on this important project. We welcome your call if you have questions on the proposed project or if you wish to arrange a meeting. If you have any questions, comments or concerns, please contact State Cultural Resources Specialist Tara S. Hoffmann at 801-524-4556 or tara.hoffmann@usda.gov, at your earliest convenience.

Sincerely,



EMILY FIFE
NRCS State Conservationist

Encl: NOA Flyer

cc:

Tara S. Hoffmann, State Cultural Resources Specialist, Salt Lake City, UT
Norm Evenstad, NRCS, Assistant State Conservationist- Water Resources, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

November 20, 2020

Ms. Carlene Yellowhair
President
San Juan Southern Paiute Tribe of Arizona
50 South Main Street
Suite 201
Tuba City, Arizona 86045

Reference: Cove Reservoir Watershed Plan-EA Project, Kane County, Utah

Dear Ms. Yellowhair:

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) in coordination with the Kane County Water Conservancy District (KCWCD) announce the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah. The project would improve agricultural and municipal water supply, provide for more water-based recreational opportunities and provide benefits to habitat for sensitive wildlife species downstream.

As designed, the project will involve the construction of a new, approximately 6,055-acre-foot reservoir east of Orderville, Utah. Project components associated with the reservoir include an earthen dam, principal and auxiliary spillways, reservoir outlet works and emergency drain, an access road around the reservoir, camping and recreation area, and a boat ramp to allow for non-motorized boating. The project would also involve the replacement of approximately 1.7-miles of pipeline in Glendale, Utah and the relocation and upgrade of the existing Glendale Hydroelectric Plant.

An electronic copy of the Draft Plan-EA can be downloaded from the NRCS Cove Reservoir Watershed planning webpage, accessed from the web address below. A hard copy of the Draft Plan-EA can also be made available to you upon request.

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We look forward to hearing from and working with you on this important project. We welcome your call if you have questions on the proposed project or if you wish to arrange a meeting. If you have any questions, comments or concerns, please contact State Cultural Resources Specialist Tara S. Hoffmann at 801-524-4556 or tara.hoffmann@usda.gov, at your earliest convenience.

Sincerely,



EMILY FIFE
NRCS State Conservationist

Encl: NOA Flyer

cc:

Tara S. Hoffmann, State Cultural Resources Specialist, Salt Lake City, UT
Norm Evenstad, NRCS, Assistant State Conservationist- Water Resources, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

From: Daniel Bulletts
To: Hoffmann, Tara - NRCS, Salt Lake City, UT
Subject: Re: [Take care when opening attachments] reaching out regarding Cove Reservoir EA - Public Meeting Dec 9
Date: Monday, December 7, 2020 10:47:14 AM

Ok I will call you at 2pm.

talk to you then,

On Mon, Dec 7, 2020 at 10:44 AM Hoffmann, Tara - NRCS, Salt Lake City, UT <tara.hoffmann@usda.gov> wrote:

> You are sure busy but so glad to hear you'll be transferring to Cultural full time, and glad you'll be attending the virtual meeting on the 9th. After 2pm today works. I just have a practice Cove virtual meeting from 3-4pm but if that's the only time that works for you, I can take a break from it.
>
> My number is 385-258-1266.
>
> Take care,
>
> Tara
>
> **From:** Daniel Bulletts <dbulletts@kaibabpaiute-nsn.gov>
> **Sent:** Monday, December 7, 2020 10:39 AM
> **To:** Hoffmann, Tara - NRCS, Salt Lake City, UT <tara.hoffmann@usda.gov>
> **Subject:** Re: [Take care when opening attachments] reaching out regarding Cove Reservoir EA - Public Meeting Dec 9
>
> Hello,
>
> So, sorry for the late reply but I have been very busy as of late and forgot to send you a reply last week.I'm not only the acting cultural resource director but I'm the acting Tribal Administrator as well but hopefully that will be only for a few more week because we has an applicant on the hook for the admin job and then I will transfer to Cultural Full time.
>
> I have reviewed most of your documents you sent and I will be attending the virtual meeting on the 9th.
>
> On your phone message you said to call you and I can do that this afternoon around 2pm Az

time if that is ok or anytime after that??

THank you for your kind words regarding my brother. It was and still is a shock to my family but we are doing better as each day passes.

Take care and be safe

On Tue, Dec 1, 2020 at 3:30 PM Hoffmann, Tara - NRCS, Salt Lake City, UT <tara.hoffmann@usda.gov> wrote:

> Hello Daniel,
>
> I wanted to bring you into the loop on the NRCS' Cove Reservoir Project near Orderville since the EA is now out for public comment. We sent out letter notification to Ona, but I would have also sent notification to you if only I had known you had taken over for Charley. I was working very closely with Charley on this project (we made multiple site visits) and am heartbroken about his passing over the summer. I knew him for the past eight years and he was a great friend and colleague.
>
> In regards to Cove Reservoir, attached is the Notice of Availability letter submitted to Ona, with a link to the EA, along with a flyer that has information on the Zoom Public Meeting to be held next Wednesday evening from 6pm to 7pm. For ease of joining the meeting, below is the information as well:
>
> Join Zoom Meeting
>
> https://zoom.us/j/92277219285
>
> Meeting ID: 922 7721 9285
>
> One tap mobile
>
> +12532158782,,92277219285# US (Tacoma)
>
> +13462487799,,92277219285# US (Houston)
>
> If you would like to make any project site visits, please let me know and I would be glad

to come down. And in case you need another copy of the cultural resources report, I have attached a copy of that as well. Please let me know if you have any questions at all or need additional project information.

Cheers,

Tara

Tara S. Hoffmann, MA

State Cultural Resources Specialist

USDA Natural Resources Conservation Service

125 South State Street, Room 4010
Salt Lake City, UT 84138-1100

Office: 801.524.4556

Mobile: 385.258.1266

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--

Daniel Bulletts

Tribal Administrator Assistant

Kaibab Band of Paiute Indians

HC 65 Box 02

Fredonia AZ 86022

928-643-7245

--
Daniel Bulletts
Tribal Administrator Assistant
Kaibab Band of Paiute Indians
HC 65 Box 02
Fredonia AZ 86022
928-643-7245

From: Timothy Begay
To: Hoffmann, Tara - NRCS, Salt Lake City, UT
Subject: COVE RESERVOIR WATERSHHED PLAN
Date: Friday, December 4, 2020 2:18:31 PM

Dear Ms. Hoffmann:

The Navajo Nation Heritage and Historic Preservation Department's (NNHPD) Traditional Culture Program is (TCP) in receipt of your letter regarding the United States Department of Agriculture Natural Resources Conservation Service announce a draft Watershed Plane and Environmental Assessment for the Cover Reservoir with in the East Fork Virgin River Watershed in Kane County, Utah .

After reviewing your letter and cross referencing our Traditional Cultural Properties (TCP's) database, NNHHPD-TCP has determined that there are No Navajo TCP's within the project area and you may proceed without further consultation for this project.

If you have any additional questions, concerns or would like to discuss these issues further, please don't hesitate to contact our office at (928) 871-7198 or (928) 871-7152. Thank you for your cooperation and understanding.

Sincerely,

Timothy C. Begay, Navajo Cultural Specialist
Navajo Nation Heritage and Historic Preservation Department
P.O. Box 4950
Window Rock, AZ 86515
tbegay@navajo-nsn.gov

THE HOPI TRIBE

Timothy L. Nuvangyaoma
CHAIRMAN

Clark W. Tenakhongva
VICE-CHAIRMAN

December 8, 2020

Emily Fife, State Conservationist
Attention: Tara S. Hoffman, Cultural Resources Specialist
Natural Resources Conservation Service
125 South State Street, Room 4010
Salt Lake City, Utah 84138

Re: Draft Watershed Plan and Environmental Assessment (Plan-EA) for the proposed Cove Reservoir Watershed Project within the East Fork Virgin River Watershed

Dear Ms. Fife,

Thank you for your correspondence dated November 20, 2020, regarding the National Resources Conservation Service (NRCS) and Kane County Water Conservancy District announcing the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the proposed Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah.

The Hopi Tribe claims cultural affiliation to prehistoric cultural groups in Utah. The Hopi Cultural Preservation Office supports the identification and avoidance of prehistoric archaeological sites and we consider the prehistoric archaeological sites of our ancestors to be "footprints" and Traditional Cultural Properties. Therefore, we appreciate the NRCS's continuing solicitation of our input and your efforts to address our concerns.

In the enclosed letter dated June 11, 2018, the Hopi Cultural Preservation Office reiterated we request consultation on any proposal in Utah that has the potential to effect prehistoric cultural resources. We stated we are aware of the Jackson Flat Reservoir sponsored by the Kane County Water Conservancy District that adversely affected numerous sites and resulted in the disturbance of many human remains. We also stated we understand the project proposes improvements including the construction of a new 6,032 acre-foot reservoir, Cove Reservoir, as well as other improvements within the existing Glendale and Orderville irrigation systems.

We further stated we also understand an environmental analysis will be prepared, and therefore we looked forward to being provided with copies of the cultural resources report and draft environmental assessment for review and comment. We finally stated that if prehistoric cultural resources are identified that will be adversely affected by the proposed project, we request continuing consultation including being provided with a copy of any proposed treatment plans for review and comment.

We value American public lands that include our ancestral lands. Hopi People see our ancestral lands as part of being Hopi, and we expect them passed intact to the next generation. Therefore, we hereby reiterate our request to be provided with hard copies for review and comment of the cultural resources survey report of the area of potential effect and Draft Watershed Plan and Environmental Assessment (Plan-EA) for the proposed Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County.

Your decision to accept this application at this time appears to be based in the current administration. The current administration will not be current in 2021 and we anticipate the new administration will have new orders reversing current administration orders. The acceptance of this proposal at this time also ignores the current pandemic and heath crisis facing the Hopi Tribe and the World. Furthermore, December is a traditional and ceremonial quiet time for Hopisenom.

Therefore, at this time, we request you withdraw and defer the draft environmental assessment and conduct a full environmental impact statement under the new administration in 2021. If you have any questions or need additional information, please contact the Hopi Cultural Preservation Office. Thank you for your consideration.

Respectfully,

Stewart B. Koyiyumptewa, Program Manager/THPO
Hopi Cultural Preservation Office

Enclosure: June 11, 2018 letter

xc: Kaibab Band of Paiutes
Steve Bloch, Southern Utah Wilderness Alliance
Salt Lake City Tribune
Utah State Historic Preservation Office

December 15, 2020

Mr. Stewart B. Koyiyumptewa
Tribal Historic Preservation Officer
Hopi Tribe of Arizona
Hopi Cultural Preservation Office
P.O Box 123
Kykotsmovi, Arizona 86039

Re: Draft Watershed Plan and Environmental Assessment (Plan-EA) for the proposed Cove Reservoir Watershed Project within the East Fork Virgin River Watershed

Dear Mr. Koyiyumptewa,

Thank you for your letter dated December 8, 2020 regarding the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the proposed Cove Reservoir Watershed Project within the East Fork Virgin River Watershed (Cove Reservoir Watershed Project). As requested, enclosed is an additional hard copy of the cultural resources inventory report and the Draft Watershed Plan and Environmental Assessment. An initial copy of the cultural resources report was provided to your office on January 9, 2020 as part of the initial National Historic Preservation Act (NHPA) Section 106 consultation process, and concurrence was received with a determination of no adverse effect to historic properties on February 3, 2020. The consultation letter with concurrence is enclosed for reference. Utah State Historic Preservation Office (SHPO) concurrence was also received on January 17, 2020 and is enclosed with this letter.

The Natural Resources Conservation Service (NRCS) places great value on cultural resources and the need for their preservation for future generations. We recognize the deep connection of the Hopi Tribe to prehistoric archaeological sites, as well as all other Tribes that may claim affiliation to them, and NRCS Utah takes that to heart with all our projects. Because of this, it is the NRCS' default policy to avoid cultural resources sites whenever possible, and in the case of the Cove Reservoir Watershed Project, all eligible cultural resources sites will be avoided by a minimum of 50 feet. In addition, construction personnel will receive training in recognizing cultural/historic objects by an NRCS-approved archaeologist prior to project implementation. In the event that cultural resources or human remains are discovered during construction, procedures will be followed as defined in the NRCS' Prototype Programmatic Agreement with the Utah SHPO.

The NRCS' approval to provide funding to this project proposal evaluated its alignment with the PL-566 Watershed Protection and Flood Prevention Program and agency priority's. We fully grasp the magnitude of the current pandemic, its impact on our families, and especially the health crisis facing the Hopi Tribe, Indian Country, and the World. We also understand that December is a traditional and ceremonial quiet time for the Hopisenom and as such providing comment on this project is much appreciated.

The NRCS has continued planning activities at this time, and as such, has continued the environmental review of the Cove Reservoir Watershed Project. If after compiling and reviewing comments received during the public comment period, it is deemed necessary to prepare an Environmental Impact Statement, we shall do such in accordance with the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) at 40 CFR Part 1501.3.

Again, thank you for your response, and we look forward to working with you further on the Cove Reservoir Watershed Project. If you have any additional questions or comments, or would like to discuss the project further, please contact State Cultural Resources Specialist Tara S. Hoffmann at 385-258-1266 or tara.hoffmann@usda.gov.

Sincerely,



EMILY FIFE
State Conservationist

Enclosures

cc:
Terry Morgart, Hopi Tribe, Legal Researcher, Kykotsmovi, AZ
Timothy L. Nuvangyaoma, Hopi Tribe, Chairman, Kykotsmovi, AZ
Tara S. Hoffmann, State Cultural Resources Specialist, Salt Lake City, UT
Norm Evenstad, NRCS, Assistant State Conservationist- Water Resources, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Alan Atkins, NRCS, Assistant State Conservationist for Field Operations, Richfield, UT
Kristi Westwood, NRCS, District Conservationist, Panguitch, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

THE HOPI TRIBE

Timothy L. Nuvangyaoma
CHAIRMAN

Clark W. Tenakhongva
VICE-CHAIRMAN

January 4, 2021

Emily Fife, State Conservationist
Attention: Tara S. Hoffman, Cultural Resources Specialist
Natural Resources Conservation Service
125 South State Street, Room 4010
Salt Lake City, Utah 84138

Re: Draft Watershed Plan and Environmental Assessment (Plan-EA) for the proposed Cove Reservoir Watershed Project within the East Fork Virgin River Watershed

Dear Ms. Fife,

Thank you for your correspondence dated December 15, 2020, in response to our December 8, 2020 letter, regarding the National Resources Conservation Service (NRCS) and Kane County Water Conservancy District announcing the availability of the Draft Watershed Plan and Environmental Assessment (Plan-EA) for the proposed Cove Reservoir Watershed Project within the East Fork Virgin River Watershed in Kane County, Utah.

The Hopi Tribe claims cultural affiliation to prehistoric cultural groups in Utah. The Hopi Cultural Preservation Office supports the identification and avoidance of prehistoric archaeological sites. We consider the prehistoric archaeological sites of our ancestors to be "footprints" and Traditional Cultural Properties. Therefore, we appreciate the NRCS's continuing solicitation of our input and your efforts to address our concerns.

The Hopi Cultural Preservation Office previously stated we understand the project proposes improvements, including the construction of a new 6,032 acre-foot reservoir, Cove Reservoir, and other improvements within the existing Glendale Orderville irrigation systems. We also stated we understand an environmental analysis will be prepared. Therefore we looked forward to being provided with copies of the cultural resources report and draft environmental assessment for review and comment.

We now acknowledge having received a copy of the cultural resources survey of the area of potential effect and concurring with the determination of no adverse effect. We also understand the State Historic Preservation Office has concurred with the determination. However, when we attempted to review the draft environmental assessment online in response to your November 20, 2020 correspondence, we discovered a Salt Lake City Tribune article entitled "Kane County looking to dam the Virgin River in latest major project."

P.O. Box 123 - Kykotsmovi, AZ 86039 - Phone: 938-734-3000

Concerns expressed in our December 8, 2020 letter in part reflect our experience in light of the incomplete and ongoing Jackson Flat project, and the Tribune article that states:

> After spending tens of millions on water development projects, Kane County water officials are looking to spend millions more, mostly from federal sources, in their latest plan to dam the Virgin River upstream of Zion National Park for the benefit of alfalfa growers.

We have not been consulted on the 4.3 million cubic yards of fill and riprap that would come from borrow pits on federal land or a new 50-acre pit at Black Knoll on the Glendale Bench.

We also listened in to the December 9, 2020, Public Meeting where it was acknowledged this proposal is "much larger" in funding than other NRCS projects under its program and benefits a small number of users.

At this time, in light of the pandemic, the Hopi Tribe's inability to adequately review and consult on this proposal, we appreciate your consideration to conduct a full environmental impact statement under the new administration in 2021. Thank you for your consideration.

Respectfully,

Stewart B. Koyiyumptewa, Program Manager/THPO
Hopi Cultural Preservation Office

xc: Kaibab Band of Paiutes
Steve Bloch, Southern Utah Wilderness Alliance
Salt Lake City Tribune
Utah State Historic Preservation Office

From: Corbeil, Marcel - FPAC-NRCS, Richfield, UT
To: Hoffmann, Tara - NRCS, Salt Lake City, UT
Subject: Hualapai Tribe consultation update
Date: Monday, March 1, 2021 10:49:13 AM

I spoke to Mr. Peter Bungart today, he called and left a message late afternoon on Friday, and updated our Tribal Consultation Contact 2021 document to remove the Hualapai Tribe from all consultations for southern Utah. He stated that the Hualapai Tribe identifies with lands south of the Colorado River but considers all of the southern Utah Counties outside of their area of interest. If we have large multi-state projects that span lands south of the Colorado River or projects in the Glen Canyon Dam surrounding Page AZ, we can reach out to see if they are interested in consultations.

I crossed out references to the Hualapai Tribe where they are mentioned in the Counties list and put the text below beneath their contact info.

~~**Hualapai Tribe**~~
~~Dr. Damon R. Clarke (updated 5/2018)~~
~~Chairman~~
~~Hualapai Tribe~~
~~P.O. Box 179~~
~~941 Hualapai Way~~
~~Peach Springs Arizona 86434~~
~~(928) 769-2216~~
-
~~Ms. Dawn Hubbs (updated 5/2018)~~
~~Tribal Historic Preservation Officer~~
~~Hualapai Tribe~~
~~P.O. Box 310~~
~~941 Hualapai Way~~
~~Peach Springs Arizona 86434~~
~~(928) 769-2223~~

Marcel Corbeil update (phone call with Mr. Peter Bungart on 3-1-2021):
peter.bungart@hualpai.nsn.gov is the THPO (928-769-2223)

- Ms. Dawn Hubbs is one of his predecessors but has not been in the position since 2018.
- He was the Tribal archaeologist and became THPO in 2018.
- Dr. Damon Clarke is the Chairman until the 2022 election where he will term-out and be replaced
- He appreciates the effort to reach out but considers it a waste of time and paper for us to reach out to them for project is Utah, specifically mentioning the projects in Garfield and Grand Counties.
- Typically, the Hualapai Tribe identified with all area south of the Colorado River, but all of the counties in Utah are outside their area of interest.
- The Tribe will have interest if we have project surrounding Glen Canyon Dam around Page, AZ, but otherwise can be left out of consultations for counties in Southern Utah.

Marcel Corbeil
Cultural Resource Specialist

USDA, NRCS Utah-South Area
340 North 600 East
Richfield, Utah 84701
Office: 435-893-3367
Mobile: 801-360-5801

Draft Plan-EIS Tribal Scoping

January 14, 2022

Mr. Daniel Bullets
Kaibab Band of Paiute Indians of the Kaibab Indian Reservation
Cultural Preservation Office
HC65, Box 2
Fredonia, Arizona 86022

Reference: Cove-East Fork Virgin River Watershed Plan EIS Project

Dear Mr. Bullets:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with Kane County Water Conservancy District (KCWCD), as the project sponsor and Washington County Water Conservancy District (WCWCD) as the co-sponsor, is considering proposed improvements within the East Fork Virgin River Watershed. The proposed improvements include the construction of a new, approximately 6,055-acre-foot capacity reservoir (Cove Reservoir), as well as other improvements within the existing Mt. Carmel, Glendale and Orderville Irrigation Systems, as needed or identified. Improvements under consideration will address water conservation, agricultural and municipal demands, and public safety risks, while enhancing aquatic species habitat and increasing opportunities for public recreation. Alternative reservoir locations are being examined as well.

This proposed action is prepared under the authority of the Watershed Prevention and Flood Protection Act (Public Law 83–566). This action is needed because agriculture users in the Upper Virgin Watershed routinely experience water shortages during late summer months when East Fork Virgin River flows are depleted. Existing irrigation facilities have limited capabilities to divert water from the river, and there is currently no capacity for storage during non-use and high-flow periods. As a result, adequate water is not available to local users; therefore, the purpose of the action is to provide enhanced conservation and beneficial use of water by increasing water availability through collection and storage during non-use periods to provide adequate flows during the irrigation season.

In cooperation with the KCWCD and WCWCD, USDA-NRCS is in the very early planning stages of preparing an Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA) to consider and analyze potential impacts from the action. For the purposes of compliance with NEPA and Section 106 of the National Historic Preservation Act (NHPA), USDA-NRCS is the designated lead agency. Pursuant to Section 106 of the NHPA, Executive Order 13007, the American Indian Religious Freedom Act, we write to you at this time regarding the project and we welcome any information you would like to share with us regarding historic properties or places of traditional religious and cultural importance near the proposed project area

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If you have any questions, comments or concerns, please contact State Cultural Resources Specialist Tara S. Hoffmann at 385-258-1266 or tara.hoffmann@usda.gov, at your earliest convenience.

Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure: Project Fact Sheet/Scoping Notice

cc:
Tara S. Hoffmann, NRCS, State Cultural Resources Specialist, NRCS, Salt Lake City, UT
Norm Evenstad, NRCS, Assistant State Conservationist-Water Resources, NRCS, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, NRCS, Salt Lake City, UT
Leslie Warta, NRCS, Environmental Compliance Specialist, NRCS, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

January 14, 2022

Mr. Curtis Anderson
Chairman
Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony
One Paiute Drive
Las Vegas, Nevada 89106

Reference: Cove-East Fork Virgin River Watershed Plan EIS Project

Dear Mr. Anderson:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with Kane County Water Conservancy District (KCWCD), as the project sponsor and Washington County Water Conservancy District (WCWCD) as the co-sponsor, is considering proposed improvements within the East Fork Virgin River Watershed. The proposed improvements include the construction of a new, approximately 6,055-acre-foot capacity reservoir (Cove Reservoir), as well as other improvements within the existing Mt. Carmel, Glendale and Orderville Irrigation Systems, as needed or identified. Improvements under consideration will address water conservation, agricultural and municipal demands, and public safety risks, while enhancing aquatic species habitat and increasing opportunities for public recreation. Alternative reservoir locations are being examined as well.

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Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

January 14, 2022

Ms. Betsy Chapoose
THPO
Cultural Rights Protection Department
Ute Indian Tribe of the Uintah & Ouray Reservation, Utah
P.O. Box 190
Fort Duchesne, Utah 84026

Reference: Cove-East Fork Virgin River Watershed Plan EIS Project

Dear Ms. Chapoose:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with Kane County Water Conservancy District (KCWCD), as the project sponsor and Washington County Water Conservancy District (WCWCD) as the co-sponsor, is considering proposed improvements within the East Fork Virgin River Watershed. The proposed improvements include the construction of a new, approximately 6,055-acre-foot capacity reservoir (Cove Reservoir), as well as other improvements within the existing Mt. Carmel, Glendale and Orderville Irrigation Systems, as needed or identified. Improvements under consideration will address water conservation, agricultural and municipal demands, and public safety risks, while enhancing aquatic species habitat and increasing opportunities for public recreation. Alternative reservoir locations are being examined as well.

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Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

January 14, 2022

Dr. Kurt Dongoske
Director and Tribal Historic Preservation Officer
Pueblo of Zuni
P.O. Box 1149
Zuni, New Mexico 87327

Reference: Cove-East Fork Virgin River Watershed Plan EIS Project

Dear Mr. Dongoske:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with Kane County Water Conservancy District (KCWCD), as the project sponsor and Washington County Water Conservancy District (WCWCD) as the co-sponsor, is considering proposed improvements within the East Fork Virgin River Watershed. The proposed improvements include the construction of a new, approximately 6,055-acre-foot capacity reservoir (Cove Reservoir), as well as other improvements within the existing Mt. Carmel, Glendale and Orderville Irrigation Systems, as needed or identified. Improvements under consideration will address water conservation, agricultural and municipal demands, and public safety risks, while enhancing aquatic species habitat and increasing opportunities for public recreation. Alternative reservoir locations are being examined as well.

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Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

January 14, 2022

Mr. Luke Duncan
Chairman
Ute Indian Tribe of the Uintah & Ouray Reservation, Utah
P.O. Box 190
Fort Duchesne, Utah 84026

Reference: Cove-East Fork Virgin River Watershed Plan EIS Project

Dear Mr. Duncan:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with Kane County Water Conservancy District (KCWCD), as the project sponsor and Washington County Water Conservancy District (WCWCD) as the co-sponsor, is considering proposed improvements within the East Fork Virgin River Watershed. The proposed improvements include the construction of a new, approximately 6,055-acre-foot capacity reservoir (Cove Reservoir), as well as other improvements within the existing Mt. Carmel, Glendale and Orderville Irrigation Systems, as needed or identified. Improvements under consideration will address water conservation, agricultural and municipal demands, and public safety risks, while enhancing aquatic species habitat and increasing opportunities for public recreation. Alternative reservoir locations are being examined as well.

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Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

January 14, 2022

Mr. Manuel Heart
Chairman
Ute Mountain Ute Tribe
P.O. Box JJ
125 Mikewash Road
Towaoc, Colorado 81334

Reference: Cove-East Fork Virgin River Watershed Plan EIS Project

Dear Mr. Heart:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with Kane County Water Conservancy District (KCWCD), as the project sponsor and Washington County Water Conservancy District (WCWCD) as the co-sponsor, is considering proposed improvements within the East Fork Virgin River Watershed. The proposed improvements include the construction of a new, approximately 6,055-acre-foot capacity reservoir (Cove Reservoir), as well as other improvements within the existing Mt. Carmel, Glendale and Orderville Irrigation Systems, as needed or identified. Improvements under consideration will address water conservation, agricultural and municipal demands, and public safety risks, while enhancing aquatic species habitat and increasing opportunities for public recreation. Alternative reservoir locations are being examined as well.

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Leslie Warta, NRCS, Environmental Compliance Specialist, NRCS, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

January 14, 2022

Mr. Terry Knight
Tribal Historic Preservation Officer
Ute Mountain Ute Tribe
P.O. Box 468
Towaoc, Colorado 81334

Reference: Cove-East Fork Virgin River Watershed Plan EIS Project

Dear Mr. Knight:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with Kane County Water Conservancy District (KCWCD), as the project sponsor and Washington County Water Conservancy District (WCWCD) as the co-sponsor, is considering proposed improvements within the East Fork Virgin River Watershed. The proposed improvements include the construction of a new, approximately 6,055-acre-foot capacity reservoir (Cove Reservoir), as well as other improvements within the existing Mt. Carmel, Glendale and Orderville Irrigation Systems, as needed or identified. Improvements under consideration will address water conservation, agricultural and municipal demands, and public safety risks, while enhancing aquatic species habitat and increasing opportunities for public recreation. Alternative reservoir locations are being examined as well.

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cc:
Ms. Nichol Shurack, Tribal Archaeologist, Ute Mountain Ute Tribe, P.O. Box 468, Towaoc, CO 81334
Tara S. Hoffmann, NRCS, State Cultural Resources Specialist, NRCS, Salt Lake City, UT
Norm Evenstad, NRCS, Assistant State Conservationist-Water Resources, NRCS, Salt Lake City, UT
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Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

January 14, 2022

Mr. Stewart B. Koyiyumptewa
THPO
Hopi Tribe of Arizona
Hopi Cultural Preservation Office
P.O Box 123
Kykotsmovi, Arizona 86039

Reference: Cove-East Fork Virgin River Watershed Plan EIS Project

Dear Mr. Koyiyumptewa:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with Kane County Water Conservancy District (KCWCD), as the project sponsor and Washington County Water Conservancy District (WCWCD) as the co-sponsor, is considering proposed improvements within the East Fork Virgin River Watershed. The proposed improvements include the construction of a new, approximately 6,055-acre-foot capacity reservoir (Cove Reservoir), as well as other improvements within the existing Mt. Carmel, Glendale and Orderville Irrigation Systems, as needed or identified. Improvements under consideration will address water conservation, agricultural and municipal demands, and public safety risks, while enhancing aquatic species habitat and increasing opportunities for public recreation. Alternative reservoir locations are being examined as well.

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January 14, 2022

Mr. Malcolm Lehi
Council Representative
White Mesa, Ute Council
P.O. Box 7096
White Mesa, Utah 84511

Reference: Cove-East Fork Virgin River Watershed Plan EIS Project

Dear Mr. Lehi:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with Kane County Water Conservancy District (KCWCD), as the project sponsor and Washington County Water Conservancy District (WCWCD) as the co-sponsor, is considering proposed improvements within the East Fork Virgin River Watershed. The proposed improvements include the construction of a new, approximately 6,055-acre-foot capacity reservoir (Cove Reservoir), as well as other improvements within the existing Mt. Carmel, Glendale and Orderville Irrigation Systems, as needed or identified. Improvements under consideration will address water conservation, agricultural and municipal demands, and public safety risks, while enhancing aquatic species habitat and increasing opportunities for public recreation. Alternative reservoir locations are being examined as well.

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Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

January 14, 2022

Ms. Dorena Martineau
Paiute Indian Tribe of Utah
440 North Paiute Drive
Cedar City, Utah 84721

Reference: Cove-East Fork Virgin River Watershed Plan EIS Project

Dear Ms. Martineau:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with Kane County Water Conservancy District (KCWCD), as the project sponsor and Washington County Water Conservancy District (WCWCD) as the co-sponsor, is considering proposed improvements within the East Fork Virgin River Watershed. The proposed improvements include the construction of a new, approximately 6,055-acre-foot capacity reservoir (Cove Reservoir), as well as other improvements within the existing Mt. Carmel, Glendale and Orderville Irrigation Systems, as needed or identified. Improvements under consideration will address water conservation, agricultural and municipal demands, and public safety risks, while enhancing aquatic species habitat and increasing opportunities for public recreation. Alternative reservoir locations are being examined as well.

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Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

January 14, 2022

Mr. Jonathan Nez
President
Navajo Nation Office of the President
P.O. Box 7440
Window Rock, Arizona 86515

Reference: Cove-East Fork Virgin River Watershed Plan EIS Project

Dear Mr. Nez:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with Kane County Water Conservancy District (KCWCD), as the project sponsor and Washington County Water Conservancy District (WCWCD) as the co-sponsor, is considering proposed improvements within the East Fork Virgin River Watershed. The proposed improvements include the construction of a new, approximately 6,055-acre-foot capacity reservoir (Cove Reservoir), as well as other improvements within the existing Mt. Carmel, Glendale and Orderville Irrigation Systems, as needed or identified. Improvements under consideration will address water conservation, agricultural and municipal demands, and public safety risks, while enhancing aquatic species habitat and increasing opportunities for public recreation. Alternative reservoir locations are being examined as well.

This proposed action is prepared under the authority of the Watershed Prevention and Flood Protection Act (Public Law 83–566). This action is needed because agriculture users in the Upper Virgin Watershed routinely experience water shortages during late summer months when East Fork Virgin River flows are depleted. Existing irrigation facilities have limited capabilities to divert water from the river, and there is currently no capacity for storage during non-use and high-flow periods. As a result, adequate water is not available to local users; therefore, the purpose of the action is to provide enhanced conservation and beneficial use of water by increasing water availability through collection and storage during non-use periods to provide adequate flows during the irrigation season.

In cooperation with the KCWCD and WCWCD, USDA-NRCS is in the very early planning stages of preparing an Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA) to consider and analyze potential impacts from the action. For the purposes of compliance with NEPA and Section 106 of the National Historic Preservation Act (NHPA), USDA-NRCS is the designated lead agency. Pursuant to Section 106 of the NHPA, Executive Order 13007, the American Indian Religious Freedom Act, we write to you at this time regarding the project and we welcome any information you would like to share with us regarding historic properties or places of traditional religious and cultural importance near the proposed project area

that we should consider as part of our analysis. We would also appreciate your assistance in identifying any other tribes with whom we should consult on this project.

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If you have any questions, comments or concerns, please contact State Cultural Resources Specialist Tara S. Hoffmann at 385-258-1266 or tara.hoffmann@usda.gov, at your earliest convenience.

Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure: Project Fact Sheet/Scoping Notice

cc:
Mr. Richard M. Begay, THPO and Department Manager, Navajo Nation Historic Preservation Department, P.O. Box 4950, Window Rock, Arizona 86515
Tara S. Hoffmann, NRCS, State Cultural Resources Specialist, NRCS, Salt Lake City, UT
Norm Evenstad, NRCS, Assistant State Conservationist-Water Resources, NRCS, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, NRCS, Salt Lake City, UT
Leslie Warta, NRCS, Environmental Compliance Specialist, NRCS, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

January 14, 2022

Mr. Timothy L. Nuvangyaoma
Chairman
Hopi Tribe Chairman's Office
P.O. Box 123
Kykotsmovi, Arizona 86039

Reference: Cove-East Fork Virgin River Watershed Plan EIS Project

Dear Mr. Nuvangyaoma:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with Kane County Water Conservancy District (KCWCD), as the project sponsor and Washington County Water Conservancy District (WCWCD) as the co-sponsor, is considering proposed improvements within the East Fork Virgin River Watershed. The proposed improvements include the construction of a new, approximately 6,055-acre-foot capacity reservoir (Cove Reservoir), as well as other improvements within the existing Mt. Carmel, Glendale and Orderville Irrigation Systems, as needed or identified. Improvements under consideration will address water conservation, agricultural and municipal demands, and public safety risks, while enhancing aquatic species habitat and increasing opportunities for public recreation. Alternative reservoir locations are being examined as well.

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Emily Fife

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State Conservationist

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Norm Evenstad, NRCS, Assistant State Conservationist-Water Resources, NRCS, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, NRCS, Salt Lake City, UT
Leslie Warta, NRCS, Environmental Compliance Specialist, NRCS, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

January 14, 2022

Mr. Val Panteah Sr.
Governor
Pueblo of Zuni
P.O. Box 339
Zuni, New Mexico 87327

Reference: Cove-East Fork Virgin River Watershed Plan EIS Project

Dear Mr. Panteah:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with Kane County Water Conservancy District (KCWCD), as the project sponsor and Washington County Water Conservancy District (WCWCD) as the co-sponsor, is considering proposed improvements within the East Fork Virgin River Watershed. The proposed improvements include the construction of a new, approximately 6,055-acre-foot capacity reservoir (Cove Reservoir), as well as other improvements within the existing Mt. Carmel, Glendale and Orderville Irrigation Systems, as needed or identified. Improvements under consideration will address water conservation, agricultural and municipal demands, and public safety risks, while enhancing aquatic species habitat and increasing opportunities for public recreation. Alternative reservoir locations are being examined as well.

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Emily Fife

EMILY FIFE
State Conservationist

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Tara S. Hoffmann, NRCS, State Cultural Resources Specialist, NRCS, Salt Lake City, UT
Norm Evenstad, NRCS, Assistant State Conservationist-Water Resources, NRCS, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, NRCS, Salt Lake City, UT
Leslie Warta, NRCS, Environmental Compliance Specialist, NRCS, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

January 14, 2022

Ms. Laura Parry
Chairwoman
Moapa Band of Paiute Indians of the Moapa River Indian
Reservation, Nevada
P.O. Box 340
Moapa, Nevada 89025-0340

Reference: Cove-East Fork Virgin River Watershed Plan EIS Project

Dear Ms. Parry:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with Kane County Water Conservancy District (KCWCD), as the project sponsor and Washington County Water Conservancy District (WCWCD) as the co-sponsor, is considering proposed improvements within the East Fork Virgin River Watershed. The proposed improvements include the construction of a new, approximately 6,055-acre-foot capacity reservoir (Cove Reservoir), as well as other improvements within the existing Mt. Carmel, Glendale and Orderville Irrigation Systems, as needed or identified. Improvements under consideration will address water conservation, agricultural and municipal demands, and public safety risks, while enhancing aquatic species habitat and increasing opportunities for public recreation. Alternative reservoir locations are being examined as well.

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Emily Fife

EMILY FIFE
State Conservationist

Enclosure: Project Fact Sheet/Scoping Notice

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Tara S. Hoffmann, NRCS, State Cultural Resources Specialist, NRCS, Salt Lake City, UT
Norm Evenstad, NRCS, Assistant State Conservationist-Water Resources, NRCS, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, NRCS, Salt Lake City, UT
Leslie Warta, NRCS, Environmental Compliance Specialist, NRCS, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

January 14, 2022

Mr. Shanandoah (Shanan) Anderson
Cultural Manager
Moapa Band of Paiute Indians of the Moapa River Indian Reservation
P.O. Box 340
Moapa, Nevada 89025-0340

Reference: Cove-East Fork Virgin River Watershed Plan EIS Project

Dear Mr. Anderson:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with Kane County Water Conservancy District (KCWCD), as the project sponsor and Washington County Water Conservancy District (WCWCD) as the co-sponsor, is considering proposed improvements within the East Fork Virgin River Watershed. The proposed improvements include the construction of a new, approximately 6,055-acre-foot capacity reservoir (Cove Reservoir), as well as other improvements within the existing Mt. Carmel, Glendale and Orderville Irrigation Systems, as needed or identified. Improvements under consideration will address water conservation, agricultural and municipal demands, and public safety risks, while enhancing aquatic species habitat and increasing opportunities for public recreation. Alternative reservoir locations are being examined as well.

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Emily Fife

EMILY FIFE
State Conservationist

Enclosure: Project Fact Sheet/Scoping Notice

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Tara S. Hoffmann, NRCS, State Cultural Resources Specialist, NRCS, Salt Lake City, UT
Norm Evenstad, NRCS, Assistant State Conservationist-Water Resources, NRCS, Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, NRCS, Salt Lake City, UT
Leslie Warta, NRCS, Environmental Compliance Specialist, NRCS, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

January 14, 2022

Ms. Ona Segundo
Chairwoman
Kaibab Band of Paiute Indians of the Kaibab Indian Reservation
Tribal Affairs Building
HC65, Box 2
Fredonia, Arizona 86022

Reference: Cove-East Fork Virgin River Watershed Plan EIS Project

Dear Ms. Segundo:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with Kane County Water Conservancy District (KCWCD), as the project sponsor and Washington County Water Conservancy District (WCWCD) as the co-sponsor, is considering proposed improvements within the East Fork Virgin River Watershed. The proposed improvements include the construction of a new, approximately 6,055-acre-foot capacity reservoir (Cove Reservoir), as well as other improvements within the existing Mt. Carmel, Glendale and Orderville Irrigation Systems, as needed or identified. Improvements under consideration will address water conservation, agricultural and municipal demands, and public safety risks, while enhancing aquatic species habitat and increasing opportunities for public recreation. Alternative reservoir locations are being examined as well.

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Emily Fife

EMILY FIFE
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Enclosure: Project Fact Sheet/Scoping Notice

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Derek Hamilton, NRCS, Water Resources Coordinator, NRCS, Salt Lake City, UT
Leslie Warta, NRCS, Environmental Compliance Specialist, NRCS, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

January 14, 2022

Ms. Carlene Yellowhair
President
San Juan Southern Paiute Tribe of Arizona
50 South Main Street, Suite 201
P.O. Box 2950
Tuba City, Arizona 86045

Reference: Cove-East Fork Virgin River Watershed Plan EIS Project

Dear Ms. Yellowhair:

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), in coordination with Kane County Water Conservancy District (KCWCD), as the project sponsor and Washington County Water Conservancy District (WCWCD) as the co-sponsor, is considering proposed improvements within the East Fork Virgin River Watershed. The proposed improvements include the construction of a new, approximately 6,055-acre-foot capacity reservoir (Cove Reservoir), as well as other improvements within the existing Mt. Carmel, Glendale and Orderville Irrigation Systems, as needed or identified. Improvements under consideration will address water conservation, agricultural and municipal demands, and public safety risks, while enhancing aquatic species habitat and increasing opportunities for public recreation. Alternative reservoir locations are being examined as well.

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Leslie Warta, NRCS, Environmental Compliance Specialist, NRCS, Salt Lake City, UT
Brian Parker, Environmental Coordinator, Transcon Environmental, Cedar City, UT

Project Information

The U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), with assistance of the Kane County Water Conservancy District as the project sponsor and Washington County Water Conservancy District as the co-sponsor, is considering proposed improvements within the East Fork Virgin River Watershed. The proposed improvements include a new water storage facility (Cove Reservoir), or an alternate reservoir site, as well as other improvements associated with the Mt. Carmel, Glendale, and Orderville irrigation systems.

Supplemental technical studies are scheduled to take place during fall 2021, with a Draft Watershed Plan – Environmental Impact Statement (Plan-EIS) circulated to the public and agencies for review in mid-2022. The Plan-EIS will further evaluate the proposed project along with any viable project alternatives in accordance with the rules and guidelines of the National Environmental Policy Act (NEPA) and Council on Environmental Quality (CEQ).

The Plan-EIS is being funded under the NRCS Watershed Flood Prevention and Protection Program (PL83-566), which provides both technical and financial assistance to help communities protect, improve, and develop water and land resource in watersheds up to 250,000 acres.

Project Background

Initially known as the “Cove Reservoir Watershed” project, alternatives and associated impacts were analyzed in a Watershed Plan-Environmental Assessment (Plan-EA); however, after careful project review and consideration of comments received on the Draft Plan-EA presented in winter 2020/2021, the NRCS has initiated the preparation of a Plan-EIS.

Improvements under consideration include water conservation, water storage, agricultural and municipal demands, public safety risks, and increased opportunities for public recreation in the East Fork Virgin River watershed.

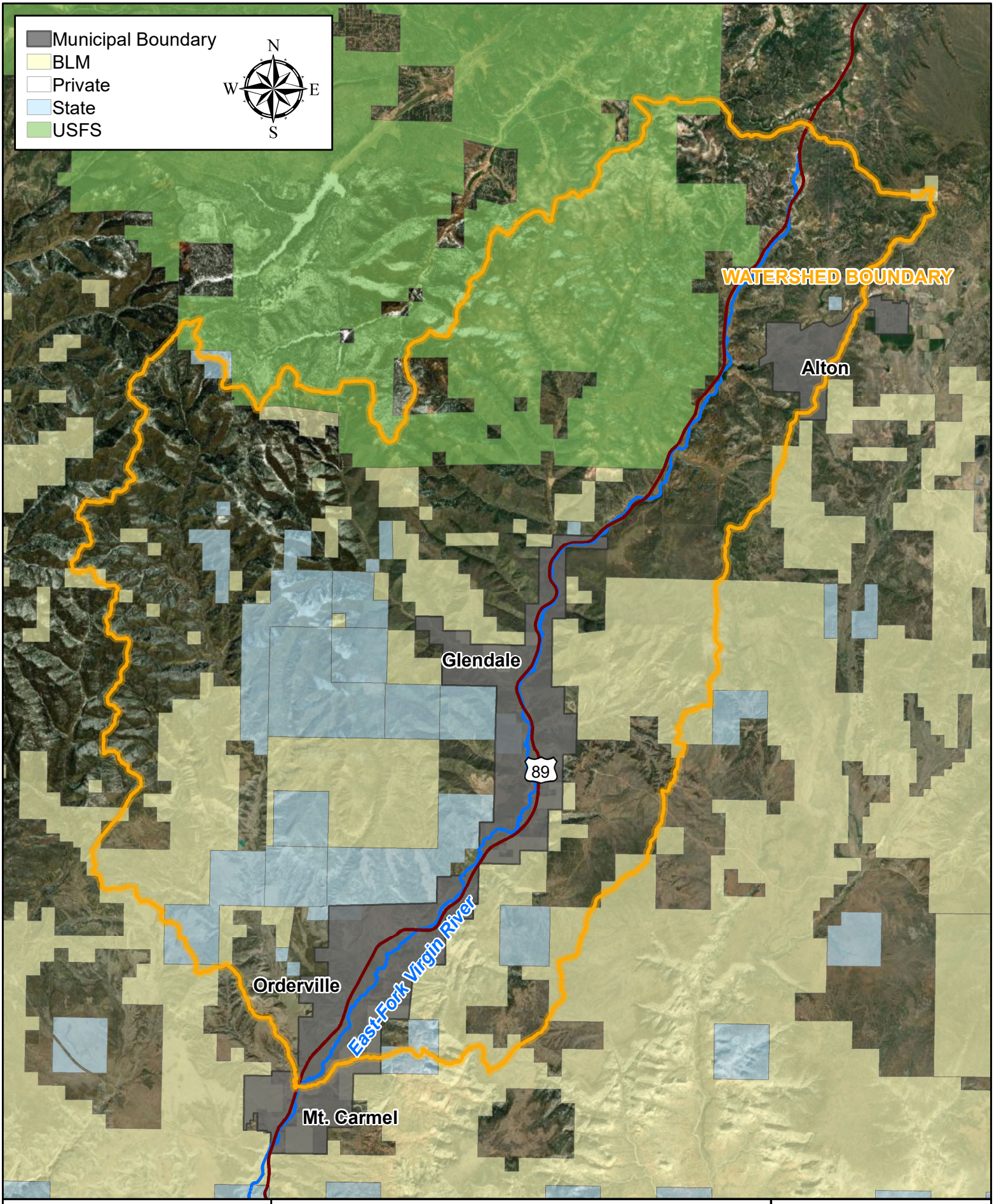
Project Location Map



Project Website

Additional information can be found at the NRCS project website:

https://www.nrcs.usda.gov/wps/portal/nrcs/detail/ut/programs/planning/wpfp/?cid=nrcseprd1403022



Transcon environmental | Planners & Scientists

USDA United States Department of Agriculture
Natural Resources Conservation Service

Cove - East Fork Virgin River Watershed Project

Watershed Boundary Exhibit (97,427 acres)

A-687

0 11,000
Feet

THE HOPI TRIBE

Timothy L. Nuvangyaoma
CHAIRMAN

Craig Andrews
VICE-CHAIRMAN

February 7, 2022

Emily Fife, State Conservationist
Attention: Tara S. Hoffman, Cultural Resources Specialist
Natural Resources Conservation Service
125 South State Street, Room 4010
Salt Lake City, Utah 84138

Re: Warner Draw Watershed Plan-EA
Kanab Creek Watershed Plan-EA
Cove-East Fork Virgin River Watershed=EA

Dear Conservationist Fife,

Thank you for your correspondences dated January 14, 2022, regarding the National Resources Conservation Service (NRCS), proposing the Warner Draw, Kanab Creek, and Cove East Fork Virgin River Watershed Plans-Environmental Assessments. The Hopi Cultural Preservation Office appreciates the NRCS's continuing solicitation of our input and your efforts to address our concerns.

The Hopi Tribe claims cultural affiliation to prehistoric cultural groups in Utah. The Hopi Cultural Preservation Office supports the identification and avoidance of prehistoric archaeological sites and we consider the prehistoric archaeological sites of our ancestors to be "footprints" and Traditional Cultural Properties. We request consultation on any proposal in Utah that has the potential to effect prehistoric cultural resources.

We understand environmental analyses will be prepared, and therefore we look forward to being provided with hard copies of the cultural resources reports and draft environmental assessments for review and comment. If prehistoric cultural resources are identified that will be adversely affected by the proposed projects, we request continuing consultation including being provided with a copy of any proposed treatment plans for review and comment. Thank you for your consideration.

Respectfully,

Stewart B. Koyiyumptewa, Program Manager/ THPO
Hopi Cultural Preservation Office

xc: Utah State Historic Preservation Office

From: Shanan Anderson
To: Hoffmann, Tara - NRCS, Salt Lake City, UT
Subject: [External Email]Cove-East Fork Virgin River Watershed Plan EIS Project
Date: Thursday, March 31, 2022 10:42:06 AM
Attachments: image002.png

[External Email]
If this message comes from an **unexpected sender** or references a **vague/unexpected topic;**
Use caution before clicking links or opening attachments.
Please send any concerns or suspicious messages to: Spam.Abuse@usda.gov

Hi Tara

The Moapa Band of Paiutes do not have any questions or comments concerning project: ***Cove-East Fork Virgin River Watershed Plan EIS Project.***

Thank you for contacting the Moapa band of Paiutes.

Shanandoah Anderson
Cultural Manager
Moapa Band of Paiutes
Office: 702-865-2787 ext. 91
Cell: 702-371-7802

Draft Plan-EIS Notice of Intent - Tribes

May 3, 2022

Ms. Betsy Chapoose
THPO
Cultural Rights Protection Department
Ute Indian Tribe of the Uintah & Ouray Reservation, Utah
P.O. Box 190
Fort Duchesne, Utah 84026

Reference: Cove-East Fork Virgin River Watershed Plan, Kane County, Utah

Dear Ms. Chapoose:

The Natural Resources Conservation Service (NRCS) would like to inform you that the Notice of Intent to prepare an Environmental Impact Statement (EIS) for the Cove-East Fork Virgin River Watershed Plan has been published in the *Federal Register* on Tuesday, March 29, 2022.

A copy of the NOI is enclosed with this letter, and may also be read in its entirety by visiting https://www.federalregister.gov/ and searching for NRCS-2022-0002. You can find additional project information at the NRCS project website:

https://bit.ly/3AX7Pg4

The NRCS invites you to comment on the scope of the EIS. Scoping comments will be accepted through **June 3, 2022**.

Comments may be provided in the following ways:

Online—Go to http://www.regulations.gov and search for docket ID "NRCS-2022-0002". Follow the online instructions for submitting comments.

Mail—Please address to:

Brian Parker, Biologist, Southwest Assistant Regional Manager, 1745 South Alma School Rd. Suite 220, Mesa, Arizona 85044. Please specify the docket ID "NRCS-2022-0002".

Thank you for your interest and input in the planning process for this project. Questions, comments, or concerns may be directed to Tara Hoffmann, NRCS State Cultural Resources Specialist at tara.hoffmann@usda.gov or 801-524-4556.

We look forward to hearing from and continuing to work with you on this important project. We welcome your call if you have questions on the proposed project or if you wish to arrange a

meeting. If you have any questions, comments or concerns, please contact State Cultural Resources Specialist Tara S. Hoffmann at 385-258-1266 or tara.hoffmann@usda.gov, at your earliest convenience.

Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure: NOI Flyer

cc:
Tara S. Hoffmann, NRCS, State Cultural Resources Specialist, Salt Lake City, UT
Norm Evenstad, NRCS, ASTC-Partnerships (Water Resources), Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Transcon, Southwest Assistance Regional Manager, Mesa, AZ

May 3, 2022

Ms. Carlene Yellowhair
President
San Juan Southern Paiute Tribe of Arizona
50 South Main Street, Suite 201
P.O. Box 2950
Tuba City, Arizona 86045

Reference: Cove-East Fork Virgin River Watershed Plan, Kane County, Utah

Dear Ms. Yellowhair:

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Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure: NOI Flyer

cc:
Tara S. Hoffmann, NRCS, State Cultural Resources Specialist, Salt Lake City, UT
Norm Evenstad, NRCS, ASTC-Partnerships (Water Resources), Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Transcon, Southwest Assistance Regional Manager, Mesa, AZ

May 3, 2022

Mr. Curtis Anderson
Chairman
Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony
One Paiute Drive
Las Vegas, Nevada 89106

Reference: Cove-East Fork Virgin River Watershed Plan, Kane County, Utah

Dear Mr. Anderson:

The Natural Resources Conservation Service (NRCS) would like to inform you that the Notice of Intent to prepare an Environmental Impact Statement (EIS) for the Cove-East Fork Virgin River Watershed Plan has been published in the *Federal Register* on Tuesday, March 29, 2022.

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https://bit.ly/3AX7Pg4

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Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Transcon, Southwest Assistance Regional Manager, Mesa, AZ

May 3, 2022

Ms. Dorena Martineau
Paiute Indian Tribe of Utah
440 North Paiute Drive
Cedar City, Utah 84721

Reference: Cove-East Fork Virgin River Watershed Plan, Kane County, Utah

Dear Ms. Martineau:

The Natural Resources Conservation Service (NRCS) would like to inform you that the Notice of Intent to prepare an Environmental Impact Statement (EIS) for the Cove-East Fork Virgin River Watershed Plan has been published in the *Federal Register* on Tuesday, March 29, 2022.

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Brian Parker, Transcon, Southwest Assistance Regional Manager, Mesa, AZ

May 3, 2022

Mr. Daniel Bullets
Kaibab Band of Paiute Indians of the Kaibab Indian Reservation
Cultural Preservation Office
HC65, Box 2
Fredonia, Arizona 86022

Reference: Cove-East Fork Virgin River Watershed Plan, Kane County, Utah

Dear Mr. Bullets:

The Natural Resources Conservation Service (NRCS) would like to inform you that the Notice of Intent to prepare an Environmental Impact Statement (EIS) for the Cove-East Fork Virgin River Watershed Plan has been published in the *Federal Register* on Tuesday, March 29, 2022.

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Brian Parker, Transcon, Southwest Assistance Regional Manager, Mesa, AZ

May 3, 2022

Mr. Darren Daboda
THPO
Moapa Band of Paiutes
1 Lincoln Street
PO Box 340
Moapa, NV 89025

Reference: Cove-East Fork Virgin River Watershed Plan, Kane County, Utah

Dear Mr. Daboda:

The Natural Resources Conservation Service (NRCS) would like to inform you that the Notice of Intent to prepare an Environmental Impact Statement (EIS) for the Cove-East Fork Virgin River Watershed Plan has been published in the *Federal Register* on Tuesday, March 29, 2022.

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Brian Parker, Transcon, Southwest Assistance Regional Manager, Mesa, AZ

May 3, 2022

Mr. Jonathan Nez
President
Navajo Nation Office of the President
P.O. Box 7440
Window Rock, Arizona 86515

Reference: Cove-East Fork Virgin River Watershed Plan, Kane County, Utah

Dear Mr. Nez:

The Natural Resources Conservation Service (NRCS) would like to inform you that the Notice of Intent to prepare an Environmental Impact Statement (EIS) for the Cove-East Fork Virgin River Watershed Plan has been published in the *Federal Register* on Tuesday, March 29, 2022.

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Brian Parker, Transcon, Southwest Assistance Regional Manager, Mesa, AZ

May 3, 2022

Dr. Kurt Dongoske
Director and Tribal Historic Preservation Officer
Pueblo of Zuni
P.O. Box 1149
Zuni, New Mexico 87327

Reference: Cove-East Fork Virgin River Watershed Plan, Kane County, Utah

Dear Dr. Dongoske:

The Natural Resources Conservation Service (NRCS) would like to inform you that the Notice of Intent to prepare an Environmental Impact Statement (EIS) for the Cove-East Fork Virgin River Watershed Plan has been published in the *Federal Register* on Tuesday, March 29, 2022.

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Brian Parker, Transcon, Southwest Assistance Regional Manager, Mesa, AZ

May 3, 2022

Ms. Laura Parry
Chairwoman
Moapa Band of Paiute Indians of the Moapa River Indian
Reservation, Nevada
P.O. Box 340
Moapa, Nevada 89025-0340

Reference: Cove-East Fork Virgin River Watershed Plan, Kane County, Utah

Dear Ms. Parry:

The Natural Resources Conservation Service (NRCS) would like to inform you that the Notice of Intent to prepare an Environmental Impact Statement (EIS) for the Cove-East Fork Virgin River Watershed Plan has been published in the *Federal Register* on Tuesday, March 29, 2022.

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Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Transcon, Southwest Assistance Regional Manager, Mesa, AZ

May 3, 2022

Mr. Luke Duncan
Chairman
Ute Indian Tribe of the Uintah & Ouray Reservation, Utah
P.O. Box 190
Fort Duchesne, Utah 84026

Reference: Cove-East Fork Virgin River Watershed Plan, Kane County, Utah

Dear Mr. Duncan:

The Natural Resources Conservation Service (NRCS) would like to inform you that the Notice of Intent to prepare an Environmental Impact Statement (EIS) for the Cove-East Fork Virgin River Watershed Plan has been published in the *Federal Register* on Tuesday, March 29, 2022.

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Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Transcon, Southwest Assistance Regional Manager, Mesa, AZ

May 3, 2022

Mr. Malcolm Lehi
Council Representative
White Mesa, Ute Council
P.O. Box 7096
White Mesa, Utah 84511

Reference: Cove-East Fork Virgin River Watershed Plan, Kane County, Utah

Dear Mr. Lehi:

The Natural Resources Conservation Service (NRCS) would like to inform you that the Notice of Intent to prepare an Environmental Impact Statement (EIS) for the Cove-East Fork Virgin River Watershed Plan has been published in the *Federal Register* on Tuesday, March 29, 2022.

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Brian Parker, Transcon, Southwest Assistance Regional Manager, Mesa, AZ

May 3, 2022

Mr. Manuel Heart
Chairman
Ute Mountain Ute Tribe
P.O. Box JJ
125 Mikewash Road
Towaoc, Colorado 81334

Reference: Cove-East Fork Virgin River Watershed Plan, Kane County, Utah

Dear Mr. Heart:

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May 3, 2022

Ms. Ona Segundo
Chairwoman
Kaibab Band of Paiute Indians of the Kaibab Indian Reservation
Tribal Affairs Building
HC65, Box 2
Fredonia, Arizona 86022

Reference: Cove-East Fork Virgin River Watershed Plan, Kane County, Utah

Dear Ms. Segundo:

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Brian Parker, Transcon, Southwest Assistance Regional Manager, Mesa, AZ

May 3, 2022

Mr. Shanandoah (Shanan) Anderson
Cultural Manager
Moapa Band of Paiute Indians of the Moapa River Indian Reservation
P.O. Box 340
Moapa, Nevada 89025-0340

Reference: Cove-East Fork Virgin River Watershed Plan, Kane County, Utah

Dear Mr. Anderson:

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May 3, 2022

Mr. Stewart B. Koyiyumptewa
THPO
Hopi Tribe of Arizona
Hopi Cultural Preservation Office
P.O Box 123
Kykotsmovi, Arizona 86039

Reference: Cove-East Fork Virgin River Watershed Plan, Kane County, Utah

Dear Mr. Koyiyumptewa:

The Natural Resources Conservation Service (NRCS) would like to inform you that the Notice of Intent to prepare an Environmental Impact Statement (EIS) for the Cove-East Fork Virgin River Watershed Plan has been published in the *Federal Register* on Tuesday, March 29, 2022.

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cc:
Tara S. Hoffmann, NRCS, State Cultural Resources Specialist, Salt Lake City, UT
Norm Evenstad, NRCS, ASTC-Partnerships (Water Resources), Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Transcon, Southwest Assistance Regional Manager, Mesa, AZ

May 3, 2022

Mr. Terry Knight
Tribal Historic Preservation Officer
Ute Mountain Ute Tribe
P.O. Box 468
Towaoc, Colorado 81334

Reference: Cove-East Fork Virgin River Watershed Plan, Kane County, Utah

Dear Mr. Knight:

The Natural Resources Conservation Service (NRCS) would like to inform you that the Notice of Intent to prepare an Environmental Impact Statement (EIS) for the Cove-East Fork Virgin River Watershed Plan has been published in the *Federal Register* on Tuesday, March 29, 2022.

A copy of the NOI is enclosed with this letter, and may also be read in its entirety by visiting https://www.federalregister.gov/ and searching for NRCS-2022-0002. You can find additional project information at the NRCS project website:

https://bit.ly/3AX7Pg4

The NRCS invites you to comment on the scope of the EIS. Scoping comments will be accepted through **June 3, 2022**.

Comments may be provided in the following ways:

Online—Go to http://www.regulations.gov and search for docket ID "NRCS-2022-0002". Follow the online instructions for submitting comments.

Mail—Please address to:

Brian Parker, Biologist, Southwest Assistant Regional Manager, 1745 South Alma School Rd. Suite 220, Mesa, Arizona 85044. Please specify the docket ID "NRCS-2022-0002".

Thank you for your interest and input in the planning process for this project. Questions, comments, or concerns may be directed to Tara Hoffmann, NRCS State Cultural Resources Specialist at tara.hoffmann@usda.gov or 801-524-4556.

We look forward to hearing from and continuing to work with you on this important project. We welcome your call if you have questions on the proposed project or if you wish to arrange a meeting. If you have any questions, comments or concerns, please contact State Cultural Resources

Specialist Tara S. Hoffmann at 385-258-1266 or tara.hoffmann@usda.gov, at your earliest convenience.

Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure: NOI Flyer

cc:
Tara S. Hoffmann, NRCS, State Cultural Resources Specialist, Salt Lake City, UT
Norm Evenstad, NRCS, ASTC-Partnerships (Water Resources), Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Transcon, Southwest Assistance Regional Manager, Mesa, AZ
Ms. Nichol Shurack, Tribal Archaeologist, Ute Mountain Ute Tribe, P.O. Box 468, Towaoc, CO 81334

May 3, 2022

Mr. Timothy L. Nuvangyaoma
Chairman
Hopi Tribe Chairman's Office
P.O. Box 123
Kykotsmovi, Arizona 86039

Reference: Cove-East Fork Virgin River Watershed Plan, Kane County, Utah

Dear Mr. Nuvangyaoma:

The Natural Resources Conservation Service (NRCS) would like to inform you that the Notice of Intent to prepare an Environmental Impact Statement (EIS) for the Cove-East Fork Virgin River Watershed Plan has been published in the *Federal Register* on Tuesday, March 29, 2022.

A copy of the NOI is enclosed with this letter, and may also be read in its entirety by visiting https://www.federalregister.gov/ and searching for NRCS-2022-0002. You can find additional project information at the NRCS project website:

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Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure: NOI Flyer

cc:
Tara S. Hoffmann, NRCS, State Cultural Resources Specialist, Salt Lake City, UT
Norm Evenstad, NRCS, ASTC-Partnerships (Water Resources), Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Transcon, Southwest Assistance Regional Manager, Mesa, AZ

May 3, 2022

Mr. Val Panteah Sr.
Governor
Pueblo of Zuni
P.O. Box 339
Zuni, New Mexico 87327

Reference: Cove-East Fork Virgin River Watershed Plan, Kane County, Utah

Dear Mr. Panteah:

The Natural Resources Conservation Service (NRCS) would like to inform you that the Notice of Intent to prepare an Environmental Impact Statement (EIS) for the Cove-East Fork Virgin River Watershed Plan has been published in the *Federal Register* on Tuesday, March 29, 2022.

A copy of the NOI is enclosed with this letter, and may also be read in its entirety by visiting https://www.federalregister.gov/ and searching for NRCS-2022-0002. You can find additional project information at the NRCS project website:

https://bit.ly/3AX7Pg4

The NRCS invites you to comment on the scope of the EIS. Scoping comments will be accepted through **June 3, 2022**.

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Brian Parker, Biologist, Southwest Assistant Regional Manager, 1745 South Alma School Rd. Suite 220, Mesa, Arizona 85044. Please specify the docket ID "NRCS-2022-0002".

Thank you for your interest and input in the planning process for this project. Questions, comments, or concerns may be directed to Tara Hoffmann, NRCS State Cultural Resources Specialist at tara.hoffmann@usda.gov or 801-524-4556.

We look forward to hearing from and continuing to work with you on this important project. We welcome your call if you have questions on the proposed project or if you wish to arrange a meeting. If you have any questions, comments or concerns, please contact State Cultural Resources

Specialist Tara S. Hoffmann at 385-258-1266 or tara.hoffmann@usda.gov, at your earliest convenience.

Sincerely,

Emily Fife

EMILY FIFE
State Conservationist

Enclosure: NOI Flyer

cc:
Tara S. Hoffmann, NRCS, State Cultural Resources Specialist, Salt Lake City, UT
Norm Evenstad, NRCS, ASTC-Partnerships (Water Resources), Salt Lake City, UT
Derek Hamilton, NRCS, Water Resources Coordinator, Salt Lake City, UT
Brian Parker, Transcon, Southwest Assistance Regional Manager, Mesa, AZ

Agency Coordination and Consultation

Cooperating Agency Status Letters and Replies – Plan-EA

USDA

United States Department of Agriculture

Natural Resources
Conservation Service

Utah State Office

125 South State Street
Room 4010
Salt Lake City, UT 84138

Ph: 801-524-4550
Fax: 844-715-4928
www.ut.nrcs.usda.gov

Date: February 12, 2018

Mr. Jason Gipson
Chief - Nevada-Utah Regulatory Branch
U.S. Army Corps of Engineers
533 West 2600 South, Suite 150
Bountiful, Utah 84010

RE: Formal request to be a Cooperating Agency in the development of several watershed Environmental Assessments (EA) in Utah.

Dear Mr. Gipson:

In accordance with the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) at 40 CFR Part 1501.6, Natural Resources Conservation Service (NRCS) is formally requesting that U.S. Army Corps of Engineers (ACOE) become a cooperating agency in the planning and development of several Watershed EA efforts in Utah. The names and locations of these proposed projects are listed in Attachment-1.

This request is made since your agency is identified as having special expertise or jurisdiction by law related to this project. The EAs are being prepared to fulfill the NRCS NEPA compliance responsibilities pertaining to our Federal financial assistance through the Watershed Protection and Flood Prevention Program (Public Law 83-566) for these projects. As your agency may also have NEPA compliance responsibilities concerning these projects, preparation of the EAs should also assist in fulfilling environmental review requirements for your agency or other federal agencies and meet NEPA's intent of reducing duplication and delay between agencies.

Upon acceptance of this invitation, roles can be defined in an informal agreement or a formal MOU can be established. If your agency is unable to participate as a cooperating agency please return a written explanation why your agency cannot participate. The NRCS shall accept designation as the lead Federal agency to act on behalf of the ACOE for purposes of compliance with the Section 7 of the Endangered Species Act and Section 106 of the National Historic Preservation Act.

Please send a letter confirming your decision by **March 15, 2018 to:** Timothy Wilson, State Conservationist, USDA-NRCS, Wallace F Bennett Federal Building, 125 South State Street, Room 4010, Salt Lake City, Utah 84138-1100.

Thank you for your timely response and cooperation with these efforts. If you have any questions or comments, please contact Bronson Smart, State Conservation Engineer, at bronson.smat1@ut.usda.gov or (801) 524-4559; or Norm Evenstad, Water Resources Coordinator, at norm.evenstad@ut.usda.gov or (801) 524-4569.

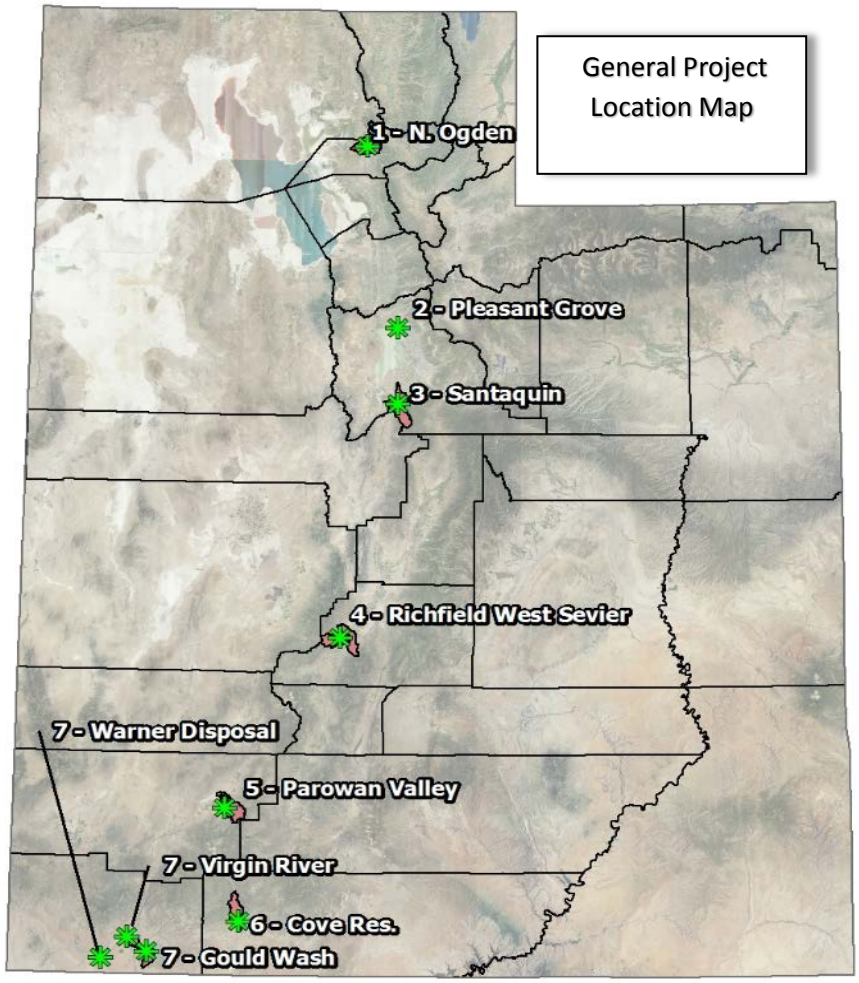
Sincerely,

TIMOTHY WILSON
State Conservationist

cc:
Mike Larsen, Acting Assistant State Conservationist-Field Operations (South), NRCS, Richfield, UT
Don Ashby, Assistance State Conservationist-Field Operations (N01th), NRCS, Ogden, UT
Bronson Smml, State Conservation Engineer-Rehab Program Manager, NRCS, Salt Lake City, UT
Norm Evenstad, Water Resources Coordinator, NRCS, Salt Lake City, UT

An Equal Opportunity Provider and Employer

UTAH-NRCS - PL566 WATERSHED PLAN-ENVIRONMENTAL ASSESSMENT WORK



PL566 Project Name	Location/Various	Summary description of proposed work
1-North Ogden Weber-Box Elder Conservation District	41.301537° -111.975893°	Relocate & expand 2550 North Detention Basin, use basin for water storage, flood control, recreation. Water provided from North Ogden canal at about 2 cfs.
2-Pleasant Grove Pleasant Grove City	40.363114° -111.774560°	Pipe 3,100 feet of the open, unlined Mill Ditch located in Pleasant Grove City with 30-inch diameter HDPE pipe.
3-Santaquin Santaquin City	39.969369° -111.770505°	Evaluate the proposed installation of approximately 5 flood control structures along the East bench of Santaquin to protect homes, infrastructure and possibly provide aquifer recharge capability.
4-Richfield W. Sevier Sevier County	38.871435° -112.004222°	New Watershed Plan- Evaluate additional flood control measures needed throughout the Richfield-West Sevier County area (Flat Canyon). Recreation, trails, canal piping, habitat development.
5-Parowan Valley Iron County	37.868987° -112.783872°	New Watershed Plan - Evaluate additional flood control measures, debris basin/s, recreation opportunities, irrigation water management, and habitat restoration/enhancement.
6-Cove Reservoir Kane County	37.280257° -112.690638°	Construction of approximately 6,000 acre-foot capacity dam/reservoir for irrigation and recreation in Cove Canyon outside of Orderville, Utah.
7-Warner Draw Group Washington County Gould Wash DB Virgin River Habitat Warner Disposal Pipe	Gould- 37.116769° -113.230050° Virgin- 37.190211° -113.348204° Warner- 37.070515° -113.498451°	Construction of a debris basin in Gould Wash above Hurricane, Utah - located on BLM land. Piping of Hurricane canal for more efficient off/on farm irrigation water management and analysis of water savings to enhance Virgin River habitat. Evaluate enhancement of Virgin River endangered fish species and SW willow flycatcher habitat. Partner incl. The Nature Conservancy.

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, SACRAMENTO DISTRICT
1325 J STREET
SACRAMENTO CA 95814-2922

June 7, 2018

Regulatory Division (SPK-2018-00439)

Attn: Mr. Smith
USDA-NRCS
197 E Tabernacle St.
St. George, Utah 84770,

Dear Mr. Smith:

This letter concerns our designation of lead Federal agency for the proposed Cove Reservoir Watershed Project. The approximately 130-acre project site is located approximately 1.25 Miles southwest of the town of Orderville, Latitude 37.2709°, Longitude -112.6621°, Kane County, Utah (enclosure 1).

Following early coordination with your agency on June 7, 2018, we hereby designate the Natural Resources Conservation Service (NRCS) as the lead Federal agency to act on our behalf for purposes of compliance with the Section 7 of the Endangered Species Act (ESA) and Section 106 of the National Historic Preservation Act (NHPA) for Department of the Army authorization required for the Cove Reservoir Watershed Project.

Prior to initiating consultation with the appropriate agency, please coordinate your draft determinations for ESA and NHPA, as well as the information used in making that determination, with our office. Additionally, please include a statement in your consultation letters indicating that we have designated NRCS as the lead Federal agency for the proposed action, along with a copy of this letter.

Please refer to identification number SPK-2018-00439 in any correspondence concerning this project. If you have any questions, please contact Craig Brown at Saint George Regulatory Office, 196 East Tabernacle Street, Suite 30, Saint George, Utah 84770-3474, by email at *Craig.J.Brown@usace.army.mil*, or telephone at (435) 986-3979.

Sincerely,



Craig Brown
Senior Project Manager,
Nevada-Utah Section
Regulatory Division

Enclosure

cc:

Brian Parker (consultant with Transcon Environmental):
bparker@transcon.com

USDA

United States Department of Agriculture

Natural Resources
Conservation Service

Utah State Office

125 South State Street
Room 4010
Salt Lake City, UT 84138

Ph: 801-524-4550
Fax: 844-715-4928
www.ut.nrcs.usda.gov

Date: February 12, 2018

Mr. Larry Crist
Utah Field Office-Supervisor
U.S. Fish and Wildlife Service
2369 West Orton Circle, Suite 50
West Valley City, Utah 84119

RE: Formal Request to be a Cooperating Agency in the development of several Environmental Assessments (EA) in Utah.

Dear Mr. Crist:

In accordance with the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) at 40 CFR Part 1501.6, Natural Resources Conservation Service (NRCS) is formally requesting that U.S. Fish and Wildlife Service (USFWS) become a cooperating agency in the planning and development of several EA efforts in Utah. The names and locations of these proposed project areas are shown and summarized in Attachment 1.

This request is made since your agency is identified as having special expe1tise or jurisdiction by law related to these projects. The EAs are being prepared to fulfill the NRCS NEPA compliance responsibilities pertaining to our Federal financial assistance through the Watershed Protection and Flood Prevention Program as authorized through Public Law 83-566. As your agency may also have NEPA compliance responsibilities concerning these projects, preparation of the EAs should also assist in fulfilling environmental review requirements for your agency or other federal agencies and meet NEPA's intent ofreducing duplication and delay between agencies.

Upon acceptance of this invitation, roles can be defined in an informal agreement or a formal MOU can be established. If your agency is unable to participate as a cooperating agency please return a written explanation why your agency cannot participate. The NRCS shall accept designation as the lead Federal agency to act on behalf of the USFWS for purposes of compliance with the Section 7 of the Endangered Species Act and Section 106 of the National Historic Preservation Act.

Please send a letter confirming your decision by March 15, 2018 to: Timothy Wilson, State Conservationist, USDA-NRCS, Wallace F Bennett Federal Building, 125 South State Street, Room 4010, Salt Lake City, Utah 84138-1100.

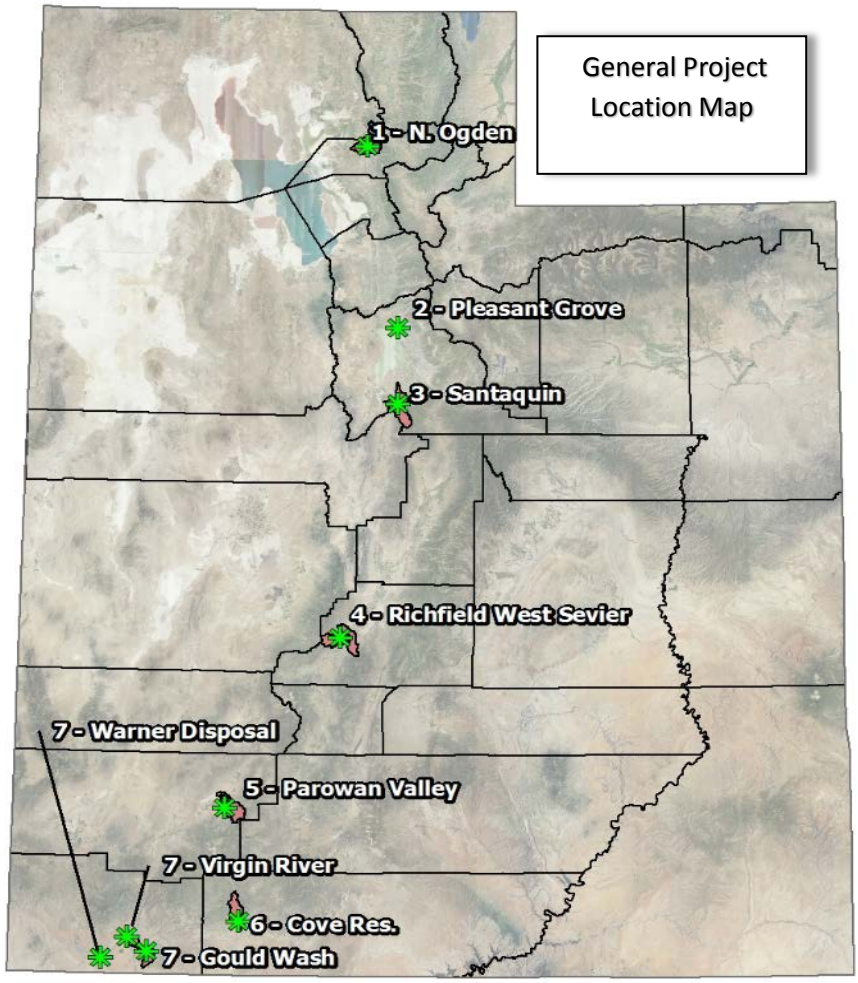
Thank you for your timely response and cooperation with these effo1ts. If you have any questions or comments, please contact Bronson Sma1t, State Conservation Engineer, at bronson.sma1t@ut.usda.gov or (801) 524-4559; or Norm Evenstad, Water Resources Coordinator, at norm.evenstad@ut.usda.gov or (801) 524-4569.

Sincerely,

TIMOTHY WILSON
State Conservationist

cc:
Mike Larsen, Acting Assistant State Conservationist-Field Operations (South), NRCS, Richfield, UT
Don Ashby, Assistance State Conservationist-Field Operations (North), NRCS, Ogden, UT
Bronson Smart, State Conservation Engineer-Rehab Program Manager, NRCS, Salt Lake City, UT
Norm Evenstad, Water Resources Coordinator, NRCS, Salt Lake City, UT

UTAH-NRCS - PL566 WATERSHED PLAN-ENVIRONMENTAL ASSESSMENT WORK



PL566 Project Name	Location/Various	Summary description of proposed work
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2-Pleasant Grove Pleasant Grove City	40.363114° -111.774560°	Pipe 3,100 feet of the open, unlined Mill Ditch located in Pleasant Grove City with 30-inch diameter HDPE pipe.
3-Santaquin Santaquin City	39.969369° -111.770505°	Evaluate the proposed installation of approximately 5 flood control structures along the East bench of Santaquin to protect homes, infrastructure and possibly provide aquifer recharge capability.
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5-Parowan Valley Iron County	37.868987° -112.783872°	New Watershed Plan - Evaluate additional flood control measures, debris basin/s, recreation opportunities, irrigation water management, and habitat restoration/enhancement.
6-Cove Reservoir Kane County	37.280257° -112.690638°	Construction of approximately 6,000 acre-foot capacity dam/reservoir for irrigation and recreation in Cove Canyon outside of Orderville, Utah.
7-Warner Draw Group Washington County Gould Wash DB Virgin River Habitat Warner Disposal Pipe	Gould- 37.116769° -113.230050° Virgin- 37.190211° -113.348204° Warner- 37.070515° -113.498451°	Construction of a debris basin in Gould Wash above Hurricane, Utah - located on BLM land. Piping of Hurricane canal for more efficient off/on farm irrigation water management and analysis of water savings to enhance Virgin River habitat. Evaluate enhancement of Virgin River endangered fish species and SW willow flycatcher habitat. Partner incl. The Nature Conservancy.

United States Department of Agriculture

Natural Resources
Conservation Service

Utah State Office

125 South State Street
Room 4010
Salt Lake City, UT 84138

Ph: 801-524-4550
Fax: 844-715-4928
www.ut.nrcs.usda.gov

Date: February 4, 2019

Ron Thompson
General Manager
Washington County Water Conservancy District
533 E. Waterworks Drive
St. George, Utah 84770

RE: Formal request to be a Cooperating Agency in the development of the Cove Reservoir Watershed Plan-Environmental Assessment (Plan-EA), Washington County, Utah for proposed reservoir storage for agricultural water management and a variety of recreation measures.

Dear Mr. Thompson,

In accordance with the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) at 40 CFR Part 1501.6, Natural Resources Conservation Service (NRCS) is formally requesting that U.S. Bureau of Reclamation (BOR) become a cooperating agency in the planning and development of the Cove Reservoir Watershed EA. The location of the proposed project area is outlined in the attached Figures.

This request is made since your agency is identified as having special expertise, interest or jurisdiction related to this project. The EA is being prepared to fulfill the NRCS NEPA compliance responsibilities pertaining to our Federal financial assistance through the Watershed Protection and Flood Prevention Program as authorized through Public Law 83-566. Upon acceptance of this invitation, draft roles are defined in the attached MOU. If your agency is unable to participate as a cooperating agency please return a written letter (or email) indicating that your agency cannot participate.

Please send notification confirming your decision by to: Timothy Wilson, State Conservationist, USDA-NRCS, Wallace F Bennett Federal Building, 125 South State Street, Room 4010, Salt Lake City, Utah 84138-1100.

Thank you for your response and cooperation with these efforts. If you have any questions or comments, please contact Bronson Smart, State Conservation Engineer, at bronson.smart@ut.usda.gov or (801) 524-4559; or Norm Evenstad, Water Resources Coordinator, at norm.evenstad@ut.usda.gov or (801) 524-4569.

Sincerely,

TIMOTHY WILSON
State Conservationist

cc:
Alan Atkins, Assistant State Con.-Field Operations (South), NRCS, Richfield, UT
Lynn Kitchen, District Conservationist, NRCS, Beaver, Utah
Bronson Smart, State Conservation Engineer-Rehab Program Manager, NRCS, Salt Lake City, UT
Norm Evenstad, Water Resources Coordinator, NRCS, Salt Lake City, UT

USDA is an equal opportunity provider, employer, and lender.

United States Department of Agriculture

Natural Resources
Conservation Service

Utah State Office

125 So. State Street
Room 4010
Salt Lake City, UT
84138-1100

Voice: 801-524-4550
Fax: 801-524-4403

Memorandum of Understanding
Between
U.S. Department of Agriculture's Natural Resources Conservation Service
as the Lead Federal Agency
and
Washington County Water Conservancy District
as Cooperating Agency for Preparation of a
Watershed Plan-Environmental Assessment
for the Cove Reservoir Public Law-566 Watershed Project

I. Introduction

The Natural Resources Conservation Service (NRCS) is the Lead Federal Agency for the development of the Supplemental Watershed Plan-Environmental Assessment (PLAN-EA) as defined in 40 CFR Section 1501.5 for the Cove Reservoir site in Kane County, on private lands near Orderville, Utah. The Washington County Water Conservancy District (WCWCD), herein referred to as the Cooperating Agency, is cooperating in the development of the PLAN-EA as defined in 40 CFR Section 1501.6.

This Memorandum of Understanding (MOU) outlines the roles and responsibilities of the NRCS and Cooperating Agency, herein referred to as Parties, with respect to preparation of the PLAN-EA. This MOU describes responsibilities and procedures agreed to by the Parties.

II. Purpose

The purposes of this MOU are:

1. To designate WCWCD as a Cooperating Agency in the PLAN-EA process.
2. To provide a framework for cooperation and coordination between the Parties that will ensure successful completion of the PLAN-EA in a timely, efficient and thorough manner.
3. To recognize that the NRCS is the Lead Federal Agency with responsibility for the completion of the PLAN-EA and the Finding of No Significant Impact (FONSI).
4. To describe the respective responsibilities, jurisdictional authority, and expertise of the Cooperating Agency in the planning process.

III. Authorities

The authorities and regulations of the NRCS to enter into and engage in the activities described within this MOU include, but are not limited to:

1. National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.).
2. Council on Environmental Quality regulations (40 CFR 1500-1508 et seq.)
3. NRCS Regulations Implementing the NEPA (7 CFR Part 650)
4. Watershed Protection and Flood Prevention Act (PL 83-566, 16 U.S.C. 1000 et seq.)

The authorities and regulations of Cooperating Agency to enter into this MOU include, but are not limited to:

1. National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.)
2. Council on Environmental Quality regulations (40 CFR 1501 et seq.)
3. Federal Land Policy and Management Act of 1976 (43 U.S.C. § 1701, et seq.)

This MOU does not alter any other written agreements, authorities, or responsibilities between the Parties and the project sponsors or other government agencies, or parties.

IV. Roles and Responsibilities

1. General Responsibilities

a. The Parties agree to participate in this planning process in good faith and make all reasonable efforts to resolve disagreements.

b. Each Party agrees to fund its own expenses associated with the PLAN-EA process, except that the NRCS may contract with the Cooperating Agency for technical studies within its jurisdiction or special expertise.

2. NRCS Responsibilities

a. The NRCS, as Lead Federal Agency, has primary responsibility for compliance with the requirements of the National Environmental Policy Act (NEPA) and preparation of the draft PLAN-EA, final PLAN-EA and FONSI.

b. NRCS will provide the Cooperating Agency with those PLAN-EA resource characterization studies and technical reports, as determined necessary by the respective cooperator, for review and comment.

c. NRCS will consult with the Cooperating Agency regarding the alternatives considered and associated mitigation measures to be evaluated in the PLAN-EA.

d. NRCS will identify the Cooperating Agency on the draft PLAN-EA and final PLAN-EA cover pages and will describe in the introduction sections, as provided by the Cooperating Agency, the specific roles and authorities of the Cooperating Agency with respect to the proposed Cove Reservoir Watershed Project.

3. Cooperating Agency Responsibilities

a. The Cooperating Agency will provide early input to NRCS regarding issues to address in the resource characterization studies, technical reports, and PLAN-EA. The Cooperating Agency will also provide comments or analyses to NRCS in those areas where the Cooperating Agency has regulatory authority, technical expertise, and a need for the PLAN-EA to support decisions by the Cooperating Agency. The Cooperating Agency is recognized to have the following jurisdiction by law and/or special expertise:

i. Landowner; Water Rights; Water Conservation; Water Resource Management

b. The Cooperating Agency may review, and provide to NRCS, comments on the issued draft PLAN-EA and final PLAN-EA.

c. The Cooperating Agency and the NRCS will together coordinate under this MOU to maximize the use of resources and minimize duplication of effort during the preparation of the PLAN-EA.

d. Upon issuance of the final PLAN-EA and any resulting FONSI by NRCS, the Cooperating Agency may be able to then adopt the PLAN-EA and issue a separate decision notice under the Cooperating Agency's NEPA implementing regulations.

4. Other Responsibilities

a. Nothing in this MOU shall require any of the Parties to assume any obligation or expend any sum in excess of authorization and appropriations available.

b. Each Party retains all immunities and defenses provided by law with respect to any action based on or occurring because of this MOU.

c. Where the Parties disagree on substantive elements of the PLAN-EA, and these disagreements cannot be resolved, the NRCS will include a summary of the Cooperating Agency's views in the draft PLAN-EA and final PLAN-EA. The NRCS will also describe substantial inconsistencies between its proposed action(s) and the objectives of state, local, or tribal land use plans and policies.

d. Transcon Environmental serves as the Kane County Water Conservancy District's (sponsor) contractor for the PLAN-EA preparation. The project planning is funded through NRCS's Public Law-566 Watershed Protection and Flood Prevention Program. The Cooperating Agency may provide information and comments directly to the contractor as well as collaborate with contractor's technical staff and subcontractors on matters within the Cooperating Agency's jurisdiction or special expertise. The Cooperating Agency acknowledges that the NRCS retains the exclusive responsibility to authorize modifications to the contract with Transcon Environmental and that the Cooperating Agency is not authorized to provide technical or policy direction regarding the performance of this contract.

V. Agency Representatives

1. Each Party will designate a representative and alternate representative, as described in Attachment A, to ensure coordination between the Parties during the preparation of the PLAN-EA. Each Party may change its representative at will by providing written notice to the other Party.

VI. Administration of the MOU

1. This MOU becomes effective upon signature by the authorized officials of the NRCS and the Cooperating Agency.

2. This MOU may be modified by the Parties hereto by mutual agreement only. Any modification will be in writing.

3. This MOU does not alter the authority and responsibilities of the Cooperating Agency under their respective NEPA regulations.

4. This MOU is terminated when either the NRCS FO SI for the project is signed or when written notice is given by a respective agency.

Washington County Water Conservancy District

Ron Thompson
Name

General Manager
Title


Signature

2-8-19
Date

USDA-Natural Resources Conservation Service - Utah

Christopher Taylor
Name

Acting State Conservationist
Title


Signature

2/5/2019
Date

Attachment A
Agency Representatives

NRCS (Lead Federal Agency)

Primary Representative

Norm Evenstad 801-524-4569	Water Resources Coordinator
Name	Title

Backup Representative

Lance Smith 435-704-4861	Civil Engineer
Name	Title

Kane County Water Conservancy District (Sponsor) & Contractor Reps.

Primary Representative/s

Brian Parker -Transcon Environmental	NEPA Oversight, Management
Ron Bolander - Transcon Environmental	NEPA Preparation
Dirk Clayson – KCWCD	Local Irrigation, Planning
Name	Title

Washington County Water Conservancy District (Cooperating Agency)

Primary Representative

Ron W. Thompson	General Manager
Name	Title

Backup Representative

Zach Renstrom	Deputy General Manager
Name	Title

USDA

United States Department of Agriculture

Natural Resources
Conservation Service

Utah State Office

125 South State Street
Room 4010
Salt Lake City, UT 84138

Ph: 801-524-4550
Fax: 844-715-4928
www.ut.nrcs.usda.gov

Date: February 11, 2019

Whit Bunting
Kanab Field Office Manager
U.S. Bureau of Land Management
669 S. Hwy 89A
Kanab, UT 84741

RE: Formal request to be a Cooperating Agency in the development of the Cove Reservoir Watershed Plan-Environmental Assessment (Plan-EA), Washington County, Utah for proposed reservoir storage for agricultural water management and a variety of recreation measures. Potential to include analysis for public borrow pit that is proposed as part of this project.

Dear Mr. Bunting,

In accordance with the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) at 40 CFR Part 1501.6, Natural Resources Conservation Service (NRCS) is formally requesting that the Bureau of Land Management (BLM) become a cooperating agency in the planning and development of the Cove Reservoir Watershed Plan-EA. The location of the proposed project area is outlined in the attached Figures.

This request is made since your agency is identified as having special expertise, interest or jurisdiction related to this project. The EA is being prepared to fulfill the NRCS NEPA compliance responsibilities pertaining to our Federal financial assistance through the Watershed Protection and Flood Prevention Program as authorized through Public Law 83-566. Upon acceptance of this invitation, draft roles are defined in the attached MOU. If your agency is unable to participate as a cooperating agency please return a written letter (or email) indicating that your agency cannot participate.

Please send notification confirming your decision to: Timothy Wilson, State Conservationist, USDA-NRCS, Wallace F Bennett Federal Building, 125 South State Street, Room 4010, Salt Lake City, Utah 84138-1100. An MOU is attached for signature if you wish to be a Cooperating Agency.

Thank you for your response and cooperation with these efforts. If you have any questions or comments, please contact Bronson Smart, State Conservation Engineer, at bronson.smart@ut.usda.gov or (801) 524-4559; or Norm Evenstad, Water Resources Coordinator, at norm.evenstad@ut.usda.gov or (801) 524-4569.

Sincerely,

TIMOTHY WILSON
State Conservationist

cc:
Alan Atkins, Assistant State Con.-Field Operations (South), NRCS, Richfield, UT
Kristi Hatch, District Conservationist, NRCS, Panguitch, Utah
Bronson Smart, State Conservation Engineer-Rehab Program Manager, NRCS, Salt Lake City, UT
Norm Evenstad, Water Resources Coordinator, NRCS, Salt Lake City, UT

USDA is an equal opportunity provider, employer, and lender.

USDA

United States Department of Agriculture

Natural Resources
Conservation Service

Utah State Office

125 So State Street
Room 4010
Salt Lake City UT
84138-1100

Voice 801-524-4550
Fax 801-524-4403

Memorandum of Understanding
Between
U.S. Department of Agriculture's Natural Resources Conservation Service
as the Lead Federal Agency
and
U.S. Bureau of Land Management
as Cooperating Agency for Preparation of a
Watershed Plan-Environmental Assessment
for the Cove Reservoir Public Law-566 Watershed Project

I. Introduction

The Natural Resources Conservation Service (NRCS) is the Lead Federal Agency for the development of the Supplemental Watershed Plan-Environmental Assessment (PLAN-EA) as defined in 40 CFR Section 1501.5 for the Cove Reservoir site in Kane County, on private lands near Orderville, Utah. The Bureau of Land Management (BLM), herein referred to as the Cooperating Agency, is cooperating in the development of the PLAN-EA as defined in 40 CFR Section 1501.6.

This Memorandum of Understanding (MOU) outlines the roles and responsibilities of the NRCS and Cooperating Agency, herein referred to as Parties, with respect to preparation of the PLAN-EA. This MOU describes responsibilities and procedures agreed to by the Parties.

II. Purpose

The purposes of this MOU are:

1. To designate BLM as a Cooperating Agency in the PLAN-EA process.
2. To provide a framework for cooperation and coordination between the Parties that will ensure successful completion of the PLAN-EA in a timely, efficient and thorough manner.
3. To recognize that the NRCS is the Lead Federal Agency with responsibility for the completion of the PLAN-EA and the Finding of No Significant Impact (FONSI).
4. To describe the respective responsibilities, jurisdictional authority, and expertise of the Cooperating Agency in the planning process.

III. Authorities

The authorities and regulations of the NRCS to enter into and engage in the activities described within this MOU include, but are not limited to:

1. National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.).
2. Council on Environmental Quality regulations (40 CFR 1500-1508 et seq.)
3. NRCS Regulations Implementing the NEPA (7 CFR Part 650)
4. Watershed Protection and Flood Prevention Act (PL 83-566, 16 U.S.C. 1000 et seq.)

The authorities and regulations of Cooperating Agency to enter into this MOU include, but are not limited to:

1. National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.)
2. Council on Environmental Quality regulations (40 CFR 1501 et seq.)
3. Federal Land Policy and Management Act of 1976 (43 U.S.C. § 1701, et seq.)

This MOU does not alter any other written agreements, authorities, or responsibilities between the Parties and the project sponsors or other government agencies, or parties.

IV. Roles and Responsibilities

1. General Responsibilities

a. The Parties agree to participate in this planning process in good faith and make all reasonable efforts to resolve disagreements.

b. Each Party agrees to fund its own expenses associated with the PLAN-EA process, except that the NRCS may contract with the Cooperating Agency for technical studies within its jurisdiction or special expertise.

2. NRCS Responsibilities

a. The NRCS, as Lead Federal Agency, has primary responsibility for compliance with the requirements of the National Environmental Policy Act (NEPA) and preparation of the draft PLAN-EA, final PLAN-EA and FONSI.

b. NRCS will provide the Cooperating Agency with those PLAN-EA resource characterization studies and technical reports, as determined necessary by the respective cooperator, for review and comment.

c. NRCS will consult with the Cooperating Agency regarding the alternatives considered and associated mitigation measures to be evaluated in the PLAN-EA. Note: Only BLM land involved is potentially for a public borrow pit.

d. NRCS will identify the Cooperating Agency on the draft PLAN-EA and final PLAN-EA cover pages and will describe in the introduction sections, as provided by the Cooperating Agency, the specific roles and authorities of the Cooperating Agency with respect to the proposed Cove Reservoir Watershed Project.

3. Cooperating Agency Responsibilities

a. The Cooperating Agency will provide early input to NRCS regarding issues to address in the resource characterization studies, technical reports, and PLAN-EA. The Cooperating Agency will also provide comments or analyses to NRCS in those areas where the Cooperating Agency has regulatory authority, technical expertise, and a need for the PLAN-EA to support decisions by the Cooperating Agency. The Cooperating Agency is recognized to have the following jurisdiction by law and/or special expertise:

i. Land Manager; Mineral Rights; Land Use, Cultural Resource Inventory, Recreation.

b. The Cooperating Agency may review, and provide to NRCS, comments on the issued draft PLAN-EA and final PLAN-EA.

c. The Cooperating Agency and the NRCS will together coordinate under this MOU to maximize the use of resources and minimize duplication of effort during the preparation of the PLAN-EA.

d. Upon issuance of the final PLAN-EA and any resulting FONSI by NRCS, the Cooperating Agency may be able to then adopt the PLAN-EA and issue a separate decision notice under the Cooperating Agency's NEPA implementing regulations.

4. Other Responsibilities

a. Nothing in this MOU shall require any of the Parties to assume any obligation or expend any sum in excess of authorization and appropriations available.

b. Each Party retains all immunities and defenses provided by law with respect to any action based on or occurring because of this MOU.

c. Where the Parties disagree on substantive elements of the PLAN-EA, and these disagreements cannot be resolved, the NRCS will include a summary of the Cooperating Agency's views in the draft PLAN-EA and final PLAN-EA. The NRCS will also describe substantial inconsistencies between its proposed action(s) and the objectives of state, local, or tribal land use plans and policies.

d. Transcon Environmental serves as the Kane County Water Conservancy District's (sponsor) contractor for the PLAN-EA preparation. The project planning is funded through NRCS's Public Law-566 Watershed Protection and Flood Prevention Program. The Cooperating Agency may provide information and comments directly to the contractor as well as collaborate with contractor's technical staff and subcontractors on matters within the Cooperating Agency's jurisdiction or special expertise. The Cooperating Agency acknowledges that the NRCS retains the exclusive responsibility to authorize modifications to the contract with Transcon Environmental and that the Cooperating Agency is not authorized to provide technical or policy direction regarding the performance of this contract.

V. Agency Representatives

1. Each Party will designate a representative and alternate representative, as described in Attachment A, to ensure coordination between the Parties during the preparation of the PLAN-EA. Each Party may change its representative at will by providing written notice to the other Party.

VI. Administration of the MOU

1. This MOU becomes effective upon signature by the authorized officials of the NRCS and the Cooperating Agency.

2. This MOU may be modified by the Parties hereto by mutual agreement only. Any modification will be in writing.

3. This MOU does not alter the authority and responsibilities of the Cooperating Agency under their respective NEPA regulations.

4. This MOU is terminated when either the NRCS FONSI for the project is signed or when written notice is given by a respective agency.

Bureau of Land Management

Whit Bunting
Name

Field Office Manger
Title

Signature

2/27/2019
Date

USDA-Natural Resources Conservation Service - Utah

Timothy Wilson
Name

State Conservationist
Title

Signature

2/28/19
Date

Attachment A
Agency Representatives

NRCS (Lead Federal Agency)

Primary Representative

Norm Evenstad (801) 524-4569	Water Resources Coordinator
Name	Title

Backup Representative

Lance Smith (435) 704-4861	Civil Engineer
Name	Title

Kane County Water Conservancy District (Sponsor) & Contractor Reps.

Primary Representative's

Brian Parker -Transcon Environmental	NEPA Oversight, Management
Ron Bolander - Transcon Environmental	NEPA Preparation
Dirk Clayson - KCWCD	Local Irrigation, Planning
Name	Title

Bureau of Land Management – Kanab Field Office (Cooperating Agency)

Primary Representative

James Holland	Geologist
Name	Title

Backup Representative

Name	Title

USDA

United States Department of Agriculture

Natural Resources
Conservation Service

Utah State Office

125 South State Street
Room 4010
Salt Lake City, UT 84138

Ph: 801-524-4550
Fax: 844-715-4928
www.ut.nrcs.usda.gov

Date: February 12, 2019

Kate Hammond
Intermountain Regional Director (acting)
National Park Service
12795 Alameda Parkway
Denver, CO 80225

RE: Formal request to be a Cooperating Agency in the development of the Cove Reservoir Watershed Plan-Environmental Assessment (Plan-EA), Washington County, Utah for proposed reservoir storage for agricultural water management and a variety of recreation measures.

Dear Ms. Hammond,

In accordance with the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) at 40 CFR Part 1501.6, Natural Resources Conservation Service (NRCS) is formally requesting that the National Park Service (NPS) become a cooperating agency in the planning and development of the Cove Reservoir Watershed Plan-EA. The location of the proposed project area is outlined in the attached Figure.

This request is made since your agency is identified as having special expertise, interest or jurisdiction related to this project. The EA is being prepared to fulfill the NRCS NEPA compliance responsibilities pertaining to our Federal financial assistance through the Watershed Protection and Flood Prevention Program as authorized through Public Law 83-566. Upon acceptance of this invitation, draft roles are defined in the attached MOU. If your agency is unable to participate as a cooperating agency please return a written letter (or email) indicating that your agency cannot participate.

Please send notification confirming your decision to: Timothy Wilson, State Conservationist, USDA-NRCS, Wallace F Bennett Federal Building, 125 South State Street, Room 4010, Salt Lake City, Utah 84138-1100. An MOU is attached for signature if you wish to be a Cooperating Agency.

Thank you for your response and cooperation with these efforts. If you have any questions or comments, please contact Bronson Smart, State Conservation Engineer, at bronson.smart@ut.usda.gov or (801) 524-4559; or Norm Evenstad, Water Resources Coordinator, at norm.evenstad@ut.usda.gov or (801) 524-4569.

Sincerely,

TIMOTHY WILSON
State Conservationist

cc:
Alan Atkins, Assistant State Con.-Field Operations (South), NRCS, Richfield, UT
Kristi Hatch, District Conservationist, NRCS, Panguitch, Utah
Bronson Smart, State Conservation Engineer-Program Manager, NRCS, Salt Lake City, UT
Norm Evenstad, Water Resources Coordinator, NRCS, Salt Lake City, UT

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Natural Resources
Conservation Service

Utah State Office

125 So. State Street
Room 4010
Salt Lake City, UT
84138-1100

Voice: 801-524-4550
Fax: 801-524-4403

Memorandum of Understanding
Between
U.S. Department of Agriculture's Natural Resources Conservation Service
as the Lead Federal Agency
and
National Park Service - Zion National Park
as Cooperating Agency for Preparation of a
Watershed Plan-Environmental Assessment
for the Cove Reservoir Public Law-566 Watershed Project

I. Introduction

The Natural Resources Conservation Service (NRCS) is the Lead Federal Agency for the development of the Supplemental Watershed Plan-Environmental Assessment (PLAN-EA) as defined in 40 CFR Section 1501.5 for the Cove Reservoir site in Kane County, on private lands near Orderville, Utah. The National Park Service-Zion National Park (NPS), herein referred to as the Cooperating Agency, is cooperating in the development of the PLAN-EA as defined in 40 CFR Section 1501.6.

This Memorandum of Understanding (MOU) outlines the roles and responsibilities of the NRCS and Cooperating Agency, herein referred to as Parties, with respect to preparation of the PLAN-EA. This MOU describes responsibilities and procedures agreed to by the Parties.

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3. To recognize that the NRCS is the Lead Federal Agency with responsibility for the completion of the PLAN-EA and the Finding of No Significant Impact (FONSI).
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3. NRCS Regulations Implementing the NEPA (7 CFR Part 650)
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c. NRCS will consult with the Cooperating Agency regarding the alternatives considered and associated mitigation measures to be evaluated in the PLAN-EA.

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i. Land Manager; Wild & Scenic Values, Mineral Rights; Land Use, Recreation.

b. The Cooperating Agency may review, and provide to NRCS, comments on the issued draft PLAN-EA and final PLAN-EA.

c. The Cooperating Agency and the NRCS will together coordinate under this MOU to maximize the use of resources and minimize duplication of effort during the preparation of the PLAN-EA.

d. Upon issuance of the final PLAN-EA and any resulting FONSI by NRCS, the Cooperating Agency may be able to then adopt the PLAN-EA and issue a separate decision notice under the Cooperating Agency's NEPA implementing regulations.

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d. Transcon Environmental serves as the Kane County Water Conservancy District's (sponsor) contractor for the PLAN-EA preparation. The project planning is funded through NRCS's Public Law-566 Watershed Protection and Flood Prevention Program. The Cooperating Agency may provide information and comments directly to the contractor as well as collaborate with contractor's technical staff and subcontractors on matters within the Cooperating Agency's jurisdiction or special expertise. The Cooperating Agency acknowledges that the NRCS retains the exclusive responsibility to authorize modifications to the contract with Transcon Environmental and that the Cooperating Agency is not authorized to provide technical or policy direction regarding the performance of this contract.

V. Agency Representatives

1. Each Party will designate a representative and alternate representative, as described in Attachment A, to ensure coordination between the Parties during the preparation of the PLAN-EA. Each Party may change its representative at will by providing written notice to the other Party.

VI. Administration of the MOU

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2. This MOU may be modified by the Parties hereto by mutual agreement only. Any modification will be in writing.

3. This MOU does not alter the authority and responsibilities of the Cooperating Agency under their respective NEPA regulations.

4. This MOU is terminated when either the NRCS FONSI for the project is signed or when written notice is given by a respective agency.

National Park Service-Zion National Park

Kate Hammond
Name

Intermountain Regional Director (acting)
Title

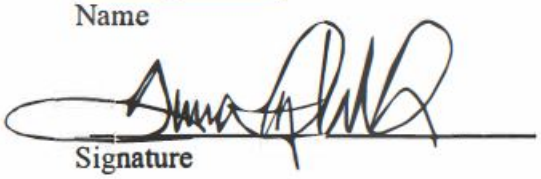
Signature

Date

USDA-Natural Resources Conservation Service - Utah

Timothy Wilson
Name

State Conservationist
Title



Signature

2/12/19
Date

Attachment A
Agency Representatives

NRCS (Lead Federal Agency)

Primary Representative

Norm Evenstad (801) 524-4569	Water Resources Coordinator
Name	Title

Backup Representative

Lance Smith (435) 704-4861	Civil Engineer
Name	Title

Kane County Water Conservancy District (Sponsor) & Contractor Reps.

Primary Representative/s

Brian Parker -Transcon Environmental	NEPA Oversight, Management
Ron Bolander - Transcon Environmental	NEPA Preparation
Dirk Clayson – KCWCD	Local Irrigation, Planning
Name	Title

National Park Service - Zion National Park (Cooperating Agency)

Primary Representative

Jeff Bradybaugh	Zion National Park Superintendent
Name	Title

Backup Representative

Kate Hammond	Intermountain Regional Director (acting)
Name	Title

Cooperating Agency Status Letters and Replies – Plan-EIS

October 15, 2021

Mr. Whit Bunting
Field Manager, Kanab Field Office
Bureau of Land Management
669 East Highway 89A
Kanab, Utah 84741

RE: Formal request to be a Cooperating Agency in the development of the Cove-East Fork Virgin River Watershed Plan-Environmental Impact Statement (Plan-EIS) for proposed improvements in Kane County, Utah.

Dear Mr. Bunting:

In accordance with the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) at 40 CFR Part 1501.8, the Natural Resources Conservation Service (NRCS) is formally requesting that the Bureau of Land Management become a cooperating agency in the planning and development of the Cove-East Fork Virgin River Watershed Plan-EIS. Please visit the project website at https://bit.ly/cove-eastforkvirginriver-EIS for information on the Plan-EIS.

This request is made since your agency is identified as having special expertise or jurisdiction by law related to this project. The Plan-EIS is being prepared to fulfill our NEPA compliance responsibilities pertaining to our federal financial assistance through the Watershed Protection and Flood Prevention Program as authorized through Public Law 83-566. Upon acceptance of this invitation, roles can be defined in an informal agreement or a memorandum of understanding. If your agency is unable to participate as a cooperating agency, please return a written explanation indicating that your agency cannot participate.

Please send notification confirming your decision to: Emily Fife, State Conservationist, NRCS, Wallace F Bennett Federal Building, 125 South State Street, Room 4010, Salt Lake City, Utah 84138-1100.

Thank you for your timely response and assistance with these efforts. If you have any questions, please contact Derek Hamilton, Water Resources Coordinator, at derek.hamilton@usda.gov or 801/524-4560.

Sincerely,

Norm Evenstad

NORM EVENSTAD
Asst. State Conservationist - Water Resources

cc:
Alan Atkins, Area Conservationist, NRCS, Richfield, UT
Kristi Westwood, District Conservationist, NRCS, Panguitch, UT
Derek Hamilton, Water Resources Coordinator, NRCS, Salt Lake City, UT

October 15, 2021

Environmental Protection Agency
ATTN: NEPA Program Director
1595 Wynkoop Street
Denver, CO 80202

RE: Formal request to be a Cooperating Agency in the development of the Cove-East Fork Virgin River Watershed Plan-Environmental Impact Statement (Plan-EIS) for proposed improvements in Kane County, Utah.

Dear NEPA Program Director:

In accordance with the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) at 40 CFR Part 1501.8, the Natural Resources Conservation Service (NRCS) is formally requesting that the Environmental Protection Agency become a cooperating agency in the planning and development of the Cove-East Fork Virgin River Watershed Plan-EIS. Please visit the project website at https://bit.ly/cove-eastforkvirginriver-EIS for information on the Plan-EIS.

This request is made since your agency is identified as having special expertise or jurisdiction by law related to this project. The Plan-EIS is being prepared to fulfill our NEPA compliance responsibilities pertaining to our federal financial assistance through the Watershed Protection and Flood Prevention Program as authorized through Public Law 83-566. Upon acceptance of this invitation, roles can be defined in an informal agreement or a memorandum of understanding. If your agency is unable to participate as a cooperating agency, please return a written explanation indicating that your agency cannot participate.

Please send notification confirming your decision to: Emily Fife, State Conservationist, NRCS, Wallace F Bennett Federal Building, 125 South State Street, Room 4010, Salt Lake City, Utah 84138-1100.

Thank you for your timely response and assistance with these efforts. If you have any questions, please contact Derek Hamilton, Water Resources Coordinator, at derek.hamilton@usda.gov or 801/524-4560.

Sincerely,

Norm Evenstad

NORM EVENSTAD
Asst. State Conservationist - Water Resources

cc:
Alan Atkins, Area Conservationist, NRCS, Richfield, UT
Kristi Westwood, District Conservationist, NRCS, Panguitch, UT
Derek Hamilton, Water Resources Coordinator, NRCS, Salt Lake City, UT

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
1595 Wynkoop Street
Denver, CO 80202-1129
Phone 800-227-8917
www.epa.gov/region08

October 29, 2021

Ref: 8ORA-N

Emily Fife, State Conservationist
USDA-NRCS
Wallace F Bennett Federal Building
125 South State Street, Room 4010
Salt Lake City, Utah 84138-1100

Dear Ms. Fife:

The U.S. Environmental Protection Agency (EPA) received the Natural Resources Conservation Service's (NRCS) invitation to become a cooperating agency on the *Cove-East Fork Virgin River Watershed Plan* (EIS). We appreciate NRCS's interest in working with EPA and accept your invitation.

As a cooperating agency, and to the extent that time and resources allow, EPA intends to:

1) Participate in the EIS process, including attending inter-agency coordination meetings and reviewing draft documents in accordance with the lead agency's schedule for providing cooperating agency comments. Due to limited travel funding and pandemic precautions, participation may occur via teleconference;

2) Assist NRCS in identifying significant environmental issues, particularly those that relate to EPA's special expertise and jurisdiction;

3) Provide comments to NRCS on preliminary versions of the Draft and Final EIS in accordance with the lead agency's schedule for providing cooperating agency comments;

4) If requested by NRCS, assist with responses to public comments that concern EPA's areas of expertise and jurisdictional responsibilities as EPA resources allow; and

5) Work with NRCS to develop an EIS consistent with EPA program or agency requirements.

Please note that EPA's status as a cooperating agency does not affect our independent responsibilities under Section 309 of the Clean Air Act to review and does not obligate, commit, or transfer funds. The EPA's cooperating agency status may be acknowledged in the document, but the EPA seal or symbol should not be used unless NRCS receives prior written approval from EPA, and then only if a disclaimer is attached stating that the use of the Agency seal or symbol on this document does not imply any agency's endorsement of the proposed action.

The EPA looks forward to working with NRCS as a cooperating agency in the efficient and effective development of the subject EIS. If you have any questions, please contact Matt Hubner, who will serve as EPA's point of contact at (303) 312-6500 or hubner.matt@epa.gov.

Sincerely,



Philip S. Strobel
Chief, NEPA Branch
Office of the Regional Administrator

Cc: Mr. Derek Hamilton, NRCS

October 15, 2021

Mr. Jeff Bradybaugh
Superintendent, Zion National Park
National Park Service
1 Zion Park Blvd.
Springdale, UT 84767

RE: Formal request to be a Cooperating Agency in the development of the Cove-East Fork Virgin River Watershed Plan-Environmental Impact Statement (Plan-EIS) for proposed improvements in Kane County, Utah.

Dear Mr. Bradybaugh:

In accordance with the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) at 40 CFR Part 1501.8, the Natural Resources Conservation Service (NRCS) is formally requesting that the National Park Service become a cooperating agency in the planning and development of the Cove-East Fork Virgin River Watershed Plan-EIS. Please visit the project website at https://bit.ly/cove-eastforkvirginriver-EIS for information on the Plan-EIS.

This request is made since your agency is identified as having special expertise or jurisdiction by law related to this project. The Plan-EIS is being prepared to fulfill our NEPA compliance responsibilities pertaining to our federal financial assistance through the Watershed Protection and Flood Prevention Program as authorized through Public Law 83-566. Upon acceptance of this invitation, roles can be defined in an informal agreement or a memorandum of understanding. If your agency is unable to participate as a cooperating agency, please return a written explanation indicating that your agency cannot participate.

Please send notification confirming your decision to: Emily Fife, State Conservationist, NRCS, Wallace F Bennett Federal Building, 125 South State Street, Room 4010, Salt Lake City, Utah 84138-1100.

Thank you for your timely response and assistance with these efforts. If you have any questions, please contact Derek Hamilton, Water Resources Coordinator, at derek.hamilton@usda.gov or 801/524-4560.

Sincerely,

Norm Evenstad

NORM EVENSTAD
Asst. State Conservationist - Water Resources

cc:
Alan Atkins, Area Conservationist, NRCS, Richfield, UT
Kristi Westwood, District Conservationist, NRCS, Panguitch, UT
Derek Hamilton, Water Resources Coordinator, NRCS, Salt Lake City, UT

United States Department of the Interior
NATIONAL PARK SERVICE
REGIONS 6, 7, & 8
12795 West Alameda Parkway
P.O. Box 25287
Denver, CO 80225-0287

IN REPLY REFER TO:
1.A.1 (ZION)

April 18, 2022

Ms. Emily Fife, USDA NRCS State Conservationist
Wallace F Bennett Federal Building
125 South State Street Room #4010
Salt Lake City, UT 84138

Subject: NPS comments on the Watershed Plan and Environmental Impact Statement for the Cove-East Fork Virgin River Watershed Project Scoping Period and Cooperating Agency Acceptance

Dear Ms. Fife,

The National Park Service (NPS) appreciates the opportunity to provide comments during the scoping period of the Watershed Plan and Environmental Impact Statement for the Cove-East Fork Virgin River Watershed Project and accepts the request to become a formal cooperating agency with the United States Department of Agriculture, Natural Resource Conservation Service (NRCS). The NPS within Zion National Park (ZION) manages a portion of the East Fork of the Virgin River within the park and holds special expertise regarding Wild and Scenic River, Endangered Species Act, Migratory Bird Treaty Act and Wilderness management. At your earliest convenience, please send ZION a draft of the proposed Memorandum of Understanding for NPS review. In addition to the comments and information requests outlined below, we strongly encourage NRCS to provide information related to impacts this project may have on regional dark night skies and mitigations planned to reduce those impacts.

1. 1996 Zion National Park Water Rights Settlement Agreement

Notably, in 1996 the NPS, State of Utah, Washington County Water Conservancy District, and Kane County Water Conservancy District entered into a historic agreement to establish federal reserved water rights memorialized in the Zion National Park Water Rights Settlement

Agreement (SA). In the SA, the NPS agreed to subordinate its senior water rights to limited future water development in the East Fork of the Virgin River. This includes a cap on cumulative storage capacity in one or more reservoirs not to exceed 6,750 acre-feet and a limitation of individual new reservoirs with total storage capacities greater than 20 acre-feet not to exceed 10 (SA Article II.D.1.a&b). With this limitation on new reservoir development addressed in the SA, restrictions on flow were also established for any new diversion structures constructed for new, large reservoirs (SA Article II.D.3), as well as the timing of diversion for any diversions associated with the new reservoirs with a storage capacity greater than 20 acre-feet (SA Article II.D.6). In addition, limits were set on the bypass flows below any new reservoirs (SA Article II.D.4) and reservoir discharge (SA Article II.D.5). We respectfully request the following information to determine if this proposed project is in compliance with the terms of the SA:

1.A. The location of any diversions associated with this proposed reservoir and the flow planned to be maintained below any new surface water diversions associated with the proposed reservoir.

1.B. The planned timing and diversion rate on all diversions associated with the proposed reservoir.

1.C. The proposed location, timing, and volumetric flow rate of releases and any return flow associated with the proposed reservoir.

The NPS anticipated development of this proposed reservoir whose terms were outlined in the SA. In addition, the NPS is required to evaluate the proposed development for compliance with other federal laws as described below. Therefore, the NPS requests additional information in order to complete the required analyses.

2. Wild and Scenic River Act

As a water resources project requiring federal assistance located upstream of a designated Wild and Scenic River, the East Fork of the Virgin River, this project is required to be evaluated using Section 7 of the Wild and Scenic Rivers Act, to determine if it will invade the river area or unreasonably diminish the river's scenic, recreational, fish, or wildlife values. This evaluation will be completed by the NPS as the river administering agency. The NPS will use information available in the project's National Environmental Policy Act (NEPA) documents to complete the Section 7 Determination. The NPS requests specific information and analysis to be completed in the Watershed Plan and Environmental Impact Statement to inform its Section 7 Determination.

The East Fork of the Virgin River designated Wild and Scenic River provides habitat for four native fish species: desert sucker *(Catostomus clarkia)*, flannelmouth sucker (*Catostomus latipinnis*), virgin spinedace (*Lepidomeda mollispinis*) and speckled dace (*Rhinichthys osculus*). The desert sucker, flannelmouth sucker and Virgin spinedace are each listed as a Utah Species of

Greatest Conservation Need by the Utah Department of Natural Resources. Flow depletion and dewatering caused by stream diversions for agricultural, municipal, and industrial uses are among the primary threats to the desert sucker, flannelmouth sucker, and Virgin spinedace. Prolonged periods of drought and increasing stream temperatures are compounding threat factors that are further exacerbated by flow depletion from stream diversions. Other threat factors listed for fish species native to the East Fork Virgin River include pesticides and other pollutants introduced by return flows from municipal and agricultural drains and runoff, invasive wildlife species, invasive plant species, and the introduction of aquatic invasive parasites and diseases. We respectfully request the following information to help inform the Section 7 Determination:

2.A. The effects this water development project may have on Virgin spinedace, desert sucker, and flannelmouth sucker population and habitat maintenance in the East Fork of the Virgin River must be assessed in the EIS. The 2002 Conservation Agreement and Strategy for Virgin spinedace placed management of the recovery and conservation of Virgin spinedace with the Virgin River Resource Management and Recovery Program (VRRMRP), a multi-agency cooperative program. Please work with the VRRMRP to assess potential impacts and develop mitigations to reduce negative impacts on Virgin spinedace population and habitat in the East Fork of the Virgin River which may include the establishment of population maintenance flows or minimum flow requirements.

2.B. Analysis of how this proposed project will impact natural flow regimes (including the magnitude, frequency, and timing of flood flows) and flow-related habitat variables (including water temperature, turbidity, and sediment transport) under a variety of scenarios including low, normal, and high-water years through the East Fork of the Virgin River Wild and Scenic River.

2.C. Mitigation(s) to prevent non-native fish and aquatic invasive species from escaping into the East Fork of the Virgin River from the proposed reservoir associated with this project.

2.D. Analysis of how municipal and agricultural runoff as well as chemical and pesticide loads will be altered as a result of this proposed project. If increased runoff is expected, please provide information regarding mitigation measures to reduce runoff into the East Fork of the Virgin River.

2.E. Analysis, including any mitigation measures, on the anticipated effects climate change may have on this proposed project, including a reduction in snowpack in the East Fork of the Virgin River Watershed and spring runoff as well as increased air temperatures.

3. Endangered Species Act and Other Sensitive Species

Mexican Spotted Owl (MSO) and MSO Critical Habitat:

The East Fork of the Virgin River and its tributaries are inhabited by MSO and the entirety of ZION is designated critical habitat for MSO. Two breeding territories have been confirmed near the East Fork of the Virgin River. Inventory surveys have not been conducted in the majority of potential breeding habitat that exist along the East Fork, and it is likely more territories exist. Water development, including water diversion and reservoirs can degrade, reduce, and/or fragment MSO habitat and/or disrupt migration corridors, inhibit gene flow, alter prey habitat and/or alter grazing patterns by wild ungulates. Data on the timing of the discharges from the reservoir and how these discharges will alter the natural hydrological cycles and flow rates of the East Fork of the Virgin River (as requested in 2.B) will be needed to evaluate impacts to this protected species and habitat and consult with the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act.

Southwestern Willow Flycatcher (SWFL) and Yellow-Billed Cuckoo (YBCU):

The riparian habitat along the East Fork of the Virgin River provides migratory stop-over habitat and marginal breeding habitat for SWFL and YBCU. Both species have been detected along the Virgin River in ZION or Springdale, UT during migration. Water development can modify, degrade, or reduce SWFL and YBCU habitat especially if water in riparian ecosystems and associated subsurface water tables are reduced. Reduced flows during spring runoff may degrade/alter the quantity of prey (insects) available to migrating SWFL and YBCU. An increase in upstream establishment of non-native vegetation, such as tamarisk and Russian olive, will increase the rate of establishment of these species downstream which can negatively alter SWFL and YBCU habitat. Data on the timing of the discharges from the reservoir and how these discharges will alter the natural hydrological cycles and flow rates of the East Fork of the Virgin River (as requested in 2.B) will be needed to evaluate impacts to these protected species and consult with the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act.

3.A. Provide information on how non-native vegetation will be controlled near the proposed reservoir.

Sensitive and State-listed Species/Other Native Wildlife:

The East Fork of the Virgin River provides habitat for numerous native wildlife species, including State-listed species such as the Arizona toad. Water development projects have the potential to negatively affect wildlife if riparian habitat, fish communities, or aquatic invertebrate populations are negatively altered. Ecologically, if one functional group of wildlife is negatively impacted those effects will cascade to other wildlife species (e.g., if aquatic invertebrates are negatively affected numerous species of bats, birds, amphibians, and reptiles will also be affected). Data on the timing of the discharges from the reservoir and how these discharges will alter the water temperature, natural hydrological cycles and events and flow rates including the

magnitude, frequency, and timing of flood flows (as requested in 2.B) will be needed to evaluate impacts on these species.

4. Migratory Bird Treaty Act

The riparian habitat along the East Fork provides breeding, stop-over, and/or winter habitat for many species of migratory birds. Water development projects can negatively impact the quality and quantity of various habitat components (food, shelter, etc) which can reduce their breeding success or survival. An increase in upstream establishment of non-native vegetation, such as tamarisk and Russian olive, will increase the rate of establishment of these species downstream which can negatively affect migratory birds. Data on timing of the discharges from the reservoir and how these discharges will alter the natural hydrological cycles and flow rates of the East Fork (as requested in 2.B) will be needed to evaluate impacts on these species. Data (as requested in 3.A) on how non-native vegetation will be controlled near the proposed reservoir will also be important to identify.

5. Wilderness Act and Research Natural Areas

The East Fork of the Virgin River flows within congressionally designated Wilderness at ZION and is a primary feature that defines the Wilderness Character of the park. Three characteristics of Wilderness have the potential to be adversely impacted by the proposed water development project: Natural, Untrammeled, and Other Features of Value. NPS management focuses on maintaining this ecological system as substantially free from the effects of modern civilization (Natural) and unhindered and free from initial actions of modern human control or manipulation (Untrammeled). This area also holds unique features of ecological, geological, scientific, educational, scenic, and historical values (Other Features of Value). The presence of human civilization has long resided within Parunuweap Canyon which was only made possible by the river.

This area is also managed by ZION as a Research Natural Area (RNA). In accordance with the NPS Natural Resource Management Reference Manual (DO-77), RNAs are areas designated to be permanently protected and maintained in natural conditions. The ZION General Management Plan specifically calls out Parunuweap Canyon to be managed as an, “undisturbed watershed and riparian corridor.” The East Fork of the Virgin River is a critical component of the Parunuweap RNA which contains a unique ecosystem, ecological features, rare and sensitive species of plants, animals, and their habitats, and provides a high-quality example of a natural ecosystem. ZION manages the East Fork as an RNA to protect the area as a prime example of natural resources and processes, including significant genetic resources that have value for long-term observational studies or as control areas for manipulative research taking place outside of NPS lands.

Again, this aspect of the river emphasizes the need to establish a firm understanding of natural streamflow rates and how these might be altered with any water development infrastructure upstream within the drainage. Data on the timing of the discharges from the reservoir and how these discharges will alter the natural hydrological cycles and flow rates of the East Fork of the Virgin River (as requested in 2.C) will be needed to evaluate impacts to wilderness and the RNA. Identifying and communicating strategies for managing flows, to include anticipated discharge schedules and pulse volumes, will be of critical importance in order for the NPS to remain involved in for the life of the project. Any impacts or changes to winter, scouring flows may alter the riparian corridor and how flow rates would be managed to address low water years when pulses cannot be released will be essential for the NPS to understand.

5.A. Please provide an analysis of impacts this project may have on Wilderness characteristics within the East Fork of the Virgin River in Zion National Park.

We appreciate the opportunity to identify information needs, important needed analyses and to provide comments during the scoping period of the Watershed Plan and Environmental Impact Statement for the Cove-East Fork Virgin River Watershed Project. Further, we request the information and analyses discussed above be initiated in consultation with all cooperating agencies. Please work directly with ZION staff to advance the responsibilities and expectations that will be assigned in the memorandum of understanding for cooperating agencies. If you have any questions, please contact Jeff Bradybaugh, ZION Superintendent, as the primary point of contact by phone at 435-772-0140 or by email at Jeff_Bradybaugh@nps.gov.

Sincerely,

Michael Reynolds
NPS Regional Director
Regions 6, 7, 8

cc:
Jeff Bradybaugh, NPS, Zion National Park, Superintendent
Norm Evenstad, USDA NRSC Water Resources Coordinator
Brian Parker, Transcon Environmental
Christopher Keleher, VRRMRP Director

October 15, 2021

Mr. Jason Gipson
Chief, Nevada-Utah Regulatory Branch
U.S. Army Corps of Engineers
533 West 2600 South, Suite 150
Bountiful, Utah 84010

RE: Formal request to be a Cooperating Agency in the development of the Cove-East Fork Virgin River Watershed Plan-Environmental Impact Statement (Plan-EIS) for proposed improvements in Kane County, Utah.

Dear Mr. Gipson:

In accordance with the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) at 40 CFR Part 1501.8, the Natural Resources Conservation Service (NRCS) is formally requesting that the U.S. Army Corps of Engineers become a cooperating agency in the planning and development of the Cove-East Fork Virgin River Watershed Plan-EIS. Please visit the project website at https://bit.ly/cove-eastforkvirginriver-EIS for information on the Plan-EIS.

This request is made since your agency is identified as having special expertise or jurisdiction by law related to this project. The Plan-EIS is being prepared to fulfill our NEPA compliance responsibilities pertaining to our federal financial assistance through the Watershed Protection and Flood Prevention Program as authorized through Public Law 83-566. Upon acceptance of this invitation, roles can be defined in an informal agreement or a memorandum of understanding. If your agency is unable to participate as a cooperating agency, please return a written explanation indicating that your agency cannot participate.

Please send notification confirming your decision to: Emily Fife, State Conservationist, NRCS, Wallace F Bennett Federal Building, 125 South State Street, Room 4010, Salt Lake City, Utah 84138-1100.

Thank you for your timely response and assistance with these efforts. If you have any questions, please contact Derek Hamilton, Water Resources Coordinator, at derek.hamilton@usda.gov or 801/524-4560.

Sincerely,

Norm Evenstad

NORM EVENSTAD
Asst. State Conservationist - Water Resources

cc:
Alan Atkins, Area Conservationist, NRCS, Richfield, UT
Kristi Westwood, District Conservationist, NRCS, Panguitch, UT
Derek Hamilton, Water Resources Coordinator, NRCS, Salt Lake City, UT

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, SACRAMENTO DISTRICT
1325 J STREET
SACRAMENTO CA 95814-2922

November 15, 2021

Regulatory Division (SPK-2020-00507)

Natural Resources Conservation Service
Attn: Ms. Emily Fife
125 South State Street
Salt Lake City, Utah 84138-1100
Emily.fife@usda.gov

Dear Ms. Fife:

We are responding to your October 15, 2021 request for the U.S. Army Corps of Engineers to participate as a cooperating agency under the National Environmental Policy Act for the preparation of an Environmental Impact Statement (EIS) for the Cove-East Fork Virgin River Watershed Plan. The proposed watershed plan is located within the East Fork Virgin River watershed in Washington County, Utah.

Our jurisdiction over the proposed action is under the authority of Section 404 of the Clean Water Act and/or Section 10 of the Rivers and Harbors Act. In accordance with Title 40 of the Code of Federal Regulations Part 1501.6, we agree to participate as a cooperating agency in the preparation of the EIS. Our involvement in the EIS process will be limited to those areas within our statutory authority. We will work with your office to develop a cooperating agency agreement that outlines our role and responsibilities as well as the coordination procedures for preparation of the EIS.

In addition, we recommend that you conduct early coordination with us to identify the action area and permit area for compliance with Section 7 of the Endangered Species Act (ESA) and Section 106 of the National Historic Preservation Act (NHPA) pursuant to 50 CFR Part 402.07 and 36 CFR 800.2(a)(2). Provided early coordination results in our concurrence that the action area and permit area adequately cover those areas under our regulatory authority, we can formally designate your agency to act on our behalf for compliance with ESA and NHPA.

Please refer to identification number SPK-2020-00507 in any correspondence concerning this project. If you have any questions, please contact Hollis Jencks at the Utah Regulatory Office, 533 West 2600 South, Suite 150, Bountiful, Utah 84010, by email at Hollis.G.Jencks@usace.army.mil, or telephone at (801) 295-8380 ext. 8318. For more information regarding our program, please visit our website at www.spk.usace.army.mil/Missions/Regulatory.aspx.

Sincerely,

Jason Gipson
Chief, NV/UT Section

cc:
Derek Hamilton, NRCS, derek.hamilton@usda.gov

October 15, 2021

Ms. Veronica Magnuson
District Ranger, Cedar City Ranger District
U.S. Forest Service
1789 N. Wedgewood Lane
Cedar City, UT 84721

RE: Formal request to be a Cooperating Agency in the development of the Cove-East Fork Virgin River Watershed Plan-Environmental Impact Statement (Plan-EIS) for proposed improvements in Kane County, Utah.

Dear Ms. Magnuson:

In accordance with the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) at 40 CFR Part 1501.8, the Natural Resources Conservation Service (NRCS) is formally requesting that the U.S. Forest Service become a cooperating agency in the planning and development of the Cove-East Fork Virgin River Watershed Plan-EIS. Please visit the project website at https://bit.ly/cove-eastforkvirginriver-EIS for information on the Plan-EIS.

This request is made since your agency is identified as having special expertise or jurisdiction by law related to this project. The Plan-EIS is being prepared to fulfill our NEPA compliance responsibilities pertaining to our federal financial assistance through the Watershed Protection and Flood Prevention Program as authorized through Public Law 83-566. Upon acceptance of this invitation, roles can be defined in an informal agreement or a memorandum of understanding. If your agency is unable to participate as a cooperating agency, please return a written explanation indicating that your agency cannot participate.

Please send notification confirming your decision to: Emily Fife, State Conservationist, NRCS, Wallace F Bennett Federal Building, 125 South State Street, Room 4010, Salt Lake City, Utah 84138-1100.

Thank you for your timely response and assistance with these efforts. If you have any questions, please contact Derek Hamilton, Water Resources Coordinator, at derek.hamilton@usda.gov or 801/524-4560.

Sincerely,

Norm Evenstad

NORM EVENSTAD
Asst. State Conservationist - Water Resources

cc:
Alan Atkins, Area Conservationist, NRCS, Richfield, UT
Kristi Westwood, District Conservationist, NRCS, Panguitch, UT
Derek Hamilton, Water Resources Coordinator, NRCS, Salt Lake City, UT

October 15, 2021

Ms. Yvette Converse
Supervisor, Utah Field Office
U.S. Fish and Wildlife Service
2369 West Orton Circle, Suite 50
West Valley City, UT 84119

RE: Formal request to be a Cooperating Agency in the development of the Cove-East Fork Virgin River Watershed Plan-Environmental Impact Statement (Plan-EIS) for proposed improvements in Kane County, Utah.

Dear Ms. Converse:

In accordance with the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) at 40 CFR Part 1501.8, the Natural Resources Conservation Service (NRCS) is formally requesting that the U.S. Fish and Wildlife Service become a cooperating agency in the planning and development of the Cove-East Fork Virgin River Watershed Plan-EIS. Please visit the project website at https://bit.ly/cove-eastforkvirginriver-EIS for information on the Plan-EIS.

This request is made since your agency is identified as having special expertise or jurisdiction by law related to this project. The Plan-EIS is being prepared to fulfill our NEPA compliance responsibilities pertaining to our federal financial assistance through the Watershed Protection and Flood Prevention Program as authorized through Public Law 83-566. Upon acceptance of this invitation, roles can be defined in an informal agreement or a memorandum of understanding. If your agency is unable to participate as a cooperating agency, please return a written explanation indicating that your agency cannot participate.

Please send notification confirming your decision to: Emily Fife, State Conservationist, NRCS, Wallace F Bennett Federal Building, 125 South State Street, Room 4010, Salt Lake City, Utah 84138-1100.

Thank you for your timely response and assistance with these efforts. If you have any questions, please contact Derek Hamilton, Water Resources Coordinator, at derek.hamilton@usda.gov or 801/524-4560.

Sincerely,

Norm Evenstad

NORM EVENSTAD
Asst. State Conservationist - Water Resources

cc:
Alan Atkins, Area Conservationist, NRCS, Richfield, UT
Kristi Westwood, District Conservationist, NRCS, Panguitch, UT
Derek Hamilton, Water Resources Coordinator, NRCS, Salt Lake City, UT

October 15, 2021

Mr. Dave Ure
Director
Utah School and Institutional Trust Lands Administration
675 East 500 South, Suite 500
Salt Lake City, UT 84102

RE: Formal request to be a Cooperating Agency in the development of the Cove-East Fork Virgin River Watershed Plan-Environmental Impact Statement (Plan-EIS) for proposed improvements in Kane County, Utah.

Dear Mr. Ure:

In accordance with the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) at 40 CFR Part 1501.8, the Natural Resources Conservation Service (NRCS) is formally requesting that the Utah School and Institutional Trust Lands Administration become a cooperating agency in the planning and development of the Cove-East Fork Virgin River Watershed Plan-EIS. Please visit the project website at https://bit.ly/cove-eastforkvirginriver-EIS for information on the Plan-EIS.

This request is made since your agency is identified as having special expertise or jurisdiction by law related to this project. The Plan-EIS is being prepared to fulfill our NEPA compliance responsibilities pertaining to our federal financial assistance through the Watershed Protection and Flood Prevention Program as authorized through Public Law 83-566. Upon acceptance of this invitation, roles can be defined in an informal agreement or a memorandum of understanding. If your agency is unable to participate as a cooperating agency, please return a written explanation indicating that your agency cannot participate.

Please send notification confirming your decision to: Emily Fife, State Conservationist, NRCS, Wallace F Bennett Federal Building, 125 South State Street, Room 4010, Salt Lake City, Utah 84138-1100.

Thank you for your timely response and assistance with these efforts. If you have any questions, please contact Derek Hamilton, Water Resources Coordinator, at derek.hamilton@usda.gov or 801/524-4560.

Sincerely,

Norm Evenstad

NORM EVENSTAD
Asst. State Conservationist - Water Resources

cc:
Alan Atkins, Area Conservationist, NRCS, Richfield, UT
Kristi Westwood, District Conservationist, NRCS, Panguitch, UT
Derek Hamilton, Water Resources Coordinator, NRCS, Salt Lake City, UT

Ian Snyder

From: Hamilton, Derek - NRCS, Salt Lake City, UT <derek.hamilton@usda.gov>
Sent: Friday, October 29, 2021 1:03 PM
To: Ian Snyder; Brian Parker; Ronald Bolander
Subject: FW: Cove-East Fork Virgin River Watershed Plan-EIS

Follow Up Flag: Follow up
Flag Status: Completed

From: David Ure <dure@utah.gov>
Sent: Monday, October 25, 2021 12:20 PM
To: Hamilton, Derek - NRCS, Salt Lake City, UT <derek.hamilton@usda.gov>
Subject: Re: Cove-East Fork Virgin River Watershed Plan-EIS

Yes, we would like to be a partner in this study. The person that will be over this for Sitla will be Ron Torgerson. rontorgerson@utah.gov thanks for the invite. dave
S

On Thu, Oct 21, 2021 at 11:29 AM Hamilton, Derek - NRCS, Salt Lake City, UT <derek.hamilton@usda.gov> wrote:

> Hello Dave:
>
> Please find attached correspondence from NRCS requesting that SITLA become a cooperating agency in development of the Cove-East Fork Virgin River Watershed Plan-EIS.
>
> Hard copy will be sent upon request.
>
> Thx..Derek
>
> ~~~~~~
>
> Derek Hamilton
>
> Water Resources Coordinator

U.S. Department of Agriculture

Natural Resources Conservation Service

125 South State Street Room 4010, Salt Lake City, UT 84138

Office: 801.524.4560 **Mobile:** 385.321.4987

E-mail: derek.hamilton@usda.gov | www.ut.nrcs.usda.gov

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"They didn't know they couldn't do it so they went out and did it anyway."

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State of Utah

SPENCER J. COX
Governor

DEIDRE M. HENDERSON
Lieutenant Governor

Office of the Governor
Public Lands Policy Coordinating Office

REDGE B. JOHNSON
Executive Director

October 20, 2021

Submitted via email: bparker@transcon.com

Brian Parker
Transcon Environment
1745 South Alma School, Suite 220
Phoenix, AZ 85210

Subject: **Cove-East Fork Virgin River Watershed Project EIS**
Cooperating Agency Status Request
RDCC Project No. 81123

Dear Mr. Parker:

The State of Utah (State) through the Public Lands Policy Coordinating Office (PLPCO) requests Cooperating Agency status to participate in developing the Cove-East Fork Virgin River Watershed Project Environmental Impact Statement.

Please call to discuss any questions or concerns.

Sincerely,

Redge B. Johnson
Executive Director

State of Utah

SPENCER J. COX
Governor

DEIDRE M. HENDERSON
Lieutenant Governor

Office of the Governor
Public Lands Policy Coordinating Office

REDGE B. JOHNSON
Executive Director

February 2, 2022

Sent via electronic mail: bparker@transcon.com

Brian Parker
Transcon
1745 South Alma School Road, Suite 220
Mesa, AZ 85210

Subject: **Cove Reservoir Project EIS – Request for Cooperating Agency Status**

Dear Mr. Parker:

The state of Utah, through the Governor's Public Lands Policy Coordinating Office, requests Cooperating Agency status to participate in the NEPA process in developing the environmental impact statement for the Cove Reservoir Project.

We look forward to working with NRCS and Transcon. Please send the draft MOU to Jake Garfield at jmgarfield@utah.gov and Sindy Smith at sindysmith@utah.gov or call to discuss any questions or concerns.

Sincerely,

Redge B. Johnson
Executive Director

From: Corey Cram
To: derek.hamilton@usda.gov; Brian Parker; Mike Noel; Brent Gardner; Dale Harris (frontdesk@infowest.com)
Subject: Cove Reservoir - Cooperating Agency
Date: Thursday, January 27, 2022 10:10:49 AM
Attachments: image001.png

Derek,

The Washington County Water Conservancy District requests formal cooperating agency status on the project. Thank you .

Corey

Corey Cram
Associate General Manager
Washington County Water Conservancy District
P: 435.673.3617 | C: 435.668.1819 | wcwcd.org

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USDA United States Department of Agriculture
Farm Production and Conservation
Natural Resources Conservation Service
Utah State Office
125 South State Street
Room 4010
Salt Lake City, Utah 84138-1100

Memorandum of Understanding
Between
U.S. Department of Agriculture's Natural Resources Conservation Service
as the Lead Federal Agency
and
Bureau of Land Management, U.S. Army Corps of Engineers, National Park Service, School and Institutional Trust Lands Administration, State of Utah Public Lands Policy and Coordinating Office, and Environmental Protection Agency
as Cooperating Agencies in the Preparation of an Environmental Impact Statement
for the Cove-East Fork Virgin River Watershed Project

I. Introduction

The Natural Resources Conservation Service (NRCS) is the Lead Federal Agency for the development of a Watershed Plan-Environmental Impact Statement (PLAN-EIS) as defined in 40 C.F.R. §1501.7 for Cove-East Fork Virgin River Watershed Project. The Kane County Water Conservancy District (KCWCD) proposes to develop a water storage reservoir, facilities appurtenant to the reservoir, a hydroelectric power plant, access roads, and irrigation improvements on private lands near the towns of Orderville and Mt. Carmel, Utah. The purpose and need for this project is to improve agricultural water management by allowing for reliable water storage and irrigation water delivery within rural Kane and Washington counties. The NRCS is providing technical and financial assistance for the project under the PL-566 program. The Bureau of Land Management (BLM), U.S. Army Corps of Engineers (USACE), The National Park Service-Zion National Park (NPS), School and Institutional Trust Lands Administration (SITLA), Public Lands Policy and Coordinating Office (PLPCO), and Environmental Protection Agency (EPA) are Cooperating Agencies as defined in 40 C.F.R §1501.8 in the development of the PLAN-EIS.

This Memorandum of Understanding (MOU) outlines the roles and responsibilities of the NRCS, BLM, USACE, NPS, SITLA, PLPCO, and EPA, herein referred to as Parties, with respect to preparation of the PLAN-EIS. This MOU describes responsibilities and procedures agreed to by the Parties.

II. Purpose

The purposes of this MOU are as follows:

1. To designate BLM, USACE, NPS, SITLA, PLPCO, and EPA as Cooperating Agencies in the PLAN-EIS process.
2. To provide a framework for cooperation and coordination among the Parties that will ensure successful completion of the PLAN-EIS in a timely, efficient, and thorough manner.
3. To recognize that the NRCS is the Lead Federal Agency with responsibility for the completion of the PLAN-EIS and preparation of a single Record of Decision (ROD) the NRCS and BLM who require a NEPA decision for the project.
4. To describe the respective responsibilities, jurisdictional authority, and expertise of the BLM, USACE, NPS, SITLA, PLPCO, and EPA in the planning process.

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III. Authorities

The authorities and regulations of the NRCS to enter into and engage in the activities described within this MOU include, but are not limited to:

1. National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. §§ 4321 et seq.)
2. Council on Environmental Quality regulations (40 C.F.R. parts 1500 to 1508)
3. National Historic Preservation Act of 1966
4. NRCS Regulations Implementing the NEPA (7 C.F.R. Part 650)
5. Watershed Protection and Flood Prevention Act (PL 83-566, 16 U.S.C. §§ 1000 et seq.)

The authorities and regulations of the BLM to enter into this MOU include, but are not limited to:

1. NEPA of 1969 (42 U.S.C. §§ 4321 et seq.)
2. Council on Environmental Quality regulations (40 C.F.R. §§ 1500 et seq.), (40 C.F.R. § 1501.8)
3. Endangered Species Act of 1973 (16 U.S.C §§ 1531, et seq.)
4. National Historic Preservation Act of 1966
5. Federal Land Policy and Management Act of 1976 (43 U.S.C. § 1761)

The authorities and regulations of the USACE to enter into and engage in the activities described within this MOU include, but are not limited to:

1. NEPA of 1969 (42 U.S.C. §§ 4321 et seq.).
2. Council on Environmental Quality regulations (40 C.F.R. §§ 1500 et seq.), (40 C.F.R. § 1501.8)
3. National Historic Preservation Act of 1966
4. Section 404 of the Clean Water Act (CWA) (33 U.S.C §§ 1344 et seq.)
5. Section 10 of the Rivers and Harbors Act of 1899 (33 C.F.R. § 320.2)

The authorities and regulations of the NPS to enter into this MOU include, but are not limited to:

1. NEPA of 1969 (42 U.S.C. §§ 4321 et seq.)
2. Council on Environmental Quality regulations (40 C.F.R. §§ 1500 et seq.), (40 C.F.R. § 1501.8)
3. Wild and Scenic Rivers Act of 1968 (16 U.S.C §§ 1271 et seq.)
4. Migratory Bird Treaty Act of 1918 (16 U.S.C §§ 703 et seq.)
5. Endangered Species Act of 1973 (16 U.S.C §§ 1531, et seq.)
6. Wilderness Act of 1964 (16 U.S.C §§ 1131 et seq.)
7. National Park Service Organic Act (54 U.S.C. §§ 100101 et seq.)

The authorities and regulations of SITLA to enter into this MOU include, but are not limited to:

1. NEPA of 1969 (42 U.S.C. §§ 4321 et seq.)

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2. Council on Environmental Quality regulations (40 C.F.R. §§ 1500 et seq.), (40 C.F.R. § 1501.8)

The authorities and regulations of PLPCO to enter into this MOU include, but are not limited to:

1. NEPA of 1969 (42 U.S.C. §§ 4321 et seq.)
2. Council on Environmental Quality regulations (40 C.F.R. §§ 1500 et seq.), (40 C.F.R. § 1501.8)

The authorities and regulations of the EPA to enter into this MOU include, but are not limited to:

1. NEPA of 1969 (42 U.S.C. §§ 4321 et seq.)
2. Council on Environmental Quality regulations (40 C.F.R. §§ 1500 et seq.), (40 C.F.R. § 1501.8)
3. National Historic Preservation Act of 1966
4. Section 309 of the Clean Air Act of 1970 (42 U.S.C. § 7609)
5. Section 404 of the CWA (33 U.S.C §1344)

This MOU does not alter any other written agreements, authorities, or responsibilities between the Parties and the project sponsors or other government agencies, or parties.

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IV. Roles and Responsibilities

1. General Responsibilities

   a. The Parties resolve to participate in this planning process in good faith and make all reasonable efforts to resolve disagreements.

   b. The Parties resolve to fund their own expenses associated with the PLAN-EIS process.

2. NRCS Responsibilities

   a. The NRCS, as the Lead Federal Agency, has primary responsibility for compliance with the requirements of the NEPA and completion of the draft PLAN-EIS, final PLAN-EIS, and preparation of a single ROD.

   b. The NRCS resolves to work cooperatively with BLM, NPS, SITLA, PLPCO, USACE, and EPA to identify the necessary processes to allow the Parties to complete an appropriate analysis to formulate their respective decisions with regards to jurisdictional responsibilities.

   c. The NRCS resolves to work with BLM, NPS, SITLA, PLPCO, USACE, and EPA to identify concerns, issues, and opportunities to be addressed as part of the PLAN-EIS.

   d. The NRCS resolves to provide BLM, USACE, NPS, SITLA, PLPCO, and EPA with those PLAN-EIS resource characterization studies and technical reports, as determined necessary by the respective Party, for review and comment.

   e. The NRCS resolves to consult with the BLM, NPS, SITLA, PLPCO, USACE, and EPA regarding the alternatives considered and associated mitigation measures to be evaluated in the PLAN-EIS.

   f. The NRCS resolves to identify BLM, NPS, SITLA, PLPCO, USACE, and EPA on the draft PLAN-EIS and final PLAN-EIS cover pages, and will describe in the introduction sections, as provided by BLM, NPS, SITLA, PLPCO, USACE, and EPA, the specific roles and authorities of BLM, NPS, SITLA, PLPCO, USACE, and EPA with respect to this planning project.

   g. Where the Parties disagree on substantive elements of the PLAN-EIS, and these disagreements cannot be resolved, the NRCS resolves to include the BLM's, NPS's, SITLA's, PLPCO's, USACE's, and EPA's views in the draft PLAN-EIS and final PLAN-EIS. The NRCS also resolves to describe substantial inconsistencies between its proposed action(s) and the objectives of state, local, or tribal land use plans and policies.

3. BLM, NPS, SITLA, PLPCO, USACE, and EPA Responsibilities

   a. BLM, NPS, SITLA, PLPCO, USACE, and EPA resolve to provide early input to the NRCS regarding issues to address in the resource characterization studies, technical reports, and PLAN-EIS. BLM, NPS, SITLA, PLPCO, USACE, and EPA also resolve to provide comments or analyses to the NRCS in those areas where BLM, NPS, SITLA, PLPCO, USACE, and EPA have regulatory authority or technical expertise.

      BLM is recognized to have the following jurisdiction by law and/or special expertise:

      > Land Management, Water Resource Management, Recreation Management, Rights-of-Way (ROW), Public Land Survey System, Habitat Management, Heritage Resource Management.

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NPS is recognized to have the following jurisdiction by law and/or special expertise:

> The NPS preserves unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations. The NPS manages a section of the designated Wild and Scenic River, the East Fork of the Virgin River, located downstream of this water resources project. The NPS manages habitat protected under the Endangered Species Act and the Migratory Bird Treaty Act. The NPS manages the congressionally designated Zion Wilderness and protects wilderness values under the Wilderness Act.

SITLA is recognized to have the following jurisdiction by law and/or special expertise:

> Trust lands are administered by SITLA, the School and Institutional Trust Lands Administration. Created in 1994 by the Utah Legislature, SITLA manages Utah's 3.4 million acres of trust land, generating revenue through energy and mineral leases, rent, and royalties; real estate development and sales; and surface estate sales, leases, and easements. SITLA deposits all proceeds into permanent endowments for each beneficiary

PLPCO is recognized to have the following jurisdiction by law and/or special expertise:

> The Resource Development Coordinating Committee, overseen by and part of the PLPCO, in fulfilling the responsibilities of reviewing and coordinating technical and policy actions that may affect the physical resources of the state and facilitates the exchange of information on those actions among state agencies and other levels of government.

USACE is recognized to have the following jurisdiction by law and/or special expertise:

> USACE has jurisdiction of navigable waters of the United States and waters of the United States under the Rivers and Harbors Act of 1899 Section 10 and the CWA Section 404. USACE has special expertise in dredging, excavation, and construction of revetments, groins, breakwaters, beach enhancement, jetties, levees, dams, dikes, and weirs.

EPA is recognized to have the following jurisdiction by law and/or special expertise:

> EPA has jurisdiction under the CWA, including co-administering the CWA Section 404 Program with the USACE, the Clean Air Act, and other environmental statutes administered by the EPA. EPA has special expertise in environmental statutes and regulations, including but not limited to NEPA, and in surface water, ground water, stream and wetland systems, water quality, climate change, and environmental justice.

b. EPA maintains its independent obligations under Section 309 of the Clean Air Act (42 U.S.C. § 7609), to review and comment in writing on the environmental impacts of this federal agency action and, in the event the EPA determines that the action is unsatisfactory from the standpoint of public health or welfare or environmental quality, to publish its determination and refer the matter to the Council on Environmental Quality.

c. USACE maintains its independent obligation under Section 404(b)(1) of the CWA (33 U.S.C. § 1344(b)(1)) and 40 C.F.R. Part 230, to evaluate compliance with the CWA 404(b)(1) Guidelines' requirements for consideration of alternatives and to identify the least environmentally damaging practicable alternative for projects under this plan that require a CWA Section 404 dredge and fill permit.

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As staff and funding allow, BLM, NPS, SITLA, PLPCO, USACE, and EPA will review, and provide to the NRCS, comments on the issued draft PLAN-EIS and final PLAN-EIS prior to public circulation.

d. The Parties resolve to coordinate with each other pursuant to this MOU in order to maximize the use of resources and minimize duplication of effort during the preparation of the PLAN-EIS.

4. Other Terms

a. Parties retain all immunities and defenses provided by law with respect to any action based on or occurring as a result of this MOU.

V. Agency Representatives

1. Parties resolve to designate a representative and alternate representative, as described in section VIII, to ensure coordination between the Parties during the preparation of the PLAN-EIS. Each Party may change its representative at will by providing written notice to the other Parties.

VI. Administration of the MOU

1. This MOU becomes effective upon signature by the authorized officials of the Parties and remains in effect until either a ROD is executed or five (5) years, whichever comes first.
2. This MOU may be extended or modified by the Parties hereto by mutual agreement only, as discussed in Section XII, Modifications. Any modification will be in writing.
3. This MOU does not alter the authority and responsibilities of the Parties under their respective NEPA regulations.
4. This MOU is not intended to, and does not create, any right, benefit, or trust responsibility, substantive or procedural, enforceable at law or equity, by any party against the Unites States, its agencies, its officers, or any person.
5. Any Party may terminate its participation in this MOU upon written notice to the other Parties as specified in Section VII, Notices. The MOU will remain in effect for any and all remaining Parties.

VII. Notices

Termination or modification of this MOU is sufficient only if in writing and delivered in person, mailed, or transmitted electronically by e-mail or fax, as follows:

1. To the NRCS Program Contact, at the address specified in the MOU or through a written change notification made pursuant to section VIII.
2. To the BLM Program Contact, at the address shown in the MOU or such other address designated within the MOU or through a written change notification made pursuant to section VIII.
3. To the USACE Program Contact, at the address shown in the MOU or such other address designated within the MOU or through a written change notification made pursuant to section VIII.
4. To the EPA Program Contact, at the address shown in the MOU or such other address designated within the MOU or through a written change notification made pursuant to section VIII.
5. To the NPS Program Contact, at the address shown in the MOU or such other address designated within the MOU or through a written change notification made pursuant to section VIII.
6. To the SITLA Program Contact, at the address specified in the MOU or through a written change notification made pursuant to section VIII.

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7. To the PLPCO Program Contact, at the address specified in the MOU or through a written change notification made pursuant to section VIII.

Notices are effective when delivered in accordance with this provision, or on the effective date of the notice, whichever is later.

VIII. Agency Representatives

Individuals listed below are authorized to act in their respective areas for matters related to this MOU. Changes to the Principal Contacts for each of the Parties to this MOU may be made at any time by written notification to all Parties as to the name and contact information for the updated contact person by the respective Party requesting the change.

NRCS Representatives (Lead Federal Agency):

NRCS Primary Contact	NRCS Backup Contact
Name: Norm Evenstad Title: Assistant State Conservationist–Water Resources Address: Wallace F. Bennett Federal Building 125 South State Street Room 4010 Salt Lake City, Utah 84138 Telephone: 801-524-4569 Email: norm.evenstad@usda.gov	Name: Derek Hamilton Title: Water Resource Coordinator Address: Wallace F. Bennett Federal Building 125 South State Street Room 4010 Salt Lake City, Utah 84138 Telephone: 801-524-4560 Email: derek.hamilton@usda.gov

BLM Representatives (Cooperating Agency):

BLM Primary Contact	BLM Backup Contact
Name: Whit Bunting Title: Field Office Manager Address: Bureau of Land Management Kanab Field Office 669 South Highway 89A Kanab, Utah 84741 Telephone: 435-644-1200 Email: utknmail@blm.gov	Name: James Holland Title: Hydrologist/Geologist Address: Bureau of Land Management Kanab Field Office 669 South Highway 89A Kanab, Utah 84741 Telephone: 435-644-1200 Email: jholland@blm.gov

NPS Representatives (Cooperating Agency):

NPS Primary Contact	NPS Backup Contact
Name: Jeff Bradybaugh Title: Superintendent Address: 1 Zion Park Boulevard., State Route 9 Springdale, Utah 84767 Telephone: 435-772-0140 Email: jeff_bradybaugh@nps.gov	Name: Robyn Henderek Title: Physical Scientist Address: 1 Zion Park Boulevard., State Route 9 Springdale, Utah 84767 Telephone: 435-772-0158 Email: robyn_henderek@nps.gov

SITLA Representatives (Cooperating Agency):

SITLA Primary Contact	SITLA Signer
Name: Ron Torgerson Title: Southeast Surface Resource Specialist	Name: Chris Fausett Title: Assistant Director

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Address: 675 East 500 South, #500 Telephone: 435-893-2980 Email: rgtorgerson@utah.gov	Address: 675 East 500 South, #500 Telephone: 801-538-5139 Email: chrisfausett@utah.gov

PLPCO Representatives (Cooperating Agency):

PLPCO Primary Contact	PLPCO Primary Contact
Name: Sindy Smith Title: RDDC Coordinator Address: 3760 S. Highland Drive, Third Floor Salt Lake City, Utah 84106 Telephone: 385-522-0007 Email: sindysmith@utah.gov	Name: Dillon Hoyt Title: Natural Resources Planner Address: 3760 S. Highland Drive, Third Floor Salt Lake City, Utah 84114 Telephone: 385-479-0423 Email: dillonhoyt@utah.gov

USACE Representatives (Cooperating Agency):

USACE Primary Contact	USACE Backup Contact
Name: Hollis Jencks Title: Project Manager Address: USACE 533 West 2600 South, Suite 150 Bountiful, Utah 84010-7744 Telephone: 801-295-8380 ext. 8318 Email: hollis.g.jencks@usace.army.mil	Name: Jason Gipson Title: Branch Chief Address: USACE 533 West 2600 South, Suite 150 Bountiful, Utah 84010-7744 Telephone: 801-295-8380 Email: jason.a.gipson@usace.army.mil

EPA Representatives (Cooperating Agency):

EPA Primary Contact	EPA Backup Contact
Name: Matt Hubner Title: NEPA Reviewer Address: U.S. EPA Region 8 (ORA-N) 1595 Wynkoop Street Denver, Colorado, 80202-1129 Telephone: 303-312-6312 Email: hubner.matt@epa.gov	Name: Shannon Snyder Title: NEPA Reviewer Address: U.S. EPA Region 8 (ORA-N) 1595 Wynkoop Street Denver, Colorado, 80202-1129 Telephone: 303-312-6335 Email: snyder.shannon@epa.gov

IX. Participation in Similar Activities

This MOU in no way restricts the Parties from participating in similar activities with other public or private agencies, organizations, and individuals.

X. Nonbinding Agreement

This MOU creates no right, benefit, or trust responsibility, substantive or procedural, enforceable by law or equity against the Parties, their officers or employees, or any other person. This MOU does not apply to any person or entity outside of the Parties.

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The Parties shall manage their respective resources and activities in a separate, coordinated, and mutually beneficial manner to meet the purposes of this MOU. Nothing in this MOU authorizes or requires any of the Parties to transfer funds or to commit, obligate, or expend their appropriations or to enter into any contract, assistance agreement, interagency agreement, or incur other financial obligation. Specific projects or activities that involve the transfer of funds, services, or property among the Parties will be handled in accordance with applicable laws, regulations, and procedures under separate written agreements and are contingent upon the availability of appropriated funds.

These activities must be independently authorized by statute. This MOU does not provide that authority. Negotiation, execution, and administration of these agreements must comply with all applicable laws. Each Party operates under its own laws, regulations, and policies, subject to the availability of appropriated funds. Nothing in this MOU is intended to alter, limit, or expand the statutory and regulatory authority of the Parties.

XI. Agency Review and Concurrence Timeline

The Parties resolve to process the PLAN-EIS and develop an environmental review and authorization schedule. Parties will work together to develop a single Permitting Timetable for the necessary environmental review and authorization decisions, prepare a single EIS, sign a single ROD, and issue all necessary authorization decisions within 90 days of issuance of the ROD, subject to limited exceptions.

XII. Modifications

Modifications within the scope of this MOU must be made by mutual consent of the Parties, by the issuance of a written modification signed and dated by all properly authorized officials, prior to any changes being performed. Requests for modification should be made, in writing, at least 30 days prior to implementation of the requested change.

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XIII. Authorized Representatives

By signature below, each Party certifies that the individuals listed in this document as representatives of the individual Parties are authorized to act in their respective areas for matters related to this MOU.

In witness whereof, the Parties hereto have executed this MOU as of the last date written below.

USDA-Natural Resources Conservation Service—Utah

Trisha Cracroft — Emily Fife
Name

DocuSigned by: Trisha Cracroft 577BAF5A64A2459...

Utah State Conservationist Acting
Title

8/24/2022

_____ _____
Signature Date

Bureau of Land Management

Whitney Bunting — Kanab Field Office Manager
Name — Title

DocuSigned by: Whitney Bunting 5722E9DE787B4F7...

8/16/2022

_____ _____
Signature Date

National Parks Service

Jeff Bradybaugh — Superintendent
Name — Title

DocuSigned by: Jeff Bradybaugh AC5E13F037714CF...

8/8/2022

_____ _____
Signature Date

Utah School and Institutional Trust Lands Administration

Chris Fausett — Assistant Director
Name — Title

DocuSigned by: Chris Fausett 0964CD9FB0A5496...

8/16/2022

_____ _____
Signature Date

DocuSign Envelope ID: CA079600-486F-4215-A08E-28D21CBEBF2D

Utah Public Lands Policy Coordinating Office

Redge B. Johnson — Executive Director

Name — Title

DocuSigned by: Redge B Johnson EAF6F48BD2A9403...

8/23/2022

_____ _____

Signature — Date

U.S. Army Corp of Engineers

Jason A Gipson — Nevada/Utah Regulatory Section Chief

Name — Title

DocuSigned by: Jason A Gipson B2006026107847F...

8/24/2022

_____ _____

Signature — Date

Environmental Protection Agency

Melissa McCoy — NEPA Branch Manager

Name — Title

DocuSigned by: Melissa McCoy 85BA4F86750B45D...

8/22/2022

_____ _____

Signature — Date

USFWS Consultation

May 17, 2024

George Weekley
Field Supervisor, Utah Field Office
U.S. Fish and Wildlife Service
2369 West Orton Circle, Suite 50
West Valley City, UT 84119

RE: Cove-East Fork Virgin River Watershed Plan-Environmental Impact Statement (Plan-EIS)
Section 12 Notification--Public Law 83-566

Dear George Weekley:

The Natural Resources Conservation Service (NRCS) is currently preparing the Cove-East Fork Virgin River Watershed Plan-EIS for agricultural water management and recreational measures in Kane County, Utah. In accordance with Section 12 of the Watershed Protection and Flood Prevention Act, Public Law 83-566 (U.S.C. Section 1008), this letter serves to notify the U.S. Fish and Wildlife Service (USFWS) that NRCS invites the USFWS to submit survey reports or investigations regarding wildlife resources that will be considered in development of the Cove-East Fork Virgin River Watershed Plan-EIS. Additionally, the NRCS welcomes USFWS participation in the preparation of the Plan-EIS in accordance with Section 12 of Public Law 83-566.

Thank you for your assistance. If you have any questions, please contact Derek Hamilton, Water Resources Coordinator, at derek.hamilton@usda.gov or 801/524-4560.

Sincerely,

Travis Mote
Acting State Conservationist

cc:
Anders Fillerup, Acting Assistant State Conservationist—Water Resources, NRCS, Salt Lake City, UT
Derek Hamilton, Water Resources Coordinator, NRCS, Salt Lake City, UT

Hamilton, Derek - FPAC-NRCS, UT

From: Hamilton, Derek - FPAC-NRCS, UT
Sent: Wednesday, September 9, 2026 1:03 PM
To: 'Schratz, Samuel A'; Weekley, George M; UtahFieldOfficeESA, FW6
Cc: Reisor, Rita S; Costantini, Danielle N; Jencso, Emily D; Weiss, Dannette T; Mote, Travis - FPAC-NRCS, UT; Westwood, Kristi - FPAC-NRCS, UT; Schick, David - FPAC-NRCS, UT; Marshall, Mike - FPAC-NRCS, UT
Subject: RE: [EXTERNAL] Cove-EFVR Watershed Plan...request for USFWS concurrence

Received...thx to all at USFWS for quick concurrence turnaround!

Derek

~~~~~~

Derek Hamilton
Water Resources Coordinator

U.S. DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service
Utah—State Office
125 South State Street Room 6416, Salt Lake City, UT 84138
Mobile: 385.867.8513

~~~~~~

From: Schratz, Samuel A <samuel_schratz@fws.gov>
Sent: Wednesday, September 9, 2026 12:26 PM
To: Hamilton, Derek - FPAC-NRCS, UT <derek.hamilton@usda.gov>; Weekley, George M <george_weekley@fws.gov>; UtahFieldOfficeESA, FW6 <UtahFieldOffice_ESA@fws.gov>
Cc: Reisor, Rita S <rita_reisor@fws.gov>; Costantini, Danielle N <danielle_costantini@fws.gov>; Jencso, Emily D <emily_jencso@fws.gov>; Weiss, Dannette T <dannette_weiss@fws.gov>; Mote, Travis - FPAC-NRCS, UT <travis.mote@usda.gov>; Westwood, Kristi - FPAC-NRCS, UT <kristi.westwood@usda.gov>; Schick, David - FPAC-NRCS, UT <david.schick@usda.gov>; Marshall, Mike - FPAC-NRCS, UT <mike.marshall@usda.gov>
Subject: Re: [EXTERNAL] Cove-EFVR Watershed Plan...request for USFWS concurrence

My apologies, there was a typo in the previous email. It should have said:

Thank you for submitting your request for informal consultation for the Cove EFVR Watershed Plan Project. Based on the information provided to our office, we concur with the Not Likely to Adversely Affect determination for the Mexican spotted owl, southwestern willow flycatcher, Virgin river chub, woundfin, and California condor as well as Mexican spotted owl, Virgin river chub, and woundfin critical habitat. We also concur with the not likely to jeopardize the continued existence determination for the experimental non-essential California condor and monarch butterfly. Please note the attached record of concurrence.

This concludes informal consultation for the Project. At this time, further consultation pursuant to section 7(a)(2) of the Act is not required. Reinitiation of consultation on this action may be necessary if: (1) new information reveals effects of the action that may affect listed species or designated critical habitat in a manner or to an extent not considered in the assessment, (2) the action is subsequently modified in a manner that causes

an effect to listed species or critical habitat that was not considered in the analysis, or (3) a new species is listed or critical habitat designated that may be affected by the proposed action.

Thank you for your continued interest in the conservation of Utah's threatened and endangered species. If you have questions regarding this consultation, please feel free to contact our office.

Cheers,

Samuel Schratz, CWB®
President of AFGE Local 4302
Fish and Wildlife Biologist
Utah Ecological Services Field Office
Desk: (801) 239-0562

Please submit Section 7 project requests to: UtahFieldOffice_ESA@fws.gov
Book time to meet with me

From: Schratz, Samuel A <samuel_schratz@fws.gov>
Sent: Wednesday, September 9, 2026 12:16
To: Hamilton, Derek - FPAC-NRCS, UT <derek.hamilton@usda.gov>; Weekley, George M <george_weekley@fws.gov>; UtahFieldOfficeESA, FW6 <UtahFieldOffice_ESA@fws.gov>
Cc: Reisor, Rita S <rita_reisor@fws.gov>; Costantini, Danielle N <danielle_costantini@fws.gov>; Jencso, Emily D <emily_jencso@fws.gov>; Weiss, Dannette T <dannette_weiss@fws.gov>; Mote, Travis - FPAC-NRCS, UT <travis.mote@usda.gov>; Westwood, Kristi - FPAC-NRCS, UT <kristi.westwood@usda.gov>; Schick, David - FPAC-NRCS, UT <david.schick@usda.gov>; Marshall, Mike - FPAC-NRCS, UT <mike.marshall@usda.gov>
Subject: Re: [EXTERNAL] Cove-EFVR Watershed Plan...request for USFWS concurrence

Derek,

Thank you for submitting your request for informal consultation for the Cove EFVR Watershed Plan Project. Based on the information provided to our office, we concur with the Not Likely to Adversely Affect determination for the Mexican spotted owl, southwestern willow flycatcher, Virgin river chub, woundfin, and California condor as well as Mexican spotted owl, Virgin river chub, and woundfin critical habitat. We also concur with jeopardize the continued existence of experimental non-essential California condor and monarch butterfly. Please note the attached record of concurrence.

This concludes informal consultation for the Project. At this time, further consultation pursuant to section 7(a)(2) of the Act is not required. Reinitiation of consultation on this action may be necessary if: (1) new information reveals effects of the action that may affect listed species or designated critical habitat in a manner or to an extent not considered in the assessment, (2) the action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in the analysis, or (3) a new species is listed or critical habitat designated that may be affected by the proposed action.

Thank you for your continued interest in the conservation of Utah's threatened and endangered species. If you have questions regarding this consultation, please feel free to contact our office.

Cheers,

Samuel Schratz, CWB®
President of AFGE Local 4302
Fish and Wildlife Biologist

Utah Ecological Services Field Office
Desk: (801) 239-0562

Please submit Section 7 project requests to: UtahFieldOffice_ESA@fws.gov
Book time to meet with me

From: Hamilton, Derek - FPAC-NRCS, UT <derek.hamilton@usda.gov>
Sent: Thursday, September 3, 2026 17:33
To: Weekley, George M <george_weekley@fws.gov>; UtahFieldOfficeESA, FW6 <UtahFieldOffice_ESA@fws.gov>
Cc: Reisor, Rita S <rita_reisor@fws.gov>; Costantini, Danielle N <danielle_costantini@fws.gov>; Jencso, Emily D <emily_jencso@fws.gov>; Weiss, Dannette T <dannette_weiss@fws.gov>; Schratz, Samuel A <samuel_schratz@fws.gov>; Mote, Travis - FPAC-NRCS, UT <travis.mote@usda.gov>; Westwood, Kristi - FPAC-NRCS, UT <kristi.westwood@usda.gov>; Schick, David - FPAC-NRCS, UT <david.schick@usda.gov>; Marshall, Mike - FPAC-NRCS, UT <mike.marshall@usda.gov>
Subject: [EXTERNAL] Cove-EFVR Watershed Plan...request for USFWS concurrence

This email has been received from outside of DOI - Use caution before clicking on links, opening attachments, or responding.

George...

Please find attached letter (and associated BA & Water Model Report) requesting USFWS concurrence with NRCS's determination that the Cove-East Fork Virgin River Watershed Plan is **not likely to adversely affect** the Mexican spotted owl (*Strix occidentalis lucida*), southwestern willow flycatcher (*Empidonax traillii extimus*), Virgin River chub (*Gila seminuda*), woundfin (*Plagopterus argentissimus*), and California condor (*Gymnogyps californianus*). It has also been determined that the project would have **no effect** or would **not likely jeopardize the continued existence** on the remaining federally listed/proposed species or critical habitat identified in the IPaC report.

Please contact me if you have any questions.

Thank you...Derek

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USDA

United States Department of Agriculture

The U.S. Fish and Wildlife Service concurs with your determination that the proposed action *may affect, and is not likely to adversely affect*:
Species: Mexican spotted owl, southwestern willow flycatcher, Virgin river chub, woundfin, California condor

Critical Habitat: Mexican spotted owl, Virgin river chub, woundfin

The proposed action is expected to be:
Insignificant ✓ Discountable ✓ Beneficial ___

The U.S. Fish and Wildlife Service concurs with your determination that the action is *not likely to jeopardize the continuing existence of*:
Species: California condor (experimental non-essential), monarch butterfly

U.S. Fish and Wildlife Utah Field Supervisor

Office Code: 06E23000 Project Code: 2025-0118842

August 31, 2026

George Weekley
Supervisor, Utah Ecological Services Field Office
U.S. Fish and Wildlife Service
440 West 200 South, Suite 500
Salt Lake City, UT 84101

RE: Cove-East Fork Virgin River Watershed Plan
Kane and Washington Counties, Utah

Dear George Weekley:

The Natural Resources Conservation Service (NRCS) is providing assistance to Kane County Water Conservancy District and Washington County Water Conservancy District through the PL-566 Watershed Protection and Flood Prevention Program to prepare the Cove-East Fork Virgin River Watershed Plan. This letter is being submitted in compliance with Section 7 of the Endangered Species Act (ESA) to document our determination of potential project effects on federally listed/proposed species and designated critical habitat; additionally, this letter serves as a request for U.S. Fish and Wildlife Service concurrence with our determinations.

The NRCS has determined that the Cove-East Fork Virgin River Watershed Plan **may affect but is not likely to adversely affect** the Mexican spotted owl (*Strix occidentalis lucida*), southwestern willow flycatcher (*Empidonax traillii extimus*), Virgin River chub (*Gila seminuda*), woundfin (*Plagopterus argentissimus*), and California condor (*Gymnogyps californianus*). Furthermore, it has been determined that the project would have **no effect** or would **not likely jeopardize the continued existence** on the remaining federally listed/proposed ESA species, including critical habitat, identified in the Information for Planning and Consultation report. Please find the enclosed Biological Assessment that has been prepared to document the basis for our determinations and identify conservation measures for the project.

Thank you for your assistance. If you have any questions or need additional information, please contact Derek Hamilton of my staff at 385/867-8513 or derek.hamilton@usda.gov.

Sincerely,

TRAVIS MOTE Digitally signed by TRAVIS MOTE
Date: 2026.08.31 16:02:43 -06'00'

TRAVIS MOTE
Acting State Conservationist

Enclosure

cc:
Derek Hamilton, Biologist/Water Resources Coordinator, NRCS, Salt Lake City, UT
Kristi Westwood, Acting Assistant State Conservationist-Field Operations, NRCS, Panguitch, UT
David Schick, Acting District Conservationist, NRCS, Richfield, UT
Mike Marshall, District Conservationist, NRCS, Cedar City, UT

USACE Coordination

From:	Pectol, Michael A CIV USARMY CESPK (USA)
To:	Paris, Emily
Cc:	Hamilton, Derek - FPAC-NRCS, UT; Gipson, Jason A CIV USARMY CESPK (USA)
Subject:	RE: Request for Review - Draft LEDPA Report for Cove-East Fork Virgin River Watershed Project
Date:	Wednesday, August 13, 2025 9:28:21 AM
Attachments:	image001.png

Hello Emily,

My apologies that these comments are a bit after the due date. I didn't go too in depth for this review as it appears likely that the Cove Reservoir alternative would result in little to no impacts to jurisdictional aquatic features. I would recommend requesting an Approved Jurisdictional Determination to be sure of what proposed impacts would need 404 authorization. Listed below are a few comments I had on the alternatives analysis:

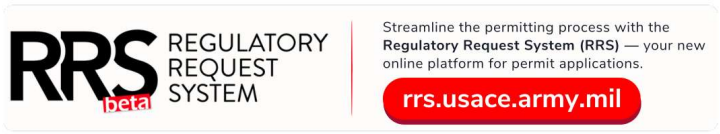
- Table 1 in the Alternatives Analysis document briefly mentions the Orderville Site but no map location or additional description was included.

- Some alternatives were screened out partially based on the comparative cost to the Cove Reservoir alternative. Under the 404(b)(1) Guidelines, cost can only be used as screening criteria when comparing a given alternative to the typical cost to construct this type of project in this general area. Comparing the cost of one alternative to another alternative is not an appropriate screening method.

- The two Cove Reservoir alternatives carried forward for analysis would likely result in the same or very similar aquatic resource impacts and 404 permitting requirements. Since it appears the impacts from either alternative could qualify for authorization under a Nationwide Permit, no additional detailed alternatives analysis would be necessary. However, if other factors or constraints outside our purview result in the need to complete the project at another location and/or with greater impacts to waters of the US, a more detailed analysis by this office would likely be needed.

We appreciate the opportunity to provide comments on this project. Let me know if there are questions on any of the above. Thank you,

Mike Pectol, Senior Project Manager
U.S. Army Corps of Engineers
Office (801) 295-8380, ext. 8315
Mobile (801) 857-0653
Michael.A.Pectol@usace.army.mil
For program information or to submit a customer service survey:
http://www.spk.usace.army.mil/Missions/Regulatory.aspx



From: Paris, Emily <EParis@eocene.com>
Sent: Friday, July 11, 2025 5:12 PM
To: Pectol, Michael A CIV USARMY CESPK (USA) <Michael.A.Pectol@usace.army.mil>
Cc: Hamilton, Derek - FPAC-NRCS, UT <derek.hamilton@usda.gov>; Gipson, Jason A CIV USARMY CESPK (USA) <Jason.A.Gipson@usace.army.mil>
Subject: [Non-DoD Source] Request for Review - Draft LEDPA Report for Cove-East Fork Virgin River Watershed Project

Good afternoon, Michael,

Since the U.S. Army Corps is a cooperating agency on the Cove-East Fork Virgin River Watershed Project, we have prepared the attached Draft Least Environmentally Damaging Practicable Alternative Analysis for your review. We kindly request your comments by **August 11th**. Please don't hesitate to reach out with any questions or if additional information is needed. We sincerely appreciate your time and attention to this matter.

Have a nice weekend,

Emily Paris
Project Manager

Eocene Environmental Group

Reno, Nevada 89503
MOBILE 775.296.0819
EMAIL eparis@eocene.com
eocene.com | **LinkedIn** | **Employee Owner**

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, SACRAMENTO DISTRICT
1325 J STREET
SACRAMENTO CA 95814-2922

April 23, 2026

Regulatory Division (SPK-2020-00507)

Natural Resource Conservation Service
Attn: Ms. Emily Fife
125 South State Street
Salt Lake City, Utah 84138-1100
emily.fife@usda.gov

Dear Ms. Fife:

We are responding to your December 18, 2025, request for an approved jurisdictional determination (AJD) for the Cove Reservoir site. The approximately 719-acre project site is located near the communities of Glendale, Orderville, and Mt. Carmel, with a center point near Latitude 37.2754°, Longitude -112.6627°, Kane County, Utah (Enclosure 1).

Based on available information, we concur with your aquatic resources' delineation for the site, as depicted on the enclosed July 21, 2022 (updated February 18, 2026) "Aquatic Resources Detail Map" drawings, prepared by Eocene Environmental Group (Enclosure 2). Approximately 7.43 acres of aquatic resources, consisting of 9,665 linear feet (3.43 acres) of ephemeral channels, 0.62 acres of irrigation/stock pond features, and 29,415 linear feet (3.38 acres) of irrigation ditches are present within the survey area. This letter verifies that the location and boundaries of wetlands were delineated consistent with the wetland definition at 33 CFR §328.3(c)(16), the 1987 *Corps of Engineers Wetlands Delineation Manual* (Wetlands Research Program Technical Report Y-87-1) and the applicable regional supplements; and the location and boundaries of non-tidal waters conform with the ordinary high water mark definition at 33 CFR §328.3(c)(7), Regulatory Guidance Letter 05-05, and any applicable regional guide.

Of these aquatic resources, we have determined that those features identified as Stream 1 (5,712 linear feet, 1.97 acres), Stream 1A (305 linear feet, 0.02 acre), Stream 2 (2,989 linear feet, 1.22 acres), Stream 2A (29 linear feet, 0.15 acre), Stream 3 (597 linear feet, 0.06 acre), Stream 3A (33 linear feet, 0.01 acre), Pond 1 (0.18 acre), Pond 2 (0.12 acre), Pond 3 (0.12 acre), Wetland 1 (0.03 acre), Wetland 2 (0.17 acre), and the Mt. Carmel Irrigation Ditch System (29,415 linear feet, 3.38 acres) are not waters of the U.S. regulated under Section 404 of the Clean Water Act or under Section 10 of the Rivers and Harbors Act. We are enclosing a copy of the Memorandum for Record prepared to support this AJD for your site (Enclosure 3). This AJD is valid for five years from the date of this letter unless new information warrants revision of the determination before the expiration date.

If you object to this determination, you may request an administrative appeal under Corps regulations at 33 Code of Federal Regulations (CFR) Part 331. A *Notification of Appeal Process (NAP) and Request for Appeal (RFA) Form* is enclosed (Enclosure 4). If

you request to appeal this determination, you must submit a completed RFA form to the South Pacific Division Office at the following address: Administrative Appeal Review Officer, Army Corps of Engineers, South Pacific Division, CESPD-PDO, 455 Market Street, 2052B, San Francisco, California 94103-1399, Telephone: (415) 503-6574, FAX: (415) 503-6646.

In order for an RFA to be accepted by the Corps, we must determine that the form is complete, that it meets the criteria for appeal under 33 CFR Part 331.5, and that the form was received by the Division Office within 60 days of the date of the NAP. It is not necessary to submit an RFA form to the Division Office unless you object to the determination in this letter.

The delineation included herein has been conducted to identify the location and extent of the aquatic resource boundaries and/or the jurisdictional status of aquatic resources for purposes of the Clean Water Act for the particular site identified in this request. This delineation and/or jurisdictional determination may not be valid for the Wetland Conservation Provisions of the Food Security Act of 1985, as amended. If you or your tenant are USDA program participants, or anticipate participation in USDA programs, you should discuss the applicability of a certified wetland determination with the local USDA service center, prior to starting work. We recommend that you provide a copy of this letter and notice to all other affected parties, including any individual who has an identifiable and substantial legal interest in the property.

Please refer to identification number SPK-2020-00507 in any correspondence concerning this project. If you have any questions, please contact Michael Pectol at the Utah Regulatory Field Office, 523 Heritage Park Blvd, Suite 1, Layton, Utah 84041-5611, by email at Michael.A.Pectol@usace.army.mil, or telephone at (385) 303-9445. For program information or to complete our Customer Survey, visit our website at www.spk.usace.army.mil/Missions/Regulatory.aspx.

Sincerely,



Jason Gipson
Chief, Utah Regulatory Section

Enclosures

cc:
Emily Paris, Eocene (eparis@eocene.com)
Derek Hamilton, NRCS (derek.hamilton@usda.gov)

NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant: NRCS, Attn: Ms. Emily Fife	File No.: SPK-2020-00507	Date: April 23, 2026

Attached is:		See Section below
	INITIAL PROFFERED PERMIT (Standard Permit or Letter of Permission)	A
	PROFFERED PERMIT (Standard Permit or Letter of permission)	B
	PERMIT DENIAL	C
→	APPROVED JURISDICTIONAL DETERMINATION	D
	PRELIMINARY JURISDICTIONAL DETERMINATION	E

SECTION I - The following identifies your rights and options regarding an administrative appeal of the above decision. Additional information may be found at *http://www.usace.army.mil/cecw/pages/reg_materials.aspx* or Corps regulations at 33 CFR Part 331.

A: INITIAL PROFFERED PERMIT: You may accept or object to the permit.

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- OBJECT: If you object to the permit (Standard or LOP) because of certain terms and conditions therein, you may request that the permit be modified accordingly. You must complete Section II of this form and return the form to the district engineer. Your objections must be received by the district engineer within 60 days of the date of this notice, or you will forfeit your right to appeal the permit in the future. Upon receipt of your letter, the district engineer will evaluate your objections and may: (a) modify the permit to address all of your concerns, (b) modify the permit to address some of your objections, or (c) not modify the permit having determined that the permit should be issued as previously written. After evaluating your objections, the district engineer will send you a proffered permit for your reconsideration, as indicated in Section B below.

B: PROFFERED PERMIT: You may accept or appeal the permit.

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- APPEAL: If you choose to decline the proffered permit (Standard or LOP) because of certain terms and conditions therein, you may appeal the declined permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer (address on reverse). This form must be received by the division engineer within 60 days of the date of this notice.

C: PERMIT DENIAL: You may appeal the denial of a permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer (address on reverse). This form must be received by the division engineer within 60 days of the date of this notice.

D: APPROVED JURISDICTIONAL DETERMINATION: You may accept or appeal the approved JD or provide new information.

- ACCEPT: You do not need to notify the Corps to accept an approved JD. Failure to notify the Corps within 60 days of the date of this notice, means that you accept the approved JD in its entirety, and waive all rights to appeal the approved JD.
- APPEAL: If you disagree with the approved JD, you may appeal the approved JD under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer (address on reverse). This form must be received by the division engineer within 60 days of the date of this notice.

E: PRELIMINARY JURISDICTIONAL DETERMINATION: You do not need to respond to the Corps regarding the preliminary JD. The preliminary JD is not appealable. If you wish, you may request an approved JD (which may be appealed), by contacting the Corps district for further instruction. Also, you may provide new information for further consideration by the Corps to reevaluate the JD.

SECTION II - REQUEST FOR APPEAL or OBJECTIONS TO AN INITIAL PROFFERED PERMIT

REASONS FOR APPEAL OR OBJECTIONS: (Describe your reasons for appealing the decision or your objections to an initial proffered permit in clear concise statements. You may attach additional information to this form to clarify where your reasons or objections are addressed in the administrative record.)

ADDITIONAL INFORMATION: The appeal is limited to a review of the administrative record, the Corps memorandum for the record of the appeal conference or meeting, and any supplemental information that the review officer has determined is needed to clarify the administrative record. Neither the appellant nor the Corps may add new information or analyses to the record. However, you may provide additional information to clarify the location of information that is already in the administrative record.

POINT OF CONTACT FOR QUESTIONS OR INFORMATION:

If you have questions regarding this decision and/or the appeal process you may contact:

Michael Pectol
Senior Project Manager
Utah Regulatory Section
U.S. Army Corps of Engineers
Utah Regulatory Field Office
523 Heritage Park Blvd, Suite 1
Layton, Utah 84041-5611
Phone: (385) 303-9445, FAX 916-557-7803
Email: Michael.A.Pectol@usace.army.mil

If you only have questions regarding the appeal process you may also contact:

Travis Morse
Administrative Appeal Review Officer
U.S. Army Corps of Engineers
South Pacific Division
Phillip Burton Federal Building, Post Office Box 36023
450 Golden Gate Avenue
San Francisco, California 94102
Phone: 970-243-1199x1014, FAX: 971-241-2358
Email: W.Travis.Morse@usace.army.mil

RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Engineers personnel, and any government consultants, to conduct investigations of the project site during the course of the appeal process. You will be provided a 15-day notice of any site investigation and will have the opportunity to participate in all site investigations.

	Date:	Telephone number:
_____ Signature of appellant or agent.		

NPS Coordination

United States Department of the Interior
NATIONAL PARK SERVICE
REGIONS 6, 7, & 8
12795 West Alameda Parkway
P.O. Box 25287
Denver, CO 80225-0287

IN REPLY REFER TO:
1.A.1 (ZION)

April 18, 2022

Ms. Emily Fife, USDA NRCS State Conservationist
Wallace F Bennett Federal Building
125 South State Street Room #4010
Salt Lake City, UT 84138

Subject: NPS comments on the Watershed Plan and Environmental Impact Statement for the Cove-East Fork Virgin River Watershed Project Scoping Period and Cooperating Agency Acceptance

Dear Ms. Fife,

The National Park Service (NPS) appreciates the opportunity to provide comments during the scoping period of the Watershed Plan and Environmental Impact Statement for the Cove-East Fork Virgin River Watershed Project and accepts the request to become a formal cooperating agency with the United States Department of Agriculture, Natural Resource Conservation Service (NRCS). The NPS within Zion National Park (ZION) manages a portion of the East Fork of the Virgin River within the park and holds special expertise regarding Wild and Scenic River, Endangered Species Act, Migratory Bird Treaty Act and Wilderness management. At your earliest convenience, please send ZION a draft of the proposed Memorandum of Understanding for NPS review. In addition to the comments and information requests outlined below, we strongly encourage NRCS to provide information related to impacts this project may have on regional dark night skies and mitigations planned to reduce those impacts.

1. 1996 Zion National Park Water Rights Settlement Agreement

Notably, in 1996 the NPS, State of Utah, Washington County Water Conservancy District, and Kane County Water Conservancy District entered into a historic agreement to establish federal reserved water rights memorialized in the Zion National Park Water Rights Settlement

Agreement (SA). In the SA, the NPS agreed to subordinate its senior water rights to limited future water development in the East Fork of the Virgin River. This includes a cap on cumulative storage capacity in one or more reservoirs not to exceed 6,750 acre-feet and a limitation of individual new reservoirs with total storage capacities greater than 20 acre-feet not to exceed 10 (SA Article II.D.1.a&b). With this limitation on new reservoir development addressed in the SA, restrictions on flow were also established for any new diversion structures constructed for new, large reservoirs (SA Article II.D.3), as well as the timing of diversion for any diversions associated with the new reservoirs with a storage capacity greater than 20 acre-feet (SA Article II.D.6). In addition, limits were set on the bypass flows below any new reservoirs (SA Article II.D.4) and reservoir discharge (SA Article II.D.5). We respectfully request the following information to determine if this proposed project is in compliance with the terms of the SA:

1.A. The location of any diversions associated with this proposed reservoir and the flow planned to be maintained below any new surface water diversions associated with the proposed reservoir.

1.B. The planned timing and diversion rate on all diversions associated with the proposed reservoir.

1.C. The proposed location, timing, and volumetric flow rate of releases and any return flow associated with the proposed reservoir.

The NPS anticipated development of this proposed reservoir whose terms were outlined in the SA. In addition, the NPS is required to evaluate the proposed development for compliance with other federal laws as described below. Therefore, the NPS requests additional information in order to complete the required analyses.

2. Wild and Scenic River Act

As a water resources project requiring federal assistance located upstream of a designated Wild and Scenic River, the East Fork of the Virgin River, this project is required to be evaluated using Section 7 of the Wild and Scenic Rivers Act, to determine if it will invade the river area or unreasonably diminish the river's scenic, recreational, fish, or wildlife values. This evaluation will be completed by the NPS as the river administering agency. The NPS will use information available in the project's National Environmental Policy Act (NEPA) documents to complete the Section 7 Determination. The NPS requests specific information and analysis to be completed in the Watershed Plan and Environmental Impact Statement to inform its Section 7 Determination.

The East Fork of the Virgin River designated Wild and Scenic River provides habitat for four native fish species: desert sucker *(Catostomus clarkia)*, flannelmouth sucker (*Catostomus latipinnis*), virgin spinedace (*Lepidomeda mollispinis*) and speckled dace (*Rhinichthys osculus*). The desert sucker, flannelmouth sucker and Virgin spinedace are each listed as a Utah Species of

Greatest Conservation Need by the Utah Department of Natural Resources. Flow depletion and dewatering caused by stream diversions for agricultural, municipal, and industrial uses are among the primary threats to the desert sucker, flannelmouth sucker, and Virgin spinedace. Prolonged periods of drought and increasing stream temperatures are compounding threat factors that are further exacerbated by flow depletion from stream diversions. Other threat factors listed for fish species native to the East Fork Virgin River include pesticides and other pollutants introduced by return flows from municipal and agricultural drains and runoff, invasive wildlife species, invasive plant species, and the introduction of aquatic invasive parasites and diseases. We respectfully request the following information to help inform the Section 7 Determination:

2.A. The effects this water development project may have on Virgin spinedace, desert sucker, and flannelmouth sucker population and habitat maintenance in the East Fork of the Virgin River must be assessed in the EIS. The 2002 Conservation Agreement and Strategy for Virgin spinedace placed management of the recovery and conservation of Virgin spinedace with the Virgin River Resource Management and Recovery Program (VRRMRP), a multi-agency cooperative program. Please work with the VRRMRP to assess potential impacts and develop mitigations to reduce negative impacts on Virgin spinedace population and habitat in the East Fork of the Virgin River which may include the establishment of population maintenance flows or minimum flow requirements.

2.B. Analysis of how this proposed project will impact natural flow regimes (including the magnitude, frequency, and timing of flood flows) and flow-related habitat variables (including water temperature, turbidity, and sediment transport) under a variety of scenarios including low, normal, and high-water years through the East Fork of the Virgin River Wild and Scenic River.

2.C. Mitigation(s) to prevent non-native fish and aquatic invasive species from escaping into the East Fork of the Virgin River from the proposed reservoir associated with this project.

2.D. Analysis of how municipal and agricultural runoff as well as chemical and pesticide loads will be altered as a result of this proposed project. If increased runoff is expected, please provide information regarding mitigation measures to reduce runoff into the East Fork of the Virgin River.

2.E. Analysis, including any mitigation measures, on the anticipated effects climate change may have on this proposed project, including a reduction in snowpack in the East Fork of the Virgin River Watershed and spring runoff as well as increased air temperatures.

3. Endangered Species Act and Other Sensitive Species

Mexican Spotted Owl (MSO) and MSO Critical Habitat:

The East Fork of the Virgin River and its tributaries are inhabited by MSO and the entirety of ZION is designated critical habitat for MSO. Two breeding territories have been confirmed near the East Fork of the Virgin River. Inventory surveys have not been conducted in the majority of potential breeding habitat that exist along the East Fork, and it is likely more territories exist. Water development, including water diversion and reservoirs can degrade, reduce, and/or fragment MSO habitat and/or disrupt migration corridors, inhibit gene flow, alter prey habitat and/or alter grazing patterns by wild ungulates. Data on the timing of the discharges from the reservoir and how these discharges will alter the natural hydrological cycles and flow rates of the East Fork of the Virgin River (as requested in 2.B) will be needed to evaluate impacts to this protected species and habitat and consult with the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act.

Southwestern Willow Flycatcher (SWFL) and Yellow-Billed Cuckoo (YBCU):

The riparian habitat along the East Fork of the Virgin River provides migratory stop-over habitat and marginal breeding habitat for SWFL and YBCU. Both species have been detected along the Virgin River in ZION or Springdale, UT during migration. Water development can modify, degrade, or reduce SWFL and YBCU habitat especially if water in riparian ecosystems and associated subsurface water tables are reduced. Reduced flows during spring runoff may degrade/alter the quantity of prey (insects) available to migrating SWFL and YBCU. An increase in upstream establishment of non-native vegetation, such as tamarisk and Russian olive, will increase the rate of establishment of these species downstream which can negatively alter SWFL and YBCU habitat. Data on the timing of the discharges from the reservoir and how these discharges will alter the natural hydrological cycles and flow rates of the East Fork of the Virgin River (as requested in 2.B) will be needed to evaluate impacts to these protected species and consult with the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act.

3.A. Provide information on how non-native vegetation will be controlled near the proposed reservoir.

Sensitive and State-listed Species/Other Native Wildlife:

The East Fork of the Virgin River provides habitat for numerous native wildlife species, including State-listed species such as the Arizona toad. Water development projects have the potential to negatively affect wildlife if riparian habitat, fish communities, or aquatic invertebrate populations are negatively altered. Ecologically, if one functional group of wildlife is negatively impacted those effects will cascade to other wildlife species (e.g., if aquatic invertebrates are negatively affected numerous species of bats, birds, amphibians, and reptiles will also be affected). Data on the timing of the discharges from the reservoir and how these discharges will alter the water temperature, natural hydrological cycles and events and flow rates including the

magnitude, frequency, and timing of flood flows (as requested in 2.B) will be needed to evaluate impacts on these species.

4. Migratory Bird Treaty Act

The riparian habitat along the East Fork provides breeding, stop-over, and/or winter habitat for many species of migratory birds. Water development projects can negatively impact the quality and quantity of various habitat components (food, shelter, etc) which can reduce their breeding success or survival. An increase in upstream establishment of non-native vegetation, such as tamarisk and Russian olive, will increase the rate of establishment of these species downstream which can negatively affect migratory birds. Data on timing of the discharges from the reservoir and how these discharges will alter the natural hydrological cycles and flow rates of the East Fork (as requested in 2.B) will be needed to evaluate impacts on these species. Data (as requested in 3.A) on how non-native vegetation will be controlled near the proposed reservoir will also be important to identify.

5. Wilderness Act and Research Natural Areas

The East Fork of the Virgin River flows within congressionally designated Wilderness at ZION and is a primary feature that defines the Wilderness Character of the park. Three characteristics of Wilderness have the potential to be adversely impacted by the proposed water development project: Natural, Untrammeled, and Other Features of Value. NPS management focuses on maintaining this ecological system as substantially free from the effects of modern civilization (Natural) and unhindered and free from initial actions of modern human control or manipulation (Untrammeled). This area also holds unique features of ecological, geological, scientific, educational, scenic, and historical values (Other Features of Value). The presence of human civilization has long resided within Parunuweap Canyon which was only made possible by the river.

This area is also managed by ZION as a Research Natural Area (RNA). In accordance with the NPS Natural Resource Management Reference Manual (DO-77), RNAs are areas designated to be permanently protected and maintained in natural conditions. The ZION General Management Plan specifically calls out Parunuweap Canyon to be managed as an, “undisturbed watershed and riparian corridor.” The East Fork of the Virgin River is a critical component of the Parunuweap RNA which contains a unique ecosystem, ecological features, rare and sensitive species of plants, animals, and their habitats, and provides a high-quality example of a natural ecosystem. ZION manages the East Fork as an RNA to protect the area as a prime example of natural resources and processes, including significant genetic resources that have value for long-term observational studies or as control areas for manipulative research taking place outside of NPS lands.

Again, this aspect of the river emphasizes the need to establish a firm understanding of natural streamflow rates and how these might be altered with any water development infrastructure upstream within the drainage. Data on the timing of the discharges from the reservoir and how these discharges will alter the natural hydrological cycles and flow rates of the East Fork of the Virgin River (as requested in 2.C) will be needed to evaluate impacts to wilderness and the RNA. Identifying and communicating strategies for managing flows, to include anticipated discharge schedules and pulse volumes, will be of critical importance in order for the NPS to remain involved in for the life of the project. Any impacts or changes to winter, scouring flows may alter the riparian corridor and how flow rates would be managed to address low water years when pulses cannot be released will be essential for the NPS to understand.

5.A. Please provide an analysis of impacts this project may have on Wilderness characteristics within the East Fork of the Virgin River in Zion National Park.

We appreciate the opportunity to identify information needs, important needed analyses and to provide comments during the scoping period of the Watershed Plan and Environmental Impact Statement for the Cove-East Fork Virgin River Watershed Project. Further, we request the information and analyses discussed above be initiated in consultation with all cooperating agencies. Please work directly with ZION staff to advance the responsibilities and expectations that will be assigned in the memorandum of understanding for cooperating agencies. If you have any questions, please contact Jeff Bradybaugh, ZION Superintendent, as the primary point of contact by phone at 435-772-0140 or by email at Jeff_Bradybaugh@nps.gov.

Sincerely,

Michael Reynolds
NPS Regional Director
Regions 6, 7, 8

cc:
Jeff Bradybaugh, NPS, Zion National Park, Superintendent
Norm Evenstad, USDA NRSC Water Resources Coordinator
Brian Parker, Transcon Environmental
Christopher Keleher, VRRMRP Director

United States Department of the Interior

NATIONAL PARK SERVICE
ZION NATIONAL PARK
State Route 9
Springdale, Utah 84767

IN REPLY REFER TO:
1.A.1 (ZION)

May 15, 2025

Ms. Emily Fife, USDA NRCS State Conservationist
Wallace F. Bennett Federal Building
125 South State Street Room #4010
Salt Lake City, UT 84138

Subject: National Park Service (NPS) Comments on "Preliminary Draft Biological Assessment" of the Cove-East Fork Virgin River Watershed Plan-Environmental Impact Statement dated April 2025

Dear Ms. Fife,

On April 22, 2025, we received "Preliminary Draft Biological Assessment" of the Cove-East Fork Virgin River Watershed Plan-Environmental Impact Statement dated April 2025.

NPS Comments on "Preliminary Draft Biological Assessment" (April 2025)		
Comment Number	*Page, Section/Table*	*Comment*
1	1, 2.0	A more detailed description is needed for the proposed action. The description should include not only what is being proposed, but when it will occur, where, why, and how it will occur. It should include the timing, intensity, and duration of each component of the action. For example, what equipment or methods will be used? What time of year will the action be conducted? How long will the activity take place?
2	1, 2.2	Amend this section to state, "The reservoir would be constructed in compliance with Article II Section D of the Zion National Park…" Amend "One or more new reservoirs with cumulative active storage capacity of up to but not to exceed 6,750 acre-feet may be constructed in certain tributaries as outlined in Article II Section D of the Agreement 1996."
3	1.2.2	Amend this section to state, "The existing flow or 1 cfs (including seepage), whichever is less, shall be maintained immediately below any new reservoir constructed on streams defined in section 11.D.1.a) of the Agreement 1996."
4	3, 2.2.2	This section states, "Water committed to Washington County for irrigation and MR purposes could be released any time during the year to meet demand but would most likely be during the fall and winter months. Releases to Washington County would be in compliance with the ZNP Agreement (Agreement, 1996)." However, the Water Model Report (July 2024) for this project models releases from this reservoir to Washington County occurring June through August in an average annual simulation. Please clarify.

5	3, 2.2.3	Is there a plan to develop an Emergency Action Plan for this reservoir to delineate specific requirements for inspections and communication to downstream managers in the event of failure or imminent failure? This information does not need to be included in the Biological Assessment, but the NPS would like to see a summary of the plan in the EIS.
6	4, 2.3	Include specific details on conservation measures that would minimize the introduction of non-native species into the river and reservoir (e.g., all equipment should be cleaned and inspected for Aquatic Invasive Species prior to being brought on site). To ensure the success of the post-construction seeding efforts, include post-construction mitigation for non-natives that are introduced/become established. There is a substantial population of invasive knapweed (*Centaurea stoebe*) in the area that could benefit from this disturbance and potentially have a negative effect on post-construction seeding.
7	4, 2.3	Include specific details on conservation measures to prevent the introduction of stocked non-native salmonids (fish and eggs) from entering the East Fork of the Virgin River.
8	4, 2.3	Is there plan to complete construction work at night? If so, what mitigations will be in place to protect nocturnal species and systems?
9	4, 2.3	What mitigations will be in place to protect fish during their spawning periods when in-river construction is being completed?
10	4, 2.3	Include conservation measures that are specific to California condors. For example, to reduce microtrash ingestion by condors, all trash at the construction site should be cleaned up daily.
11	5, 3.0	Please elaborate on the description of the Action Area to describe the East Fork of the Virgin River passing through the Parunuweap Canyon Wilderness Study Area managed by the Bureau of Land Management and Zion National Park. Please describe the ecosystems of the lands within the Action Area such as, "the action area includes a mix of developed residential land, disturbed grasslands, grazing pastures, native vegetation communities" (include specific communities).
12	6, 3.4.1	This section states, "EFVR surface flows vary throughout the year, primarily in response to spring runoff or intense storm events, during which the river carries high sediment loads. From 1967 to 2020, the average monthly discharge of the river ranged from a high of 33.8 cfs in April to a low of 9.9 cfs in August." Is this flow data taken from a specific gage site? If so, describe the source. If this data is taken from a gage location downstream of significant surface diversions, please describe the effect of surface diversions on the flow variability throughout the year.
13	6, 3.4.1	Reference to action area should still include downstream locations. It would appear that the identified wetlands and streams are only for the area of surface disturbance. Further, does "two additional *sites* bisect the proposed pipeline" refer to two additional *streams*? Please clarify.
14	6, 3.4.1	"The river continues downstream into Washington County where it merges with other small rivers near ZNP to form the Virgin River." Please edit to elaborate, "The EFVR flows downstream from Mt. Carmel Junction through Parunuweap Canyon Wilderness Study Area (WSA) managed by the Bureau of Land Management and Zion National Park where it meets with the North Fork of the Virgin River near Rockville, UT."
15	7, 3.4.2	The state listed sensitive species *Cirsium joannae* (Joanna's thistle), G1/S1

		Critically Imperiled, is recorded within a two-mile radius of the Action Area and should be included here. This population is one of two known locations of this species. This population has been stable since it's discovery in Dennet Canyon in 2007 with only three mature producing plants counted in 2007 and again in 2024. Please let us know if you need any more specific information to be included in this BA.
16	8, 3.4.3, Table 2	Please include Mexican spotted owl (MSO) and speckled dace which are known to occur within the Action Area.
17	9, 4.0	Data on California condor, MSO, Southwestern willow flycatcher, and Yellow-billed cuckoo within Zion National Park in the Action Area were not obtained and therefore not considered as part of the BA analysis. Data is available from Zion National Park, U.S. Fish and Wildlife Service, and The Peregrine Fund (condors).
18	10, Table 4	Condors should not be dismissed for analysis. Condors are in the action area and the action area is condor habitat. Condors are obligate scavengers and since there is potential for animals to die within the Action Area, then there is condor food present in the action area and therefore the action area is habitat for condors. GPS condor data from The Peregrine Fund will show that the condors are using all parts of the action area, including the dam site. Also, in 2021 there was a successful condor nest in Mineral Gulch which should be mentioned in BA.
19	10, Table 4	There is occurrence data for MSO within the Action Area. Several protected activity centers (PACs) are within the action area; these data and any other survey data from Zion National Park and BLM should be included in BA.
20	10, Table 4	Unless surveys have been conducted, how was it determined that there is no occupied monarch butterfly habitat in the Action Area? Patches of habitat along the North Fork of the Virgin River have been surveyed for milkweed and evidence of monarch reproduction (eggs, caterpillars) are present. There is habitat for the monarch butterfly located in the East Fork of the Virgin River. Monarch caterpillars have been observed on their habitat within the proposed Action Area.
21	10, Table 4	How was a No Effect determination concluded for Southwestern willow flycatcher? If there is potential for indirect effects, even if that indirect effect is minor, then there is an effect. The main threats to this species are mostly related to habitat loss/modification due to dams and reservoirs that causes changes to natural hydrological cycles. There is currently no explanation of how this project will not change the natural hydrological cycles along the East Fork of the Virgin River. A description is needed of how this project will not change: daily water fluctuations, short-duration floods, flood-induced sediment deposition, floodplain hydration and flushing, and the establishment (i.e., seed dispersal/establishment coincides with spring flooding) and maintenance of native riparian habitats. Effects to riparian habitat, stream flow, and hydrological cycles will affect: the quality and quantity of riparian vegetation, wetted perimeter, the seasonal flooding of steams during willow flycatcher spring migration and/or breeding season, and the insect population that provides food for willow flycatchers.

22	10, Table 4	Yellow-billed cuckoo habitat in the action area is not suitable for breeding habitat, but it is suitable stop-over habitat for migrating cuckoo. This should be considered for analysis.
23	14, 4.1.2	Be specific when referring to MSO habitat. MSO nesting and roosting habitat differs from foraging habitat. In Utah, nesting and roosting habitat is primarily steep, rocky canyons. MSO use a wider variety of cover types for foraging than for roosting and nesting and this should be considered when analyzing the effects of the project on MSO.
24	14, 4.1.2	Since there are steep, rocky canyons bordering/overlapping the Action Area in Long Valley (e.g., Red Hollow), it cannot be assumed there is no habitat or MSO presence in the Action Area outside of Parunuweap Canyon unless surveys were conducted according to USFWS protocol.
25	14, 4.1.1	Please edit to correct misspellings and clarify, "Other land uses, such as livestock grazing, timber cutting, and energy development, do not occur within Parunuweap Canyon Wilderness Study Area and Zion National Park portion of the Action Area (USFWS 2004)."
26	17, 4.1.1.1	This section is the first mention on construction duration. This should be mentioned in the earlier sections describing the proposed activities.
27	17-21	For ALL species/habitat determination, rationale that supports the effect determination needs to be provided. As the BA is currently written, there is no rationale, support, or justification of how the NRCS arrived at the determinations. For example, the Operation Impacts effect determination for MSO states that "no harm or harassment would occur to MSO as a result of streamflow changes" therefore there will be "no effect" to MSO. What is the justification for concluding that individual owls will not be harmed by potential changes to riparian habitat? Describe how reduction in streamflow will not affect riparian habitat and will not reduce prey availability which affects MSO feeding success? Effects should be at the individual species level (not population level). For each species analyzed, there should be an explanation of what the species' exposure is to direct and indirect effects of the proposed management action and what their anticipated responses will be. For example, are individual MSO in proximity to the riparian habitat that may experience changes due to stream flow? What is the duration of that change? Will that exposure to that effect potentially impact essential behaviors such as feeding, breeding, sheltering, migration, and movements and the habitats that support them?
28	17, 4.4.1	Since there are steep, rocky canyons bordering/overlapping the Action Area in Long Valley (e.g., Red Hollow), it cannot be assumed that MSO are not present in the Action Area outside of Parunuweap Canyon unless surveys were conducted according to USFWS protocol. Unless all steep, rocky canyons adjacent to Long Valley have been surveyed for MSO occupancy, a No Effect determination cannot be made for construction impacts.
29	17, 4.4.2	Since several MSO PACs overlap the Action Area in Parunuweap Canyon and the entire Parunuweap Canyon area is critical habitat, a better explanation is needed to justify why there would be "negligible impacts" to the riparian vegetation in Parunuweap Canyon. How exactly was this analyzed and this conclusion reached? It is well known that the quality and quantity of riparian vegetation is directly associated with stream flow and

		hydrological cycles, so how does a project that proposes to reduce stream flow and change the hydrological cycle avoid impacting riparian habitat? This is important to analyze since any changes to riparian habitat will likely affect MSO prey availability and could reduce individual MSO feeding success which could affect MSO reproduction and survival; therefore a "No Effect" would not be the correct effect determination for MSO.
30	22, 6.1	Justifications for determinations needs to be strengthened (see comments above) and information corrected. Riparian habitat is present within occupied MSO habitat. Currently there are two confirmed PACs that include riparian habitat along the East Fork of the Virgin River. There are likely more, but surveys need to be conducted. Riparian habitat IS a PCE, so a "no effect" determination for critical habitat needs to be better justified since there will be changes to stream flow and hydrological cycles under the proposed action. A description of how those changes will impact riparian habitat is needed (i.e., cite literature, talk to experts; ask the questions: "If a river sees X (cfs) less flow during X months/year every year, then how could riparian habitat be affected long-term? Will it affect vegetation recruitment since some species require springtime flooding to germinate? Will riparian habitat along the river become narrower since there will be less wetted perimeter and less vegetation receiving the water they need to survive? Will the retreating riparian habitat be overtaken with non-native invasive plant species? What is the potential cascading effect of less surface water or less riparian habitat on the ecosystem?")
31	26, 7.0	Zion reference to condors should be 2025a. To be consistent with references below, both should contain a URL.

As described in the comments above, there is important survey data the NPS would like to share with the NRCS on species known to occur within the Action Area. We believe a meeting to discuss the transfer of these data and key comments would be of mutual benefit.

We greatly appreciate the opportunity to continue collaborating as a cooperating agency and look forward to a response from the NRCS on these comments. Please continue to work with our Physical Scientist, Robyn Henderek, who may be reached by email at robyn_henderek@nps.gov or by phone at 435-772-0158.

Sincerely,

JEFFREY BRADYBAUGH

Digitally signed by JEFFREY BRADYBAUGH
Date: 2025.05.15 14:54:13 -06'00'

Jeff Bradybaugh

Superintendent

cc:
Emily Paris, Eocene Environmental Group

July 11, 2025

Jeffrey Bradybaugh
Superintendent
Zion National Park
1 Zion Blvd. (SR-9)
Springdale, UT 84767

Submitted by email to lauren_degennaro@nps.gov

Subject: Preliminary Draft Biological Assessment for Cove-East Fork Virgin River Watershed Plan

Dear Mr. Bradybaugh:

On behalf of the Natural Resources Conservation Service (NRCS) we appreciate the time, effort, and expertise you provided in reviewing the Preliminary Draft Biological Assessment for the Cove-East Fork Virgin River Watershed Plan. The consideration extended by a cooperating agency to review our documents significantly improves their quality and clarity.

After a thorough review of the comments, we have incorporated the content, as appropriate, into the Preliminary Draft Biological Assessment. A Comment Response Table with rationale for addressing the responses is attached to this letter.

Please contact me directly if you have any questions about this information at (775) 296-0819 or eparis@eocene.com.

Sincerely,

Emily Paris
Project Manager
Eocene Environmental Group, Inc.

CC: Derek Hamilton, NRCS; Robyn Henderek, NPS; Erin Dempsey, NPS

Attachment: Comment Response Table

ATTACHMENT

Comment Number	Location	Comment	Response
1	Section 2.0 Page 1	A more detailed description is needed for the proposed action. The description should include not only what is being proposed, but when it will occur, where, why, and how it will occur. It should include the timing, intensity, and duration of each component of the action. For example, what equipment or methods will be used? What time of year will the action be conducted? How long will the activity take place?	Additional information has been added as requested.
2	Section 2.2 Page 1	Amend this section to state, “The reservoir would be constructed in compliance with Article II Section D of the Zion National Park…” Amend “One or more new reservoirs with cumulative active storage capacity of up to but not to exceed 6,750 acre-feet may be constructed in certain tributaries as outlined in Article II Section D of the Agreement 1996.”	Text change has been made as requested.
3	Section 2.2 Page 1	Amend this section to state, “The existing flow or 1 cfs (including seepage), whichever is less, shall be maintained immediately below any new reservoir constructed on streams defined in section 11.D.1.a) of the Agreement 1996.”	This measure, as stated in the Agreement, has been added to the text.
4	Section 2.2.2 Page 3	This section states, “Water committed to Washington County for irrigation and MR purposes could be released any time during the year to meet demand but would most likely be during the fall and winter months. Releases to Washington County would be in compliance with	Text has been clarified. Water would be released for agricultural use in Washington County by the HCC during the summer months of June, July, and August. Timing for water releases for M&I use in Washington County has not been determined.

Comment Number	Location	Comment	Response
		the ZNP Agreement (Agreement, 1996)." However, the Water Model Report (July 2024) for this project models releases from this reservoir to Washington County occurring June through August in an average annual simulation. Please clarify.	Washington County has emphasized the need for flexibility, and M&I related releases could occur at any time of the year. All releases would be in compliance with the ZNP Agreement.
5	Section 2.2.3 Page 3	Is there a plan to develop an Emergency Action Plan for this reservoir to delineate specific requirements for inspections and communication to downstream managers in the event of failure or imminent failure? This information does not need to be included in the Biological Assessment, but the NPS would like to see a summary of the plan in the EIS.	A Standard Operation Procedures manual as well as an Emergency Action Plan would be required as part of the final documentation for the reservoir. These documents can't be developed until the engineering and design work are completed, so would not be included in the EIS. No text change in the BA is required.
6	Section 2.3 Page 4	Include specific details on conservation measures that would minimize the introduction of non-native species into the river and reservoir (e.g., all equipment should be cleaned and inspected for Aquatic Invasive Species prior to being brought on site). To ensure the success of the postconstruction seeding efforts, include post-construction mitigation for nonnatives that are introduced/become established. There is a substantial population of invasive knapweed (*Centaurea stoebe*) in the area that could benefit from this disturbance and potentially have a negative effect on postconstruction seeding	Two committed conservation measures currently in the Plan-EIS have been added to the BA for clarification. These measure state that "All equipment would be cleaned of soil, seeds, vegetation matter, and other debris prior to entering or reentering the project area to avoid any introduction of non-native plants or weeds. "and "Prior to stocking the proposed reservoir with fish, a management plan will be developed to ensure that non-native fish species do not escape from the reservoir into the EFVR." It should be noted that no construction activities would occur within the EFVR. This would greatly reduce the potential for the

Comment Number	Location	Comment	Response
			introduction of non-native species into the river.
7	Section 2.3 Page 4	Include specific details on conservation measures to prevent the introduction of stocked non-native salmonids (fish and eggs) from entering the East Fork of the Virgin River.	Additional information has been added as requested. A measure that is currently in the Plan-EIS has been added to the BA. This measure states that, "Prior to stocking the proposed reservoir with fish, a management plan will be developed to ensure that non-native fish species do not escape from the reservoir into the EFVR". It should also be noted that several actions would be taken to prevent non-natives from entering the EFVR. These include a fish screen at the proposed reservoir intake with a 1-inch maximum pore opening that would prevent fish and debris from entering the pipeline to the Orderville hydroelectric power plant. The hydroelectric facility utilizes two Turgo Impulse turbines, which focus the water through small nozzles at high pressure and velocity into the turbines. The combination of the small nozzle size, high velocity, and sudden pressure drop would make it highly unlikely that any fish that might make it into the pipeline would survive. This information has been added to Section 2.2.1 (Project Measures for clarification.

Comment Number	Location	Comment	Response
8	Section 2.3 Page 4	Is there plan to complete construction work at night? If so, what mitigations will be in place to protect nocturnal species and systems?	There are no current plans for night time construction.
9	Section 2.3 Page 4	What mitigations will be in place to protect fish during their spawning periods when in-river construction is being completed?	No in-river construction would occur as part of the proposed project development. All structures including the reservoir, pipelines, and access road would be constructed away from the EFVR. The reservoir would be located approximately 0.7 miles away from the EFVR. Therefore, no construction related mitigation to protect fish during spawning periods would be necessary. No text change has been made.
10	Section 2.3 Page 4	Include conservation measures that are specific to California condors. For example, to reduce microtrash ingestion by condors, all trash at the construction site should be cleaned up daily.	No effects have been identified for the California condor resulting from project development. The Long Valley portion of the Action Area is the only place where surface disturbance would occur. It is not considered to be condor habitat due a to lack of habitat. However, additional committed conservation measures found in the Plan-EIS relating to plants and animals (including the condor), have been added to the BA.
11	Section 3.0 Page 5	Please elaborate on the description of the Action Area to describe the East Fork of the Virgin River passing through the Parunuweap Canyon Wilderness Study Area managed by the Bureau	Language in Section 3.5.2 has been added as requested.

Comment Number	Location	Comment	Response
		of Land Management and Zion National Park. Please describe the ecosystems of the lands within the Action Area such as, “the action area includes a mix of developed residential land, disturbed grasslands, grazing pastures, native vegetation communities” (include specific communities).	
12	Section 3.4.1 Page 6	This section states, “EFVR surface flows vary throughout the year, primarily in response to spring runoff or intense storm events, during which the river carries high sediment loads. From 1967 to 2020, the average monthly discharge of the river ranged from a high of 33.8 cfs in April to a low of 9.9 cfs in August.” Is this flow data taken from a specific gage site? If so, describe the source. If this data is taken from a gage location downstream of significant surface diversions, please describe the effect of surface diversions on the flow variability throughout the year.	This data were taken from USGS gauging station 09404450 located above the community of Glendale below the Glendale Irrigation Company Diversion Dam. Reference has been added to the text as requested.
13	Section 3.4.1 Page 6	Reference to action area should still include downstream locations. It would appear that the identified wetlands and streams are only for the area of surface disturbance. Further, does “two additional sites bisect the proposed pipeline” refer to two additional streams? Please clarify.	Because no surface disturbance would occur outside of the Long Valley area, it is not necessary to identify downstream wetlands and streams beyond the EFVR and the Virgin River. Text has been changed to clarify the discussion regarding intermittent streams in Long Valley.

Comment Number	Location	Comment	Response
14	Section 3.4.1 Page 6	“The river continues downstream into Washington County where it merges with other small rivers near ZNP to form the Virgin River.” Please edit to elaborate, “The EFVR flows downstream from Mt. Carmel Junction through Parunuweap Canyon Wilderness Study Area (WSA) managed by the Bureau of Land Management and Zion National Park where it meets with the North Fork of the Virgin River near Rockville, UT.”	Sentence has been added to the text as requested.
15	Section 3.4.2 Page 7	The state listed sensitive species Cirsium joannae (Joanna's thistle), G1/S1 Critically Imperiled, is recorded within a two-mile radius of the Action Area and should be included here. This population is one of two known locations of this species. This population has been stable since it's discovery in Dennet Canyon in 2007 with only three mature producing plants counted in 2007 and again in 2024. Please let us know if you need any more specific information to be included in this BA.	This species has been added to Table 1. per your request.
16	Section 3.4.3 Table 2 Page 8	Please include Mexican spotted owl (MSO) and speckled dace which are known to occur within the Action Area.	MSO is not included in Table 2 as it is an Endangered Species Act listed species and is identified in Table 4 (ESA - Listed and Candidate Species). Speckled dace has been added to the Table

Comment Number	Location	Comment	Response
17	Section 4.0 Page 9	Data on California condor, MSO, Southwestern willow flycatcher, and Yellow-billed cuckoo within Zion National Park in the Action Area were not obtained and therefore not considered as part of the BA analysis. Data is available from Zion National Park, U.S. Fish and Wildlife Service, and The Peregrine Fund (condors).	Data from the ZNP website, USFWS Ecos website, MSO, SWWF, and Virgin River Fishes Recovery Plans and other documents, and personal discussions with the BLM Kanab Field Office Biologist were all used in analyzing and making the effects determination for the species determined to have a potential effect resulting from project implementation. We determined that there would be no effect to the condor and did not analyze that species.
18	Table 4 Page 10	Condors should not be dismissed for analysis. Condors are in the action area and the action area is condor habitat. Condors are obligate scavengers and since there is potential for animals to die within the Action Area, then there is condor food present in the action area and therefore the action area is habitat for condors. GPS condor data from The Peregrine Fund will show that the condors are using all parts of the action area, including the dam site. Also, in 2021 there was a successful condor nest in Mineral Gulch which should be mentioned in BA	As stated in Comment No. 30 (No. 10 NPS comment), no effects have been identified for the California condor resulting from project development. The Long Valley portion of the Action Area is the only place where surface disturbance would occur. It is not considered to be condor habitat due a to lack of habitat. No surface disturbance would occur in condor habitat in ZNP. However, additional committed conservation measures found in the Plan-EIS relating to plants and animals (including the condor), have been added to the BA.
19	Table 4 Page 10	There is occurrence data for MSO within the Action Area. Several protected activity centers (PACs) are within the action area; these data and any other survey data from Zion National Park and BLM should be included in BA.	Data from the ZNP website, USFWS Ecos website, MSO Recovery Plan and other documents, and personal discussions with the BLM Kanab Field Office Biologist were all used in analyzing and making the effects

Comment Number	Location	Comment	Response
			determination for the MSO and its designated critical habitat including PACs. A review of the MSO Recovery Plan determined that project implementation would be well within the identified Recovery Plan PAC management guidelines. Because no significant impacts are anticipated for MSO habitat including designated critical habitat, we do not believe that there would be any adverse effects to any MSO PACs. A PAC discussion has been added to the BA text (Section 4.1.3).
20	Table 4 Page 10	Unless surveys have been conducted, how was it determined that there is no occupied monarch butterfly habitat in the Action Area? Patches of habitat along the North Fork of the Virgin River have been surveyed for milkweed and evidence of monarch reproduction (eggs, caterpillars) are present. There is habitat for the monarch butterfly located in the East Fork of the Virgin River. Monarch caterpillars have been observed on their habitat within the proposed Action Area.	Text clarification has been made in Table 4.
21	Table 4 Page 10	How was a No Effect determination concluded for Southwestern willow flycatcher? If there is potential for indirect effects, even if that indirect effect is minor, then there is an effect. The main threats to this species are mostly related to habitat loss/modification due to dams and reservoirs that causes changes to natural	The effects determination for the SWWF has been changed to May Affect, but is Not Likely to Adversely Affect. BA text has been added to incorporate this change. We do note that a Water Model and an analysis of waterflow changes have been prepared for Cove Reservoir project that addresses

Comment Number	Location	Comment	Response
		hydrological cycles. There is currently no explanation of how this project will not change the natural hydrological cycles along the East Fork of the Virgin River. A description is needed of how this project will not change: daily water fluctuations, short-duration floods, flood-induced sediment deposition, floodplain hydration and flushing, and the establishment (i.e., seed dispersal/establishment coincides with spring flooding) and maintenance of native riparian habitats. Effects to riparian habitat, stream flow, and hydrological cycles will affect: the quality and quantity of riparian vegetation, wetted perimeter, the seasonal flooding of steams during willow flycatcher spring migration and/or breeding season, and the insect population that provides food for willow flycatchers.	downstream flows. These documents are referenced several times in this BA. They conclude that changes in EFVR flows would be minor especially when compared with the significant changes in flows that result from snow melt, floods, etc.
22	Table 4 Page 10	Yellow-billed cuckoo habitat in the action area is not suitable for breeding habitat, but it is suitable stop-over habitat for migrating cuckoo. This should be considered for analysis.	Text has been updated to reflect the lack of breeding habitat and the presence of stop-over habitat for migrating cuckoos.
23	Section 4.1.2 Page 14	Be specific when referring to MSO habitat. MSO nesting and roosting habitat differs from foraging habitat. In Utah, nesting and roosting habitat is primarily steep, rocky canyons. MSO use a wider variety of cover types for foraging than for roosting and nesting and this should be	Language has been added to include a discussion of foraging habitat.

Comment Number	Location	Comment	Response
		considered when analyzing the effects of the project on MSO.	
24	Section 4.1.2 Page 14	Since there are steep, rocky canyons bordering/overlapping the Action Area in Long Valley (e.g., Red Hollow), it cannot be assumed there is no habitat or MSO presence in the Action Area outside of Parunuweap Canyon unless surveys were conducted according to USFWS protocol.	No steep, rocky habitat is located within the Long Valley portion of the Action Area. Red Hollow (an MSO PAC) is located to the east and well outside of the Action Area. Additionally, the town of Orderville lies between Red Hollow and the proposed reservoir site. So it is unlikely that the MSO would use the reservoir site for foraging. No text changes or a change in effects determinations are necessary for the Long Valley portion of the Action Area.
25	Section 4.1.1 Page 14	Please edit to correct misspellings and clarify, “Other land uses, such as livestock grazing, timber cutting, and energy development, do not occur within Parunuweap Canyon Wilderness Study Area and Zion National Park portion of the Action Area (USFWS 2004).”	Corrections have been made as requested.
26	Section 4.4.1.1 Page 17	This section is the first mention on construction duration. This should be mentioned in the earlier sections describing the proposed activities.	Construction duration has been added to Section 2.2.1.
27	Pages 17-21	For ALL species/habitat determination, rationale that supports the effect determination needs to be provided. As the BA is currently written, there is no rationale, support, or justification of how the NRCS arrived at the determinations. For	Additional clarifying text has been added. For consistency, we have changed the MSO Species Operation effects determination to May Affect, but is Not Likely to Adversely Affect. Effects determination is based on

Comment Number	Location	Comment	Response
		example, the Operation Impacts effect determination for MSO states that “no harm or harassment would occur to MSO as a result of streamflow changes” therefore there will be “no effect” to MSO. What is the justification for concluding that individual owls will not be harmed by potential changes to riparian habitat? Describe how reduction in streamflow will not affect riparian habitat and will not reduce prey availability which affects MSO feeding success? Effects should be at the individual species level (not population level). For each species analyzed, there should be an explanation of what the species’ exposure is to direct and indirect effects of the proposed management action and what their anticipated responses will be. For example, are individual MSO in proximity to the riparian habitat that may experience changes due to stream flow? What is the duration of that change? Will that exposure to that effect potentially impact essential behaviors such as feeding, breeding, sheltering, migration, and movements and the habitats that support them?	anticipated effects that would occur over and above what is currently happening or has happened in the past in the EFVR in Parunuweap Canyon. Based on the Water Model and follow up River Changes report, we do not believe that there would be loss of riparian habitat that would result from project development. The riparian vegetation is adapted to the significant changes in EFVR flows that have occurred over the years due to spring runoff and flooding. As the Alpha water model states, "..the effect of an additional 15 to 25 cfs flow from the proposed reservoir during flood stage or during normal streamflow conditions would be minor and that the natural variation of the river is approximately 100 times the range of effect from reservoir releases." For example, on December 21 the Springdale USGW gauging station recorded 2,020 cfs with a flood stage depth of 10.11 feet. Implementation of the Agreement would result in a flood stage river flow increase of 0.74 percent to 1.24 percent based on discharge amounts between 15 to 25 cfs. River level would increase 0.07 to 0.13 feet. Further, the gauge showed extreme variability in stream flows from 1994 to 2022 of less than 40 cfs to over 2,000 cfs. Based on these data, we believe that the minor change in stream flow resulting from project

Comment Number	Location	Comment	Response
			development would not result in a significant adverse effect to or additional loss of MSO or SWWF habitat.
28	Section 4.4.1 Page 17	Since there are steep, rocky canyons bordering/overlapping the Action Area in Long Valley (e.g., Red Hollow), it cannot be assumed that MSO are not present in the Action Area outside of Parunuweap Canyon unless surveys were conducted according to USFWS protocol. Unless all steep, rocky canyons adjacent to Long Valley have been surveyed for MSO occupancy, a No Effect determination cannot be made for construction impacts.	See response to comment 44 (NPS comment 24). There is no steep, rocky canyon habitat in the Long Valley portion of the Action Area. Red Hollow (including an associated PAC) is located well outside of the Action Area. Additionally, the town of Orderville lies between Red Hollow and the proposed reservoir site. So it is unlikely that the MSO would use the reservoir site for foraging. No change in MSO effects determination for the Long Valley portion of the Action Area is necessary.
29	Section 4.4.2 Page 17	Since several MSO PACs overlap the Action Area in Parunuweap Canyon and the entire Parunuweap Canyon area is critical habitat, a better explanation is needed to justify why there would be “negligible impacts” to the riparian vegetation in Parunuweap Canyon. How exactly was this analyzed and this conclusion reached? It is well known that the quality and quantity of riparian vegetation is directly associated with stream flow and hydrological cycles, so how does a project that proposes to reduce stream flow and change the hydrological cycle avoid impacting riparian habitat? This is important to analyze since any changes to riparian habitat	See response to comment 27

Comment Number	Location	Comment	Response
		will likely affect MSO prey availability and could reduce individual MSO feeding success which could affect MSO reproduction and survival; therefore a “No Effect” would not be the correct effect determination for MSO.	
30	Section 6.1 Page 22	Justifications for determinations needs to be strengthened (see comments above) and information corrected. Riparian habitat is present within occupied MSO habitat. Currently there are two confirmed PACs that include riparian habitat along the East Fork of the Virgin River. There are likely more, but surveys need to be conducted. Riparian habitat IS a PCE, so a “no effect” determination for critical habitat needs to be better justified since there will be changes to stream flow and hydrological cycles under the proposed action. A description of how those changes will impact riparian habitat is needed (i.e., cite literature, talk to experts; ask the questions: “If a river sees X (cfs) less flow during X months/year every year, then how could riparian habitat be affected long-term? Will it affect vegetation recruitment since some species require springtime flooding to germinate? Will riparian habitat along the river become narrower since there will be less wetted perimeter and less vegetation receiving the water they need to survive? Will the retreating riparian habitat be overtaken with non-native invasive plant species? What is the potential	See response to previous comments. The presence of PACs has been added to the text is Section 4.1.3.

Comment Number	Location	Comment	Response
		cascading effect of less surface water or less riparian habitat on the ecosystem?")	
31	Section 7.0 Page 26	Zion reference to condors should be 2025a. To be consistent with references below, both should contain a URL.	Text correction has been made. URL has been added.
	General Comment	As described in the comments above, there is important survey data the NPS would like to share with the NRCS on species known to occur within the Action Area. We believe a meeting to discuss the transfer of these data and key comments would be of mutual benefit.	Thank you. We would be happy to discuss this.

Fillerup, Anders - FPAC-NRCS, UT

From: Bradybaugh, Jeffrey S <Jeff_Bradybaugh@nps.gov>
Sent: Friday, August 29, 2025 1:26 PM
To: Fife, Emily - FPAC-NRCS, UT
Cc: Fillerup, Anders - FPAC-NRCS, UT; Magee, Catherine - FPAC-NRCS, MA
Subject: Re: [EXTERNAL] RE: Cove Reservoir

My apologies for the long delay in providing a response to your request, Emily! As I indicated several weeks ago by phone, DOI was re-examining the Wild & Scenic River Section 7 analysis requirement. DOI has changed its decision and has decided NPS will not be conducting a Section 7 analysis.

We, of course, will continue assisting NRCS as a cooperating agency for the Cove Reservoir project's Environmental Impact Statement process.

Have a great Labor Day weekend!!!

Jeff Bradybaugh (he/him)
Superintendent
Zion National Park
State Highway Route 9
Springdale, UT 84767
phone: 435-772-0140
e-mail: jeff_bradybaugh@nps.gov

"Optimism is true moral courage"
Sir Ernest Shackleton, 1874-1922
shipwrecked Antarctic Explorer



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From: Fife, Emily - FPAC-NRCS, UT <emily.fife@usda.gov>
Sent: Thursday, August 7, 2025 1:49 PM
To: Bradybaugh, Jeffrey S <Jeff_Bradybaugh@nps.gov>
Cc: Fillerup, Anders - FPAC-NRCS, UT <anders.fillerup@usda.gov>
Subject: [EXTERNAL] RE: Cove Reservoir

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Good afternoon Jeff,

Just wanted to circle back and see if you are able to help with my request. Thanks!

Emily Fife
State Conservationist
Utah - NRCS#

USDA U.S. DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service
125 S State Street, Room 6416, Salt Lake City, UT 84138
p: (801) 524-4550 | c: (801) 718-8828

From: Fife, Emily - FPAC-NRCS, UT
Sent: Wednesday, July 30, 2025 11:09 AM
To: Jeff_Bradybaugh@nps.gov
Subject: Cove Reservoir

Good morning Jeff,

Happy Wednesday and I hope you're having a good week. I wanted to follow up from our phone call. Would you be able to reply with the NPS decision to require the Section 7 analysis for the Cove Reservoir project so I have it in writing for our records? Much appreciated and please call if you'd like to discuss.

Many thanks,

Emily Fife
State Conservationist
Utah - NRCS#

USDA U.S. DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service
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United States Department of the Interior

NATIONAL PARK SERVICE
ZION NATIONAL PARK
State Route 9
Springdale, Utah 84767

IN REPLY REFER TO:
1.A.1 (ZION)

March 6, 2026

Ms. Catherine Magee, Acting USDA NRCS State Conservationist
Wallace F. Bennett Federal Building
125 South State Street Room #6416
Salt Lake City, UT 84138

Subject: National Park Service (NPS) comments on the "Preliminary Draft Watershed Plan-Environmental Impact Statement for Cove-East Fork Virgin River Watershed Project" and the "Updated Draft Biological Assessment for the Cove-EFVR Reservoir Project"

Dear Ms. Magee,

The National Park Service (NPS) reviewed the "Preliminary Draft Watershed Plan-Environmental Impact Statement for Cove-East Fork Virgin River Watershed Project" received on February 3rd, 2026 and the "Updated Draft Biological Assessment for the Cove-EFVR Reservoir Project" received on February 6th, 2026. Thank you for the opportunity as a Cooperating Agency to review and submit comments.

Please see three tables below which outline NPS comments for the two documents received mentioned above and unresolved comments from the Water Model Report. NPS comments 1, 11, 12, 16, 17, 19, 20, 22, 23, 24, 25 and 28 on the Updated Draft Biological Assessment have been resolved with the updated draft.

Table 1. NPS Comments on "Preliminary Draft Watershed Plan-Environmental Impact Statement for Cove-East Fork Virgin River Watershed Project**"**

Comment Number	*Page, Section/Table*	*Comment*
1	General Comment	We understand from Ms. Paris at Eocene Environmental Group that the EIS project schedule includes a 45-day public comment period likely in summer 2026. Given the significant public interest in this project, as a Cooperating Agency the NPS recommends this public comment opportunity as well.
2	General Comment	Our research indicates that 7 CFR 1b.7 requires the USDA electronically publish all substantive comments received on an Environmental Impact Statement. The only NPS comments included in the Appendices of the Preliminary Draft Watershed Plan-Environmental Impact Statement for Cove-East Fork Virgin River Watershed Project are the scoping comments made on April 18th, 2022. The NPS made additional comments in letters dated March 3rd, 2022, April 21st, 2023, March 7th, 2025, May 15th, 2025, August 22nd, 2025, that raised unresolved concerns and issues. These letters, as well as future correspondence related the Watershed Plan-Environmental Impact Statement for Cove-East Fork Virgin River Watershed Project and related analyses, including the Biological Assessment and Water Model Report, should be

		electronically published with the Environmental Impact Statement. NRCS indicated it would take this approach in Paragraph IV.2.g. of our Cooperating Agency Agreement.
3	General Comment	NPS appreciates the statements made in this EIS that the proposed project will comply with the 1996 Zion National Park Water Rights Settlement Agreement (1996 Agreement). The NPS is ultimately responsible for ensuring compliance with the 1996 Agreement under Article III.J. Unresolved concerns on duty values (Table 3 - Comment 2 from the Water Model Report), quantifying the involvement of all parties and rights (Table 3 – Comment 8 from the Water Model Report) and annual quantification on water rights associated with this project (Table 3 - Comment 7 and Comment 10 from the Water Model Report) must be resolved prior to the certification that this project is in compliance with Utah Water Law and the 1996 Agreement.
4	Summary – Mitigation Measures	Will the "inadvertent discovery plan" include the presence of an archaeological monitor or tribal monitor during ground disturbing activities?
5	Table S.1.	Suggest clarification of Net Economic Benefit calculation. A $162,000 net economic benefit on a $39,511,000 project seems in error.
6	Table S.2. -Water Resources; Table S.2. - Riparian Areas; Table 3.3 – Mexican Spotted Owls; 6.4.1.2.1.2; 6.4.7.2; 6.4.8.2; Table 5.7 – Water Resources; 7.4 – Riparian/Ecological Values	In Table S.2. – Water Resources, it is inaccurate to state both, "no downstream impacts to the EFVR would occur," with the data provided and in the Riparian Areas section, "No impacts to existing riparian habitat would occur" as well as all similar statements within the EIS. Please see Comment 13 from Table 2 "NPS Comments on Updated Draft Biological Assessment for the Cove-EFVR Reservoir Project" for an explanation on the inaccurate and insufficient analysis that was provided in the draft Biological Assessment.
7	Table S.2. - Waters of the U.S., Wetlands, and Special Aquatic Sites; Appendix E-2; 4.2.2.1; 4.2.2.4; 6.2.4.2; Table 5.7 - WOTUS., Wetlands, and Special Aquatic Sites	Appendix E-2 "Draft Aquatic Resources Inventory Report, July 2025" includes an assessment of effects of the area generally around the construction of the reservoir and associated pipelines, not a comprehensive analysis of impacts to wetlands and riparian areas throughout the study area including downstream on the East Fork of the Virgin River through Zion National Park. No justification has been made for the river segments within the study area not being included in this assessment report or this statement in the EIS. Include an evaluation on impacts to WOTUS throughout the study area, including downstream on the EFVR given that this project has a continuous surface connection to a perennial stream (EFVR).
8	Table S.2. – Wild and Scenic Rivers;	In Table S.2. it is inaccurate to state the "Preferred Alternative would have no impacts on the WSR values of the EFVR within ZNP, as it would also adhere to the stipulations required in the ZNP Agreement. Therefore, changes in flow in the EFVR through ZNP would be minor, particularly when the natural variation of the EFVR is approximately 100 times the range of effect from proposed reservoir releases (Alpha Engineering 2025)." Compliance with the ZNP Agreement does not equate to no impacts on the WSR values of the EFVR. Please remove this statement from the draft EIS.

9	Table S.2. – Significant Scientific Resources	Is a paleontological monitor and pre-construction paleontological training course a planned mitigation? Recommended mitigations should not be made here, only planned mitigations. Remove this statement if it is not planned to be implemented.
10	Summary - Major Conclusion	NRCS states, "The Preferred Alternative is the most environmentally friendly alternative and has the greatest net economic benefits of all alternatives analyzed... No measurable long-term adverse impacts are anticipated [from the Preferred Alternative]." The NPS has not seen evidence in this draft EIS to support these two statements. Please see Comment 13 from Table 2 "NPS Comments on "Updated Draft Biological Assessment for the Cove-EFVR Reservoir Project".
11	Summary – Areas of Controversy	"Wild and Scenic River status" is not controversial. The East Fork of the Virgin River as it runs through ZNP is a congressionally-designated Wild and Scenic River. The NPS has notified the NRCS that the NPS will not be conducting a Section 7 analysis on this water resources project.
12	3.2.3	Please remove the statement, "Some local recreational facilities are considering a cap on the number of daily visitors, including at ZNP and BCNP." NPS units routinely collect visitor use data and conduct targeted studies for planning purposes. No capacities have been established for ZNP or BCNP.
13	3.2.3.1	This statement that the irrigation duty value has changed from 6 acre-feet per acre to 5 acre-feet per acre is in conflict with the July 2024 Water Model Report and previous drafts of the Purpose and Need Chapters that the NPS has reviewed. The duty value listed for this area by the UDWRi is 4 acre-feet per acre with orders by the SE to increase the duty value for certain water rights to 5 acre-feet per acre. Not all water rights associated with this project have public documentation to demonstrate that the duty value has increased, for example: 81-1673. See Table 3, Comment 2 on the July 2024 Water Model Report for more information.
14	4.2.2.1	NRCS states, "Gauge data (USGS gauging station 09404450) revealed that the last 20 years have exhibited a drier hydrology and may be indicative of future conditions". Please provide an explanation of how this trend was incorporated into an analysis on how less water in the river in the future will impact operability of this project.
15	4.2.2.1	The NRCS states, "One or more new reservoirs with cumulative active storage capacity of up to but not exceeding 6,750 acre-feet may be constructed upstream of Glendale." This is inaccurate; the 1996 Zion National Park Water Rights Settlement Agreement allows for new large reservoirs on certain tributaries both upstream and downstream of Glendale as defined within the Agreement (Cove Canyon is downstream of Glendale). NPS recommends reciting the language exactly as it is written in the Settlement Agreement in Article II.D.1.a. Further, the NRCS states, "The existing flow or 2 cfs, whichever is less, shall be maintained immediately below any new surface water diversions or reservoirs constructed." This is inaccurate, and NPS recommends correcting the statement to, "The existing flow or 2 cfs, whichever is less, shall be maintained immediately below any new surface water diversion *to* reservoirs constructed on streams defined in Article ii.D.1.a"
16	Table 3.5	Flannelmouth sucker, Desert sucker, and Virgin Spinedace have all been found within the study area in recent surveys conducted in Zion National Park. Please add this statement to each of these species. Please ensure all recent Utah Division of Wildlife Resources Hurricane Field Office fish survey data is included in this analysis.

17	5.3	In this Alternatives Considered but Eliminated from Detailed Study section, NRCS only includes alternative reservoir sites. Please provide an explanation on why coordinating with UDWRi on establishing a Water Management Plan for the area, which would prioritize senior water rights, was not considered to achieve the purpose and need.
18	6.2.1.2.1	For a comprehensive analysis on impacts to flow regime to provide the basis of this EIS, please add additional analysis points to this "Flow Impact Analysis" beyond the single analysis point included at the East Fork Virgin River Near Springdale, UT - USGS-09404900. The EFVR through the study area undergoes significant changes in flow so a single point insufficiently analyzes impacts to the river through the study area. Describe decreases in flow as a quantification in terms of cubic feet per second, percentage of mean flow and changes to wetted perimeter. Showing decreases as a percentage of overall flow and wetted perimeter will better describe impacts to aquatic and riparian habitat of the preferred alternative. This analysis should be completed under a variety of flow conditions, including high, normal and dry years. Please see Table 2 Comment 13 for additional explanation. Also, correct spelling of Springdale in this paragraph.
19	6.2.1.2.1	The NRCS states, "Given that precipitation events already cause greater fluctuations in flow, depth, and width, the incremental effects of the proposed action would have little to no meaningful impact on the overall river system or on the habitat for Virgin River chub and woundfin downstream of the diversion point." While it is true that the EFVR undergoes significant discharge fluctuations due to spring snowmelt runoff and precipitation events, the statement that this project will have no meaningful impact on the overall river system or habitat lacks basis without analyzing the project's impacts to base flow conditions throughout the study area.
20	6.2.2.2	The NRCS states, "The change in water flow would not introduce pollutants or alter the river's chemistry in a way that would impact its designation as 'wild'." This conclusion is not substantiated by existing data or analysis within the EIS. Please remove this statement.
21	6.2.6	The heading for this section is "Desert Sucker" but based on the content in this section, the heading should likely be "Wild and Scenic Rivers". The conclusion in this section is not substantiated by existing data or analysis within the EIS. NPS recommends removing the conclusion from the document.
22	6.2.6.2.1.1	Please see unresolved comments from the Water Model Report Table 3 Comment 6. The 2001 MOU cited in this section, which provides a significant mitigation on impacts to native fish and their habitat immediately below the diversion, is only in place so long as the hydroelectric power plant is in operation (Term 11) which is not included in this project proposal. Is there a plan to amend this agreement to include this project so if the hydroelectric power plant is decommissioned the agreement and terms are still in effect?
23	6.2.6.2.1.1	The NRCS states, "The change in water flow would not disrupt the ongoing research activities within the Research Natural Area." No analysis has been made to support this statement. Please remove.
24	6.2.6.2.1.1	The NRCS states, "Formal consultation with the NPS to comply with Section 7 of the WSRA was not required for this project (Appendix A-62)." Revise to more accurately state, "The NPS notified the NRCS that the NPS will not be completing a Section 7 analysis on this project."

25	6.2.7.2	The NRCS states, “Regulating services, water quality and quantity—Alternative 2 would increase water quality in the EFVR by containing sediment within the reservoir during flash flooding events.” While this section includes a brief narrative describing impacts to water quality, this section provides no description or analysis on anticipated impacts to water quantity.
26	6.5.3.2	The NRCS states, “Additional maps and information are provided in Appendix C and the Preliminary Design Report (Appendix E-1). However, like all dams, the risk of failure exists and would be mitigated by an Emergency Action Plan (EAP), as required by the Utah Dam Safety office. The estimated number of at-risk populations is 10 to 15 people. The inundation zone encompasses four residential homes, along with barns and agricultural facilities. If a dam breach were to occur, up to 192 acres (0.3 square mile) of cropland would also be affected.” Flood inundation maps and analysis provided in the EIS and Appendices do not sufficiently analyze impacts downstream with the analysis abruptly ending prior to downstream communities, including Mt. Carmel, Utah. Inundation maps must analyze impacts to the full downstream extent that floodwater from a dam failure would extend including analyzing impacts to downstream communities and recreational areas including Mt. Carmel, UT, Parunuweap Canyon managed by the BLM, Zion National Park, Rockville, UT and Virgin, UT. The mentioned communities above should be involved in the development of an Emergency Action Plan.
27	Table 5.7 – Wild and Scenic Rivers	The NRCS states, “The Action Alternatives would have no impacts on the WSR values of the EFVR within ZNP, as it would also adhere to the stipulations required in the ZNP Agreement. Therefore, changes in flow in the EFVR through ZNP would be minor, particularly when the natural variation of the EFVR is approximately 100 times the range of effect from proposed reservoir releases (Alpha Engineering 2025).” Please remove the Wild and Scenic River Section from this table. The conclusions made here are not substantiated by data or analysis.
28	7.1	The NRCS states, “The Cooperating Agencies and project sponsors support Alternative 2 as the Preferred Alternative”. The NPS has not indicated preference for any alternative.
29	7.4 – Wild and Scenic Rivers	The NRCS states in an Area of Controversy, “Concern: WSR Values - Concern with effects to the W&S status of the river. Response: An analysis on impacts to the wild and scenic values of the EFVR are included in Section 5.2.6.” No Wild and Scenic Rivers Act Section 7 analysis has been completed; please remove this statement.
30	7.4 – Threatened and Endangered Species and State Sensitive Species	The NRCS states in an Area of Controversy, “Concern: Threatened and Endangered Species and State Sensitive Species - Damage to the Virgin Spinedace. Response: The Virgin Spinedace is a state-sensitive species with potential to occur within the ZNP portion of the project area. Changes in water flow within the EFVR would be minor, particularly when the natural variation of EFVR flows are approximately 100 times the range of effect from proposed Cove Reservoir releases (Alpha Engineering 2025), and therefore, no long-term impacts are anticipated. Reference Section 5.4.6 for supporting information”. The concern with impacts to aquatic species, including Virgin Spinedace, reliant upon riparian and aquatic habitat, derives from decreases to base flow conditions, not increases to flow within the natural flow regime. This is not a valid explanation to satisfy the concern.

31	7.4 – Climate Change	The NRCS states in an Area of Controversy, "Concern: Climate Change - Water flow in relation to climate change. Response: Water availability is anticipated to continue to decrease over time as climate change occurs. The Preferred Alternative would provide a reliable source of water for agriculture and M&I benefits and would not contribute to climate change. Reference the Cove Water Model in Appendix E-10 for supporting information." Provide an analysis of how decreases in water availability due to climate change will affect long-term operability of the project as well as impacts to the riparian and aquatic habitat. This analysis is not found in the cited Water Model Report nor is it found in the draft Biological Assessment or draft EIS.
32	7.5.1.3	The NRCS states, "Formal consultation with the NPS to comply with Section 7 of the WSRA was not required for this project." Correct this statement to more accurately reflect the message as, "the NPS stated they will not be conducting a Section 7 analysis on this project."
33	7.5.2.1	Add in this section that approved water right change applications would be required of this project. Please note here that there remain unresolved concerns on duty values (Table 3 - Comment 2 from the Water Model Report) and annual quantification on water rights associated with this project (Table 3 - Comment 7 and Comment 10 from the Water Model Report).
34	Table 9.1	Correct Robyn Henderek's years of professional experience to 10.

Table 2. NPS Comments on "Updated Draft Biological Assessment for the Cove-EFVR Reservoir Project**"**

Comment Number	*Page, Section/ Table*	*NPS May 15, 2025 Comment*	*NRCS July 11, 2025 Response*	*NPS August 18, 2025 Response*	*NPS March 6th, 2026 Response*
4	3, 2.2.2	This section states, "Water committed to Washington County for irrigation and MR purposes could be released any time during the year to meet demand but would most likely be during the fall and winter months. Releases to Washington County would be in compliance with the ZNP Agreement (Agreement, 1996)." However, the Water Model Report (July 2024) for this project models releases from this reservoir to Washington County occurring June through August in an average annual simulation. Please clarify.	Text has been clarified. Water would be released for agricultural use in Washington County by the HCC during the summer months of June, July, and August. Timing for water releases for M&I use in Washington County has not been determined. Washington County has emphasized the need for flexibility, and M&I related releases could occur at any time of the year. All releases would be in compliance	Please send an updated draft of the Biological Assessment with these changes. The concept poses challenges in properly analyzing impacts associated with Washington County Water Conservancy District (WCWCD)'s involvement in the project. Section 2 Part C of the July 2024 Water Model Report should discuss this model is based off releases occurring June through August, however, releases may occur at any time.	Comment remains unresolved. Please see unresolved Table 3 Comment 8 on from the Water Model Report.

			with the ZNP Agreement.		
6	4, 2.3	Include specific details on conservation measures that would minimize the introduction of non-native species into the river and reservoir (e.g., all equipment should be cleaned and inspected for Aquatic Invasive Species prior to being brought on site). To ensure the success of the post-construction seeding efforts, include post-construction mitigation for non-natives that are introduced/become establis hed. There is a substantial population of invasive knapweed (*Cen taurea stoebe*) in the area that could benefit from this disturbance and potentially have a negative effect on post-construction seeding.	Two committed conservation measures currently in the Plan-EIS have been added to the BA for clarification. These measure state that "All equipment would be cleaned of soil, seeds, vegetation matter, and other debris prior to entering or reentering the project area to avoid any introduction of non-native plants or weeds. “and "Prior to stocking the proposed reservoir with fish, a management plan will be developed to ensure that nonnative fish species do not escape from the reservoir into the EFVR." It should be noted that no construction activities would occur within the EFVR. This would greatly reduce the potential for the introduction of non-native species into the river.	Please send an updated draft of the Biological Assessment with these changes. As the project includes stocking of non-native fish in the proposed reservoir, a fish management plan that adequately mitigates for potential introduction into the East Fork of the Virgin River and its tributaries must be developed and included in the NEPA analysis. This plan should meet non-native stocking and control requirements set in other plans such as the Virgin Spinedace Con servation Agreement and Strategy and other relevant plans and agreements.	Comment remains unresolved. There is mention of a fish management plan which will be made prior to the proposed action in the EIS. Will the NPS have an opportunity to review and comment on this future plan?
7	4, 2.3	Include specific details on conservation measures to prevent the introduction of stocked non-native salmonids (fish	Additional informa tion has been added as requested. A measure that is	Please send an updated draft of the Biological Assessment with these changes.	Comment remains unresolved. Further, information provided on the fish screen was not included in the BA or the EIS. There is mention of a fish management plan which will be made

		and eggs) from entering the East Fork of the Virgin River.	currently in the Plan-EIS has been added to the BA. This measure states that, "Prior to stocking the proposed reservoir with fish, a management plan will be developed to ensure that non-native fish species do not escape from the reservoir into the EFVR". It should also be noted that several actions would be taken to prevent non-natives from entering the EFVR. These include a fish screen at the proposed reservoir intake with a 1-inch maximum por e opening that would prevent fish and debris from entering the pipeline to the Orderville hydr oelectric power plant. The hydroelectric facility utilizes tw o Turgo Impulse turbines, which focus the water through small nozzles at high pressure and velocity into the turbines. The combination of the small nozzle size, high velocity, and sudden pressure drop would make it highly unlikely that any fish that	As the project includes stocking of non-native fish in the proposed reservoir, a fish management plan that adequately mitigates for potential introduction into the East Fork of the Virgin River and its tributaries must be developed and included in the NEPA analysis. This plan should meet requirements set in other relevant plans a nd agreement.	prior to the proposed action in the EIS. Will the NPS have an opportunity to review and comment on this future plan?

			might make it into the pipeline would survive. This information has been added to Section 2.2.1 (Project Measures for clarification.		
10	4, 2.3	Include conservation measures that are specific to California condors. For example, to reduce microtrash ingestion by condors, all trash at the construction site should be cleaned up daily.	No effects have been identified for the California condor resulting from project development. The Long Valley portion of the Action Area is the only place where surface disturbance would occur. It is not considered to be condor habitat due a to lack of habitat. However, additional committed conservation measures found in the Plan-EIS relating to plants and animals (including the condor), have been added to the BA.	There is evidence from condors fixed with GPS units utilizing the project area on lands managed by the National Park Service and therefore should be included in the analyses.	Table 5 still states that California Condors are not present within the Action Area. The NPS has provided NRCS data to support they are found within the Action Area. Please correct this statement.
13	6, 3.4.1	Reference to action area should still include downstream locations. It would appear that the identified wetlands and streams are only for the area of surface disturbance. Further, does "two additional *sites* bisect the proposed pipeline" refer to two additional *streams*? Please clarify.	Because no surface disturbance would occur outside of the Long Valley area, it is not necessary to identify downstream wetlands and streams beyond the EFVR and the Virgin River. Text has been changed to clarify the discussion regarding intermittent streams in Long Valley.	Changes in flow regime, specifically a reduction in base flows during the period of diversion outside of spring snowmelt (November-March), has the potential to impact the total area of riparian and aquatic habitat. Riparian and aquatic habitat rely upon consistent base flow conditions to sustain	The February 2026 Updated Draft Preliminary BA includes a new Section 5.0 - Water Model Results. Section 5.3 states, "Modeling shows that reservoir operations would cause only minor changes to EFVR flows (between 15 to 25 cfs added or between 12.6 to 22.2 cfs removed) which is extremely small compared to natural river variability." While it is accurate to state that increases to discharge from summer releases would be "extremely small compared to natural river variability," it is inaccurate to make that statement on diversions during the winter and spring based on data from the July 2024 Water Model

				populations. Lower base flows mean less wetted perimeter. The July 2024 Water Model report cites the potential for an 11.6 cfs (-21% average discharge) decrease in flow at the USGS East Fork of the Virgin River Near Springdale gage (USGS 09404900) in December. Please provide an analysis of impacts changes in flow regime for aquatic and riparian habitat at various locations within habitat of ESA and candidate species in the Action Area during high, low, and average water years. This analysis will likely extend beyond the Ordinary High Water Mark cited as the Washington County Action Area therefore the action area for Washington County should include an approximately 50 foot buffer beyond the Ordinary High Water Mark.	Report. Please describe the location of the analysis point described in Tables 6, 7 and 8. Date from Tables 6, 7 and 8 conflict with data presented in the July 2024 Water Model Report. In the Cove Reservoir Average Annual Simulation, in an average year, it is modeled that there will be an 11.6 cfs decrease in river flow in November, an 11.7 cfs decrease in flow in December, a 10.2 cfs decrease in flow in January, a 7.0 cfs decrease in February, a 4.3 cfs decrease in flow in March, a 2.4 cfs decrease in flow in April, and a 5.7 cfs decrease in flow in May. While the analysis point from the Average Annual Simulation is also undisclosed, it is unclear how the NRCS can state there will only be a 1.7 cfs decrease in EFVR flow during the "low" scenario. Further, for a comprehensive analysis of impacts to the flow regime, multiple analysis points must be made along the EFVR through the Action Area as the flow regime changes considerably throughout the river from the site of the proposed reservoir diversion to the USGS East Fork of the Virgin River near Springdale Gage (09404900). The NPS provided NRCS a discharge measurement taken from the EFVR near Mt. Carmel Junction on 12/15/25 where flows were calculated at 11.99 cfs. Under planned diversions of the Cove Reservoir, discharge would be diminished to a minimum of 2 cfs to be maintained below the diversion. Therefore, flows would be reduced at this site by 83%, as an example. At the USGS East Fork of the Virgin River near Springdale Gage (09404900), the Water Model Report (July 2024) cites a 21% decrease in discharge, as another example. 83% and 21% of flow is not "extremely small" as the NRCS concludes here. A comprehensive analysis of changes to the flow regime under a variety of flow conditions must be made at several locations within the Action Area and those effects must be

					quantified in an analysis on impacts to riparian and wetland species, including recruitment. As we have stated in the past, the NPS remains available to assist the NRCS with this effort.
18	10, Table 4	Condors should not be dismissed for analysis. Condors are in the action area and the action area is condor habitat. Condors are obligate scavengers and since there is potential for animals to die within the Action Area, then there is condor food present in the action area and therefore the action area is habitat for condors. GPS condor data from The Peregrine Fund will show that the condors are using all parts of the action area, including the dam site. Also, in 2021 there was a successful condor nest in Mineral Gulch which should be mentioned in BA.	As stated in Comment No. 30 (No. 10 NPS comment), no effects have been identified for the California condor resulting from project development. The Long Valley portion of the Action Area is the only place where surface disturbance would occur. It is not considered to be condor habitat due a to lack of habitat. No surface disturbance would occur in condor habitat in ZNP. However, additional committed conservation measures found in the Plan-EIS relating to plants and animals (including the condor), have been added to the BA.	There is evidence from condors fixed with GPS units utilizing the project area on lands managed by the National Park Service and therefore should be included in the analyses.	After meeting with the NRCS and providing data on the occurrence of California Condors in Zion National Park and the Action Area, the NPS is pleased to see California Condors included in the analysis in the updated BA. However, the NPS does not agree with the statement that "No surface disturbance or changes in EFVR streamflow would occur in Parunuweap Canyon; accordingly, construction activities would result in ***No Jeopardy*** to the California condor as a result of habitat effects outside of ZNP and would have ***No Effect*** on the condor inside ZNP boundaries." An insufficient analysis has been completed, please see Table 2, Comment 13 for more details.
21	10, Table 4	How was a No Effect determination concluded for Southwestern willow flycatcher? If there is potential for indirect effects, even if that indirect effect is minor, then there is an effect. The main threats to this species are mostly related to habitat loss/modification due to	The effects determination for the SWWF has been changed to May Affect, but is Not Likely to Adversely Affect. BA text has been added to incorporate this change. We do	Please send an updated draft of the Biological Assessment with these changes. Changes in flow regime, specifically a reduction in base flows during the period of diversion	Comment remains unresolved. Please see response to Table 2, Comment 13 for more details.

		dams and reservoirs that causes changes to natural hydrological cycles. There is currently no explanation of how this project will not change the natural hydrological cycles along the East Fork of the Virgin River. A description is needed of how this project will not change: daily water fluctuations, short-duration floods, flood-induced sediment deposition, floodplain hydration and flushing, and the establishment (i.e., seed dispersal/establishment coi ncides with spring flooding) and maintenance of native riparian habitats. Effects to riparian habitat, stream flow, and hydrological cycles will affect: the quality and quantity of riparian vegetation, wetted perimeter, the seasonal flooding of steams during willow flycatcher spring migration and/or breeding season, and the insect population that provides food for willow flycatchers.	note that a Water Model and an analysis of waterflow changes have been prepared for Cove Reservoir project that addresses downstr eam flows. These documents are referenced several times in this BA. They conclude that changes in EFVR flows would be minor especially when compared with the significant changes in flows that result from snow melt, floods, etc.	outside of spring snowmelt (November-March), has the potential to impact the total area of riparian and aquatic habitat. Riparian and aquatic habitat rely upon consistent base flow conditions to sustain populations. Lower base flows mean less wetted perimeter. The July 2024 Water Model report cites the potential for an 11.6 cfs (-21% average discharge) decrease in flow at the USGS East Fork of the Virgin River Near Springdale gage (USGS 09404900) in December. Please provide an analysis of impacts changes in flow regime for aquatic and riparian habitat at various locations within habitat of ESA and candidate species in the Action Area during high, low, and average water years. This analysis will likely extend beyond the Ordinary High Water Mark cited as the Washington County Action Area therefore the action area for Washington County should include an approximately 50 foot buffer beyond the Ordinary High Water Mark.	

27	17-21	For ALL species/habitat determination, rationale that supports the effect determination needs to be provided. As the BA is currently written, there is no rationale, support, or justification of how the NRCS arrived at the determinations. For example, the Operation Impacts effect determination for MSO states that “no harm or harassment would occur to MSO as a result of streamflow changes” therefore there will be “no effect” to MSO. What is the justification for concluding that individual owls will not be harmed by potential changes to riparian habitat? Describe how reduction in streamflow will not affect riparian habitat and will not reduce prey availability which affects MSO feeding success? Effects should be at the individual species level (not population level). For each species analyzed, there should be an explanation of what the species’ exposure is to direct and indirect effects of the proposed management action and what their anticipated responses will be. For example, are individual MSO in proximity to the riparian habitat that may experience changes due to stream flow? What is the duration of that change? Will that exposure to that effect potentially impact essential behaviors such as feeding, breeding, sheltering,	Additional clarifying text has been added. For consistency, we have changed the MSO Species Operation effects determination to May Affect, but is Not Likely to Adversely Affect. Effects determination is based on anticipated effects that would occur over and above what is currently happening or has happened in the past in the EFVR in Parunuweap Canyon. Based on the Water Model and follow up River Changes report, we do not believe that there would be loss of riparian habitat that would result from project development. The riparian vegetation is adapted to the significant changes in EFVR flows that have occurred over the years due to spring runoff and flooding. As the Alpha water model states, "..the effect of an additional 15 to 25 cfs flow from the proposed reservoir during flood stage or during normal streamflow conditions would	Changes in flow regime, specifically a reduction in perennial base flows during the period of diversion, has the potential to impact the total area of riparian and aquatic habitat. Riparian and aquatic habitat rely upon consistent base flow conditions to sustain populations. The July 2024 Water Model report cites the potential for an 11.6 cfs (-21% average discharge) decrease in flow at the USGS East Fork of the Virgin River Near Springdale gage (USGS 09404900) in December. Please provide an analysis of impacts a diminishment of perennial base flow conditions may have on aquatic and riparian habitat at various locations within habitat of ESA listed and candidate species in the Action Area during high, low, and average water years. This analysis will likely extend beyond the Ordinary High Water Mark cited as the Washington County Action Area therefore the action area for Washington County should include an	Comment remains unresolved. Please see response to Table 2, Comment 13 for more details.

		migration, and movements and the habitats that support them?	be minor and that the natural variation of the river is approximately 100 times the range of effect from reservoir releases." For example, on December 21 the Springdale USGW gauging station recorded 2,020 cfs with a flood stage depth of 10.11 feet. Implementation of the Agreement would result in a flood stage river flow increase of 0.74 percent to 1.24 percent based on discharge amounts between 15 to 25 cfs. River level would increase 0.07 to 0.13 feet. Further, the gauge showed extreme variability in stream flows from 1994 to 2022 of less than 40 cfs to over 2,000 cfs. Based on these data, we believe that the minor change in stream flow resulting from project developme nt would not result in a significant adverse effect to or additional loss of MSO or SWWF habitat.	approximately 50 foot buffer beyond the Ordinary High Water Mark. In addition to sections of the East Fork of the Virgin River within the park, approximately 5.25 miles upstream of the park's upstream boundary is within the CP-11 MSO Critical Habitat Unit. These data in combination with analysis of impacts of changes in flow regime for aquatic and riparian habitat should be incorporated into the effects analysis for MSO and MSO critical habitat.	

29	17, 4.4.2	Since several MSO PACs overlap the Action Area in Parunuweap Canyon and the entire Parunuweap Canyon area is critical habitat, a better explanation is needed to justify why there would be "negligible impacts" to the riparian vegetation in Parunuweap Canyon. How exactly was this analyzed and this conclusion reached? It is well known that the quality and quantity of riparian vegetation is directly associated with stream flow and hydrological cycles, so how does a project that proposes to reduce stream flow and change the hydrological cycle avoid impacting riparian habitat? This is important to analyze since any changes to riparian habitat will likely affect MSO prey availability and could reduce individual MSO feeding success which could affect MSO reproduction and survival; therefore a "No Effect" would not be the correct effect determination for MSO.	See response to comment 27	Changes in flow regime, specifically a reduction in perennial base flows during the period of diversion, has the potential to impact the total area of riparian and aquatic habitat. Riparian and aquatic habitat rely upon consistent base flow conditions to sustain populations. The July 2024 Water Model report cites the potential for an 11.6 cfs (-21% average discharge) decrease in flow at the USGS East Fork of the Virgin River Near Springdale gage (USGS 09404900) in December. Please provide an analysis of impacts a diminishment of perennial base flow conditions may have on aquatic and riparian habitat at various locations within habitat of ESA listed and candidate species in the Action Area during high, low, and average water years. This analysis will likely extend beyond the Ordinary High Water Mark cited as the Washington County Action Area therefore the action area for Washington County should include an approximately 50 foot buffer beyond the Ordinary High	Comment remains unresolved. Please see response to Table 2, Comment 13 for more details.

				Water Mark. In addition to sections of the East Fork of the Virgin River within the park, approximately 5.25 miles upstream of the park's upstream boundary is within the CP-11 MSO Critical Habitat Unit. These data in combination with analysis of impacts of changes in flow regime for aquatic and riparian habitat should be incorporated into the effects analysis for MSO and MSO critical habitat.	
30	22, 6.1	Justifications for determinations needs to be strengthened (see comments above) and information corrected. Riparian habitat is present within occupied MSO habitat. Currently there are two confirmed PACs that include riparian habitat along the East Fork of the Virgin River. There are likely more, but surveys need to be conducted. Riparian habitat IS a PCE, so a "no effect" determination for critical habitat needs to be better justified since there will be changes to stream flow and hydrological cycles under the proposed action. A description of how those changes will impact riparian habitat is needed (i.e., cite literature, talk to experts; ask the questions: "If a	See response to previous comments. The presence of PACs has been added to the text is Section 4.1.3.	Changes in flow regime, specifically a reduction in perennial base flows during the period of diversion, has the potential to impact the total area of riparian and aquatic habitat. Riparian and aquatic habitat rely upon consistent base flow conditions to sustain populations. The July 2024 Water Model report cites the potential for an 11.6 cfs (-21% average discharge) decrease in flow at the USGS East Fork of the Virgin River Near Springdale gage (USGS 09404900) in December. Please provide an analysis of impacts a diminishment of	Comment remains unresolved. Please see response to Table 2, Comment 13 for more details.

		river sees X (cfs) less flow during X months/year every year, then how could riparian habitat be affected long-term? Will it affect vegetation recruitment since some species require springtime flooding to germinate? Will riparian habitat along the river become narrower since there will be less wetted perimeter and less vegetation receiving the water they need to survive? Will the retreating riparian habitat be overtaken with non-native invasive plant species? What is the potential cascading effect of less surface water or less riparian habitat on the ecosystem?")		perennial base flow conditions may have on aquatic and riparian habitat at various locations within habitat of ESA listed and candidate species in the Action Area during high, low, and average water years. This analysis will likely extend beyond the Ordinary High Water Mark cited as the Washington County Action Area therefore the action area for Washington County should include an approximately 50 foot buffer beyond the Ordinary High Water Mark. In addition to sections of the East Fork of the Virgin River within the park, approximately 5.25 miles upstream of the park's upstream boundary is within the CP-11 MSO Critical Habitat Unit. These data in combination with analysis of impacts of changes in flow regime for aquatic and riparian habitat should be incorporated into the effects analysis for MSO and MSO critical habitat.	
31	Table 2				Spotted Knapweed (*Centaurea stoebe)* is also prevalent in that area. It is listed as Class 2 on the Utah Noxious Weeds List. Please add

					Spotted Knapweed to Table 2.
32	5.4				New Section 5.4 states, “Overstory species, such as cottonwood and Russian olive, rely on groundwater, not surface flow. Their deep root systems, 10–15 feet for cottonwood (Greg 2026) and up to 40 feet for Russian olive (NRCS 2026), would not be affected by the minor changes in streamflow. Groundwater levels in the EFVR corridor are controlled primarily by regional hydrology and flood recharge, not by small changes in surface flow.” As described in Table 2, Comment 13, surface flow reduction is not expected to be “small”. Groundwater to surface water relationships vary by lithologic unit and its aquifer bearing properties and depth of channel fill, therefore cannot be broadly summarized across the entire Action Area here as it is in this statement. Analysis should be made on incremental reaches along the EFVR through the Action Area. The proposed considerable decreases to surface water may influence on depth to groundwater. Further, overstory species reliant primarily on groundwater should not be the only riparian species analyzed in this document. Please provide a comprehensive analysis on impacts to riparian habitat in the Action Area, including recruitment. Related to recruitment, reducing river flows during spring recruitment events may inadvertently remove trees over time. This can be exacerbated by single-aged stands. A sudden collapse of habitat could happen when trees, such as cottonwoods, reach maximum age with no or limited recruitment.

Table 3. Unresolved NPS Comments on **“**Water Model Report - Cove Reservoir**”**		
Comment Number	*Page, Section/Table*	*Comment*

2	Page 4, Section A.b	**NPS 4/21/23 Comment 2:** Water rights for the three irrigation companies are allocated based on a water right duty usage, which was recently changed by the Division of Water Rights from 4 to 5-acre-feet per acre, which is further explained in **Part C Irrigation Efficiency**." The UDWRi website still shows four acre-feet per year per acre irrigation duty for the irrigation area. Cite here the new consumptive use change policy by the UDWRi. If this consumptive use policy has not changed, this new consumptive use should not be cited and used in calculations.
		NRCS 11/21/24 Response to Comment 2: As we understand it, the only irrigation company that shows a limit of 4-acre feet per acre is Orderville. Mt Carmel and Glendale Irrigation Companies do not show a limit. The irrigation companies have historically diverted approximately 5 acre feet per acre. The UDWRi is memorializing the usage for all three irrigation companies.
		NPS 3/7/25 Response to NRCS Response to Comment 2: The NPS found the court order Civil No. 80O5O7596 dated July 9th, 2023 setting the duty value to 5 acre-feet per acre for selected water rights. The water right numbers identified in this court order impact water rights owned by Mt. Carmel Irrigation Company and Orderville Irrigation Company. However, there do not appear to be rights owned by Glendale Irrigation Company served by this court order. Please direct the NPS to the decision document on duty value change pertaining to the rights owned by the Glendale Irrigation Company as this water model sets the use to 5 acre feet per acre for all three irrigation companies.
		NRCS 3/27/25 Response to 2nd NPS Comment 2: Please find attached the amendment to the original judgement that included the Glendale Irrigation Company.
		NPS 3/6/26 Response to Comment 2: Attached the NRCS provided a judgement to assign a 5 AF Duty Value to 81-1171 (held by Glendale Town - not Irrigation Company - for 25 AF of water). This is not the 7.2 cfs water right cited in Chapter 1 of the EIS we have seen (81-1673). The NPS has not seen evidence the duty value has changed to 5 AF for 81-1673. Reviewing scanned documents for this water right (81-1673) yields no court order which changes the duty value.
6	Page 7, Section A.d	**NPS 4/21/23 Comment 6:** Please cite and provide a copy of this agreement. Please clarify which months this minimum flow is to be maintained below the OIC diversion. "When neither MCIC or the OIC are diverting water for irrigation purposes," is unclear since it is noted here company water rights allow for year-round irrigation.
		NRCS 11/21/24 Response to Comment 6: Attached is the agreement.
		NPS 3/7/25 Response to NRCS Response to Comment 6: The agreement noted was not actually attached when the response to comment was sent to the NPS. We look forward to receiving a copy of this agreement. Please clarify which months this minimum flow is to be maintained below the OIC diversion. "When neither MCIC nor the OIC are diverting water for irrigation purposes," is unclear since it is noted here company water rights allow for year-round irrigation. Further, please include a description of how these minimum flows will be measured below the OIC.
		NRCS 3/27/25 Response to Comment 6: The agreement was attached with the original response but may have not been forwarded to you. It is attached again for your use. The report that is being quoted from did not continue with the remainder of the sentence which stated, "typcially during the winter". Winter is defined as

		December to February which is the verbiage used in the memorandum. The minimum flows are measured with a parshall flume at the diversion dam.
		NPS 3/6/26 Response to Comment 6: This agreement, which provides a significant mitigation on impacts to native fish and their habitat immediately below the diversion, is only in place so long as the hydroelectric power plant is in operation (Term 11) which is not included in this project proposal. Is there a plan to amend this agreement to include this project so if the hydroelectric power plant is decommissioned the agreement and terms are still in effect?
7	Page 9, Section B.b	**NPS 4/21/23 Comment 7:** "Prior to the proposed Cove Reservoir, water right demand has not fully been met 48 of 54 years of record, or a total of 6 years that water rights were fully met. This assumes 5 acre-feet of water required per irrigation acre." This statement is misleading where it appears to assert that a new consumptive use policy can be retroactively applied to demonstrate a lack of fulfillment of a water right. Please cite the mentioned new consumptive use policy by UDWRi.
		NRCS 11/21/24 Response to Comment 7: As evidenced by the historical use records the irrigation companies have historically diverted 5 acre feet per acre. The Glendale and Mt Carmel Irrigation Company Water Rights have a limit on the cfs that can be diverted but no limit on acre feet on an annual basis. Without the reservoir they have diverted water when available to use to carry over in the dry months. The Utah Division of Water Rights is seeking to clarify the annual acre feet of water that can be diverted for all three irrigation companies as we understand it.
		NPS 3/7/25 Response to NRCS Response on Comment 7: Thank you for this clarification. We will revisit this unresolved comment when UDWRi clarifies the annual acre feet of water that can be diverted for these rights served by this project.
8	Page 10, Section C	**NPS 4/21/23 Comment 8:** "The DWR Model is included in **Appendix C** and indicates the Cove Reservoir will provide up to an additional yield of approximately 700 acre-feet of water for use by the WCWCD with the WCWCD having water priority on the Virgin River. This is accomplished by diverting water during the non-irrigation season, October through April, when the existing downstream water rights are met and there is excess water available in the system." Diversions associated with this water development project must follow the terms of the Zion National Park Water Rights Settlement Agreement which states in II.D.6, "Surface water diversions to new reservoirs described in II.D.1.a above shall not occur except during the period from November 1 to May 31, subject to the by-pass flow required decried above." Please describe which WCWCD water rights (700 acre-feet per year) are planned to be moved to this upstream diversion and stored in this reservoir for release and use downstream?
		NRCS 11/21/24 Response to Comment 8: The Washington County Water Conservancy District has several water rights that are being considered to transfer to the Cove Reservoir. The Change Application process will be handled through the Division of Water Rights and be available for review and comment through that process. All diversions will be in accordance with the Zion National Park settlement agreement.

		NPS 3/7/25 Response to NRCS Response on Comment 8: Under the Article III.J of the 1996 Zion National Park Water Rights Settlement Agreement, the NPS has the primary responsibility in protecting its water rights. The NPS seeks to understand elements of the project to inform its comments to the draft EIS when released and to evaluate upcoming change applications or applications to appropriate for water rights related to this project. Please provide a list of the WCWCD water rights that are planned on being moved to this upstream diversion. If this list cannot be provided, please explain why not.
		NRCS 3/27/25 Response to Comment 8: It is our understanding that the WCWCD is not pursuing this action at this time until the EIS is approved. The WCWCD has multiple water rights on the Virgin River and its tributaries. Currently it is anticipated a portion of water right 81-507 will be used for this project.
		NPS 3/6/26 Response to Comment 8: The effects of the entirety of this project, including the WCWCD's involvement, must be analyzed for a complete EIS.
9	Page 12, Section D	**NPS 4/21/23 Comment 9:** Generally, this section on modeled impacts the USGS East Fork of the Virgin River at Springdale gage needs to be expanded. Add an analysis of changes to wetted perimeter at this site as well as impacts to water quality including turbidity and water temperature. The NPS needs a tabulation of modeled impacts to discharge at this gage under high, normal and low water years for each month of the year. Also, please add units to Table 1.
		NPS 3/7/25 Response to Comment 9: No response was given on this comment but some changes were made to this section, including units added to the table, in the July 2024 version of the Water Model Report. Add an analysis or evaluation of changes to wetted perimeter at this site as well as impacts to water quality including turbidity and water temperature within the Environmental Impact Statement. The NPS needs a tabulation of modeled impacts to discharge at this gage under high, normal and low water years for each month of the year for the Environmental Impact Statement.
		NRCS 3/27/25 Response to Comment 9: We believe there is adequate information in the Water Model Report included in pages 12 to 15 to analyze the effects of the project. For tabulated information on a month by month basis, please refer to Appendix A of the model. The Virgin River highly variable flows with or without the project (see attached memo dated February 8, 2025). The project is part of the Zion National Park Settlement Agreement and is being constructed in accordance with that agreement and no further documentation should be necessary.
		NPS 3/6/26 Response to Comment 9: Please clarify if the "Change in River" column in the "Cove Reservoir Average Annual Simulation" refers to changes as seen at the East Fork of the Virgin River near Springdale, UT gage or just downstream of the release from reservoir? The information presented in Appendix A only shows modeled impacts in average years, the NPS would like to see the impacts during the driest and wettest years as well. We believe an assessment of impacts to wetted perimeter (which can be calculated easily with the water depth information provided), water temperature and turbidity are reasonable requests.

10		**NPS 3/7/25** Further, we hoped to better understand the Average Annual Summary in Appendix A of the report. The listed "Deman" in discharge (cubic feet per second) for the Orderville Irrigation Company and the Mt. Carmenl Irrigation Company exceeds the diversion rates for these two companies. Please explain why the demand in the model simulation table of Appendix A exceeds the diversion rate for the water rights associated with these two irrigation companies.
		NRCS 3/27/25 Response to Comment 10: The monthly demands in the simulation are based on USU Research Report 145 as stated in the Water Model Report, to provide for the crop needs. The reservoir supplements for the actual usage requirement of the crops during the dry months of the year. Water diversions from the river are still within their water right allocation. As the farmers become used to having water when it is needed the peak water use requirement will decrease.
		NPS 3/6/26 Response to Comment 10: The "demand" section should just be the water right diversion rate as there cannot be a demand higher than the water right diversion rate. In the case of Orderville Irrigation Company, the water rights listed have a diversion rate of 4.485 cfs, for Mt. Carmel Irrigation Company 6.58 cfs, and Glendale Irrigation company is 7.23 cfs. In the case of Glendale Irrigation Company, which sees no release from the reservoir, the demand from the river for three months (7.7 to 10.4 cfs) is higher than the water right diversion rate. For the Orderville Irrigation Company the demand from the river exceeds the water right diversion right for three months (4.6 to 5.3 cfs). For the Mt. Carmel Irrigation Company, demand from the river is under their diversion rate; the NPS misspoke in the original comment. Secondly, the concept of having a filled reservoir requires the irrigation companies to (1) use their water right to divert to fill the reservoir to use during irrigation season while water right owners (2) continue to divert from the river during irrigation season. A resolution to this issue will only be found when the UDWRi clarifies the issue brought up in Table 3, Comment 7.

We greatly appreciate the opportunity to continue collaborating as a cooperating agency and look forward to a response from the NRCS on these comments. Please continue to work with our Physical Scientist, Robyn Henderek, who may be reached by email at robyn_henderek@nps.gov or by phone at 435-772-0158.

Sincerely,

JEFFREY BRADYBAUGH Digitally signed by JEFFREY BRADYBAUGH Date: 2026.03.06 15:50:29 -07'00'

Jeff Bradybaugh

Superintendent

cc:
Emily Paris, Eocene Environmental Group

United States Department of the Interior

NATIONAL PARK SERVICE
INTERIOR REGIONS 6, 7 & 8
1 Denver Federal Center, Building 50
Denver, CO 80225

Arelys Ortiz, Acting USDA NRCS State Conservationist
Wallace F. Bennett Federal Building
125 South State Street Room
#6416 Salt Lake City, UT 84138

Subject: Update to NPS March 2026 Comments re: "Preliminary Draft Watershed Plan-Environmental Impact Statement for Cove-East Fork Virgin River Watershed Project" and "Updated Draft Biological Assessment for the Cove-EFVR Reservoir Project"

Dear Arelys Ortiz,

The National Park Service (NPS) is a cooperating agency in the above-captioned matter and submitted agency comments on a draft Environmental Impact Analysis and draft Biological Assessment on March 6, 2026. After further consideration, including evaluation of newly available information and continued discussions with the federal and state partners, the NPS believes that its concerns can be adequately addressed through alternative means as outlined below. This letter supersedes all prior NPS correspondence on this matter.

First, NPS comments related to duty values utilized in the Water Model have been resolved due to updated information from the Utah Division of Water Rights. After NPS submitted their March comments, the Utah State Engineer updated its water rights page for certain water rights that may be relevant to the project. In this update, the State Engineer recognized a higher duty value for certain irrigation rights that may be utilized by the project, which is consistent with inputs made in the Water Model.

Second, NPS recognizes that its other water rights-related interests should be addressed through the state Water Rights Division process, rather than in the NEPA context. NPS's primary interest in commenting on the draft Environmental Impact Analysis was to protect its water rights, which are set forth in the 1996 Zion National Park Water Rights Settlement Agreement (1996 Agreement), to which the State of Utah, NPS, Washington County Water Conservancy District and Kane County Water Conservancy District are signatories. NPS previously raised concerns regarding certain inputs that form the basis of the Water Model – namely, which water rights will be utilized, what water diversion rates and timing are necessary, total quantities of water diverted, and how those figures will be accounted for under the 1996 Agreement. Because the state water rights process will occur after the NEPA process is completed, we recognize that there must be certain assumptions made at this juncture. The NPS has a strong working relationship with the Utah Division of Water Rights and regularly engages directly with them as appropriate to address water rights-related concerns. If and when the project proponent(s) submit a water right application associated with the proposed Cove Reservoir Project, NPS will have an opportunity to participate in the State water rights process to ensure its interests are adequately protected, should that be necessary.

Finally, NPS has spoken with the Fish and Wildlife Service (FWS) to discuss some of NPS' previously stated concerns regarding Endangered Species Act-listed species, including the Mexican spotted owl. NPS

also noted concerns related to two fish species that are managed by multi-agency conservation agreements and are dependent upon aquatic and riparian habitat within Zion National Park. NPS recognizes FWS's specific expertise and critical role in completing the Endangered Species Act, Section 7 consultation process. NPS will continue to work with the Natural Resources Conservation Service and other state and federal agencies to ensure NPS resources are adequately protected.

NPS acknowledges that some comments from its original March 6 response letter are not addressed in this letter. However, based on these developments and upon further consideration, NPS recognizes that all of its previously submitted comments can be addressed through these other procedures. NPS looks forward to working with its State and federal partners on these important matters.

If you have any questions, please contact Jeff Bradybaugh, Superintendent, Zion National Park.

Sincerely,

HERBERT FROST

Digitally signed by HERBERT FROST
Date: 2026.06.12 13:22:19 -06'00'

Herbert C. Frost, Ph.D., Acting Regional Director

cc: Jeff Bradybaugh, jeff_bradybaugh@nps.gov

August 18, 2026

Jeffrey Bradybaugh
Superintendent
Zion National Park
1 Zion Boulevard (State Route 9)
Springdale, Utah 84767

Submitted by email to jeff_bradybaugh@nps.gov

Subject: National Park Service Comment Response Table for Cove-East Fork Virgin River Watershed Plan

Dear Mr. Bradybaugh:

On behalf of the Natural Resource Conservation Service, we sincerely appreciate the time and effort that has been devoted to reviewing the Watershed Plan Environmental Impact Statement (Plan-EIS) for Cove-East Fork Virgin River Watershed Project. The collaboration and valuable feedback provided during your review have contributed significantly to improving the quality, accuracy and clarity of the document. Following a thorough review of all comments received, we have incorporated the recommendations and revisions in the Plan-EIS. A Comment Response Table is attached to this letter and provides a summary of the comments reviewed, along with the response on how each comment was addressed. Please note that the National Park Service (NPS) submitted a comment addendum letter in July 2026, that withdrew certain comments included in its original review; therefore, those comments are not reflected in the attached table.

Please contact me directly if you have any questions about this information at (775) 296-0819 or eparis@eocene.com.

Sincerely,

Emily Paris
Project Manager
Eocene Environmental Group, Inc.
Attachment: Comment Response Table

ATTACHMENT

Table 1. NPS Comments on the Plan-EIS			
Comment Number	**Location**	**Comment**	**Response**
1	General	We understand from Ms. Paris at Eocene Environmental Group that the EIS project schedule includes a 45-day public comment period likely in summer 2026. Given the significant public interest in this project, as a Cooperating Agency the NPS recommends this public comment opportunity as well.	No text changes required.
2	General	Our research indicates that 7 CFR 1b.7 requires the USDA electronically publish all substantive comments received on an Environmental Impact Statement. The only NPS comments included in the Appendices of the Preliminary Draft Watershed Plan Environmental Impact Statement for Cove-East Fork Virgin River Watershed Project are the scoping comments made on April 18th, 2022. The NPS made additional comments in letters dated March 3rd, 2022, April 21st, 2023, March 7th, 2025, May 15th, 2025, August 22nd, 2025, that raised unresolved concerns and issues. These letters, as well as future correspondence related the Watershed Plan-Environmental Impact Statement for Cove-East Fork Virgin River Watershed Project and related analyses, including the Biological Assessment and Water Model Report, should be electronically published with the Environmental Impact Statement. NRCS indicated it would take this approach in Paragraph IV.2.g. of our Cooperating Agency Agreement.	Thank you for your comment. The appendices have been updated to ensure all cooperating agency comments to date have been included.
4	Summary Mitigation Measures Iii bottom paragraph	Will the “inadvertent discovery plan” include the presence of an archaeological monitor or tribal monitor during ground disturbing activities?	The Memorandum of Agreement and associated Historic Properties Treatment Plan would outline monitoring requirements during construction as described in Chapter 5.5.1 and 5.5.5. No text updates are required.
5	Summary Table	Suggest clarification of Net Economic Benefit	There is no correlation between the project cost

Table 1. NPS Comments on the Plan-EIS			
Comment Number	**Location**	**Comment**	**Response**
	S-page 1 iv	calculation. A $162,000 net economic benefit on a $39,511,000 project seems in error.	($39,511,000), which is an engineer's estimate, and the level of downstream benefits (agricultural water management, recreation, M&I water), produced and which are calculated based on economic evaluation principles. The cost of a project does not determine the net benefits that the project produces. This comment is in reference to the summary table which is intended to give a quick look at the details of the Watershed Plan Environmental Impact Statement. A detailed discussion on how the Net Economic Benefit was calculated is included in Appendix D-1; the Principles, Requirements, and Guidelines Report.
6	Summary. Table S-2. Water Resources; Table S.2. - Riparian Areas; Table 3.3 – Mexican Spotted Owls; 6.4.1.2.1.2; 6.4.7.2; 6.4.8.2; Table 5.7 – Water Resources; 7.4 – Riparian/Ecological Values vi	In Table S.2. – Water Resources, it is inaccurate to state both, “no downstream impacts to the EFVR would occur,” with the data provided and in the Riparian Areas section, “No impacts to existing riparian habitat would occur” as well as all similar statements within the EIS. Please see Comment 13 from Table 2 “NPS Comments on Updated Draft Biological Assessment for the Cove-EFVR Reservoir Project” for an explanation on the inaccurate and insufficient analysis that was provided in the draft Biological Assessment	See response to Comment 13 from Table 2. Plan-EIS has been updated to include the annual water change tables and a more detailed discussion on the impacts to riparian benefits. Text throughout the document has been updated to minor impacts rather than no impacts.
7	Summary. Waters of the U.S., Wetlands, and Special Aquatic Sites; Appendix E2; 4.2.2.1; 4.2.2.4; 6.2.4.2; Table 5.7 - WOTUS.,	Appendix E-2 "Draft Aquatic Resources Inventory Report, July 2025" includes an assessment of effects of the area generally around the construction of the reservoir and associated pipelines, not a comprehensive analysis of impacts to wetlands and riparian areas throughout the study area including downstream on the East Fork of the Virgin River through Zion National Park. No justification has been made for the river	The Draft Aquatic Resources Inventory Report was prepared in coordination with the United States Army Corps of Engineers to comply with Section 404 of the Clean Water Act and evaluates potential dredge and fill from the project within Waters of the United States. No ground disturbance would occur downstream of the immediate Project Area, as discussed throughout the report, and therefore those river segments are not required to be included in the

Table 1. NPS Comments on the Plan-EIS			
Comment Number	**Location**	**Comment**	**Response**
	Wetlands, and Special Aquatic Sites vi	segments within the study area not being included in this assessment report or this statement in the EIS. Include an evaluation on impacts to WOTUS throughout the study area, including downstream on the EFVR given that this project has a continuous surface connection to a perennial stream (EFVR).	assessment. No impacts to WOTUS outside of the immediate project area would occur and no text changes are required.
8	Summary. Table S. 2 - wild and Scenic Rivers vi	In Table S.2. it is inaccurate to state the "Preferred Alternative would have no impacts on the WSR values of the EFVR within ZNP, as it would also adhere to the stipulations required in the ZNP Agreement. Therefore, changes in flow in the EFVR through ZNP would be minor, particularly when the natural variation of the EFVR is approximately 100 times the range of effect from proposed reservoir releases (Alpha Engineering 2025)." Compliance with the ZNP Agreement does not equate to no impacts on the WSR values of the EFVR. Please remove this statement from the draft EIS.	This statement was updated to reference the minor changes in flows rather than compliance with the ZNP Agreement. While no formal Section 7 wild and scenic river evaluation was completed for the project, impacts to wild and scenic river values were still evaluated using the water model data and projected river flows. Please refer to chapter 5.2.6 for this analysis.
9	Summary. Table S-2 Sig Sci Resources x	Is a paleontological monitor and pre-construction paleontological training course a planned mitigation? Recommended mitigations should not be made here, only planned mitigations. Remove this statement if it is not planned to be implemented.	All recommended mitigations will be included within the Agreement between NRCS and the project proponent following the NEPA process to minimize impacts as discussed in the Plan-EIS. No text changes are required.
10	Summary. Major Conclusion x	NRCS states, "The Preferred Alternative is the most environmentally friendly alternative and has the greatest net economic benefits of all alternatives analyzed... No measurable long-term adverse impacts are anticipated [from the Preferred Alternative]." The NPS has not seen evidence in this draft EIS to support	See response to Comment 13 from Table 2. Plan-EIS has been updated to include the annual water change tables and impacts to water flow.

Table 1. NPS Comments on the Plan-EIS			
Comment Number	**Location**	**Comment**	**Response**
		these two statements. Please see Comment 13 from Table 2 “NPS Comments on “Updated Draft Biological Assessment for the Cove-EFVR Reservoir Project”."	
11	Summary. Areas of Controversy xi	"Wild and Scenic River status” is not controversial. The East Fork of the Virgin River as it runs through ZNP is a congressionally-designated Wild and Scenic River. The NPS has notified the NRCS that the NPS will not be conducting a Section 7 analysis on this water resources project.	This statement has been removed from this section as requested.
12	Chapter 2. page 12	Please remove the statement, “Some local recreational facilities are considering a cap on the number of daily visitors, including at ZNP and BCNP.” NPS units routinely collect visitor use data and conduct targeted studies for planning purposes. No capacities have been established for ZNP or BCNP.	This statement has been removed as requested.
14	Chapter 3. page 23	NRCS states, “Gauge data (USGS gauging station 09404450) revealed that the last 20 years have exhibited a drier hydrology and may be indicative of future conditions”. Please provide an explanation of how this trend was incorporated into an analysis on how less water in the river in the future will impact operability of this project.	Less water in the river further proves the Purpose and Need for this project by demonstrating a lack of availability for necessary water to support local agriculture and M&I water for Kane County and Washington County. An analysis of current and past water availability trends was included in the Water Model Report and demonstrates how the proposed reservoir is anticipated to impact water flows. No text changes required.
15	Chapter 3. page 23	The NRCS states, “One or more new reservoirs with cumulative active storage capacity of up to but not exceeding 6,750 acre-feet may be constructed upstream of Glendale.” This is inaccurate; the 1996 Zion National Park Water Rights Settlement Agreement allows for new large reservoirs on certain tributaries both upstream and downstream of Glendale as defined within the Agreement (Cove Canyon is downstream	Text has been updated to recite the language exactly as it is written.

Table 1. NPS Comments on the Plan-EIS			
Comment Number	**Location**	**Comment**	**Response**
		of Glendale). NPS recommends reciting the language exactly as it is written in the Settlement Agreement in Article II.D.1.a. Further, the NRCS states, “The existing flow or 2 cfs, whichever is less, shall be maintained immediately below any new surface water diversions or reservoirs constructed.” This is inaccurate, and NPS recommends correcting the statement to, “The existing flow or 2 cfs, whichever is less, shall be maintained immediately below any new surface water diversion to reservoirs constructed on streams defined in Article ii.D.1.a”	
16	Chapter 3. Table 3-5 page 40	Flannelmouth sucker, Desert sucker, and Virgin Spinedace have all been found within the study area in recent surveys conducted in Zion National Park. Please add this statement to each of these species. Please ensure all recent Utah Division of Wildlife Resources Hurricane Field Office fish survey data is included in this analysis.	These statements have been added as requested.
17	Chapter 4. page 53	In this Alternatives Considered but Eliminated from Detailed Study section, NRCS only includes alternative reservoir sites. Please provide an explanation on why coordinating with UDWR on establishing a Water Management Plan for the area, which would prioritize senior water rights, was not considered to achieve the purpose and need."	This alternative is included throughout the Plan-EIS as the "No Action Alternative" since both Kane County and Washington County already have established and follow Water Management Plans. A discussion of the water management strategies for both counties is included in Chapter 3.2.2 of the Plan-EIS. No text changes are required.
18	Chapter 5. page 73	For a comprehensive analysis on impacts to flow regime to provide the basis of this EIS, please add additional analysis points to this “Flow Impact Analysis” beyond the single analysis point included at the East	An additional analysis point, the USGS gauging station 09404700 (near Mt. Carmel Junction) was added in a Memo dated May 4, 2026, as requested to provide comparative flow data accounting for longitudinal differences in flow

Table 1. NPS Comments on the Plan-EIS			
Comment Number	**Location**	**Comment**	**Response**
		Fork Virgin River Near Springdale, UT - USGS-09404900. The EFVR through the study area undergoes significant changes in flow so a single point insufficiently analyzes impacts to the river through the study area. Describe decreases in flow as a quantification in terms of cubic feet per second, percentage of mean flow and changes to wetted perimeter. Showing decreases as a percentage of overall flow and wetted perimeter will better describe impacts to aquatic and riparian habitat of the preferred alternative. This analysis should be completed under a variety of flow conditions, including high, normal and dry years. Please see Table 2 Comment 13 for additional explanation. Also, correct spelling of Springdale in this paragraph.	regime through the EFVR. Flow impacts were evaluated across a range of hydrologic conditions, including dry, average, and wet years, using monthly mean, minimum, and maximum flows from both observed gage records and modeled scenarios. Because modeled changes are generally small relative to the natural variability of flows in the EFVR, effects on wetted permitter and associated habitat are expected to be localized and minor. Monthly mean flows for the period of record (1993-2002) at Mt. Carmel Junction were compared to modeled flows below the Cove Reservoir using the Alpha Engineering Water Model (2026). This comparison quantifies changes in discharge in cfs and percentage differences by month and annually. In addition, modeled results below the Cove Reservoir were compared to long-term observed flows at the Springdale gauge to characterize conditions further downstream. Finally, text has been updated to incorporate these results and correct the spelling of Springdale.
19	Chapter 5. page 74	The NRCS states, “Given that precipitation events already cause greater fluctuations in flow, depth, and width, the incremental effects of the proposed action would have little to no meaningful impact on the overall river system or on the habitat for Virgin River chub and woundfin downstream of the diversion point.” While it is true that the EFVR undergoes significant discharge fluctuations due to spring snowmelt runoff and precipitation events, the statement that this project will have no meaningful impact on the overall river system or habitat lacks basis without analyzing the project's impacts to base flow conditions throughout the study	Text has been updated to include the water model results analysis and further discussion of impacts to river flow.

Table 1. NPS Comments on the Plan-EIS			
Comment Number	**Location**	**Comment**	**Response**
		area.	
20	Chapter 5. page 75	The NRCS states, “The change in water flow would not introduce pollutants or alter the river's chemistry in a way that would impact its designation as ‘wild’.” This conclusion is not substantiated by existing data or analysis within the EIS. Please remove this statement.	Text has been updated to include the water model results analysis and further discussion of impacts to river flow.
21	Chapter 5. page 78	The heading for this section is “Desert Sucker” but based on the content in this section, the heading should likely be “Wild and Scenic Rivers”. The conclusion in this section is not substantiated by existing data or analysis within the EIS. NPS recommends removing the conclusion from the document.	Inadvertent text heading has been removed. Text has been added to further substantiate this conclusion and a reference to that section has been added.
22	Chapter 5. page 79	Please see unresolved comments from the Water Model Report Table 3 Comment 6. The 2001 MOU cited in this section, which provides a significant mitigation on impacts to native fish and their habitat immediately below the diversion, is only in place so long as the hydroelectric power plant is in operation (Term 11) which is not included in this project proposal. Is there a plan to amend this agreement to include this project so if the hydroelectric power plant is decommissioned the agreement and terms are still in effect?	This section has been updated to remove mention of the 2001 MOU. A discussion of the existing and planned monitoring efforts was added in its place.
23	Chapter 5. page 79	The NRCS states, “The change in water flow would not disrupt the ongoing research activities within the Research Natural Area.” No analysis has been made to support this statement. Please remove."	Text has been added to further substantiate this conclusion and a reference to that section has been added.
24	Chapter 5. page 79	The NRCS states, “Formal consultation with the NPS to comply with Section 7 of the WSRA was not required for this project (Appendix A-62).” Revise to more accurately	Text has been updated as requested.

Table 1. NPS Comments on the Plan-EIS			
Comment Number	**Location**	**Comment**	**Response**
		state, “The NPS notified the NRCS that the NPS will not be completing a Section 7 analysis on this project.”	
25	Chapter 5. page 80	The NRCS states, “Regulating services, water quality and quantity—Alternative 2 would increase water quality in the EFVR by containing sediment within the reservoir during flash flooding events.” While this section includes a brief narrative describing impacts to water quality, this section provides no description or analysis on anticipated impacts to water quantity.	Text has been added to describe modeled changes to water quantity.
26	Chapter 5. page 97	The NRCS states, “Additional maps and information are provided in Appendix C and the Preliminary Design Report (Appendix E-1). However, like all dams, the risk of failure exists and would be mitigated by an Emergency Action Plan (EAP), as required by the Utah Dam Safety office. The estimated number of at-risk populations is 10 to 15 people. The inundation zone encompasses four residential homes, along with barns and agricultural facilities. If a dam breach were to occur, up to 192 acres (0.3 square mile) of cropland would also be affected.” Flood inundation maps and analysis provided in the EIS and Appendices do not sufficiently analyze impacts downstream with the analysis abruptly ending prior to downstream communities, including Mt. Carmel, Utah. Inundation maps must analyze impacts to the full downstream extent that floodwater from a dam failure would extend including analyzing impacts to downstream communities and recreational areas including Mt. Carmel, UT, Parunuweap Canyon managed by the BLM, Zion National Park, Rockville, UT and Virgin, UT. The mentioned	The preliminary Design Report has been updated with an inundation zone that includes the downstream communities mentioned. All communities involved would be included in the preparation of the EAP as required by the Utah Dam Safety office. Text changes were made throughout the document to discuss the additional inundation areas.

Table 1. NPS Comments on the Plan-EIS			
Comment Number	**Location**	**Comment**	**Response**
		communities above should be involved in the development of an Emergency Action Plan.	
27	Chapter 5. Table 5.7. Wild and Scenic Rivers page 109	The NRCS states, “The Action Alternatives would have no impacts on the WSR values of the EFVR within ZNP, as it would also adhere to the stipulations required in the ZNP Agreement. Therefore, changes in flow in the EFVR through ZNP would be minor, particularly when the natural variation of the EFVR is approximately 100 times the range of effect from proposed reservoir releases (Alpha Engineering 2025).” Please remove the Wild and Scenic River Section from this table. The conclusions made here are not substantiated by data or analysis."	This statement was updated to reference the minor changes in flows rather than compliance with the ZNP Agreement. While no formal Section 7 wild and scenic river evaluation was completed for the project, impacts to wild and scenic river values were still evaluated using the water model data and projected river flows. Please refer to chapter 5.2.6 for this analysis.
28	6.1 page 114	"The NRCS states, “The Cooperating Agencies and project sponsors support Alternative 2 as the Preferred Alternative”. The NPS has not indicated preference for any alternative."	This statement has been updated as requested.
29	6.4 Bullet 6. WR Values page 116	The NRCS states in an Area of Controversy, “Concern: WSR Values - Concern with effects to the W&S status of the river. Response: An analysis on impacts to the wild and scenic values of the EFVR are included in Section 5.2.6.” No Wild and Scenic Rivers Act Section 7 analysis has been completed; please remove this statement.	This statement was updated to reference that an informal analysis on impacts was completed and to add a discussion to the fact that no Section 7 analysis was completed by the NPS.
30	6.4 Threatened and Endangered Species and State Sensitive Species Bullet 2. Page 117	The NRCS states in an Area of Controversy, “Concern: Threatened and Endangered Species and State Sensitive Species - Damage to the Virgin Spinedace. Response: The Virgin Spinedace is a state-sensitive species with potential to occur within the ZNP portion of the project area. Changes in water flow within the EFVR would be minor, particularly when the natural variation of	This statement is not just referring to increases to flow. The changes in flow analyzed throughout the Plan-EIS and BA discuss both increases and decreases to baseflow. A detailed discussion on impacts on riparian and aquatic habitats is discussed in Chapter 5.4 of the Plan-EIS and Chapter 5 of the BA. No text changes are required.

Table 1. NPS Comments on the Plan-EIS			
Comment Number	**Location**	**Comment**	**Response**
		EFVR flows are approximately 100 times the range of effect from proposed Cove Reservoir releases (Alpha Engineering 2025), and therefore, no long-term impacts are anticipated. Reference Section 5.4.6 for supporting information". The concern with impacts to aquatic species, including Virgin Spinedace, reliant upon riparian and aquatic habitat, derives from decreases to base flow conditions, not increases to flow within the natural flow regime. This is not a valid explanation to satisfy the concern."	
31	6.4 Climate Change Bullet 4. Page 117	The NRCS states in an Area of Controversy, "Concern: Climate Change -Water flow in relation to climate change. Response: Water availability is anticipated to continue to decrease over time as climate change occurs. The Preferred Alternative would provide a reliable source of water for agriculture and M&I benefits and would not contribute to climate change. Reference the Cove Water Model in Appendix E-10 for supporting information." Provide an analysis of how decreases in water availability due to climate change will affect long-term operability of the project as well as impacts to the riparian and aquatic habitat. This analysis is not found in the cited Water Model Report nor is it found in the draft Biological Assessment or draft EIS.	Current USDA NEPA procedures require analysis to focus on the environmental effects from the proposed action and alternatives that are reasonably foreseeable and have a reasonably foreseeable causal relationship to the proposed action. Per 7 CFR 1b.5(b), 1b.7(g), and 1b.11(a)(12), effects on broader future conditions should generally not be considered in the NEPA document. Therefore, this comment is out of the scope of the analysis, and no text changes are required.
32	6.5.1.3 NPS Page 118	The NRCS states, "Formal consultation with the NPS to comply with Section 7 of the WSRA was not required for this project." Correct this statement to more accurately reflect the message as, "the NPS stated they will not be conducting a Section 7 analysis on this project.""	Text has been updated throughout the document.
34	Table 9.1	Correct Robyn Henderek's years of	Text has been updated as requested.

Table 1. NPS Comments on the Plan-EIS			
Comment Number	**Location**	**Comment**	**Response**
		professional experience to 10.	

Table 2. NPS Comments on the Biological Assessment			
Comment Number	**Location**	**Comment**	**Response**
6	4.2.3 page 5	**May 15, 2025:** Include specific details on conservation measures that would minimize the introduction of non-native species into the river and reservoir (e.g., all equipment should be cleaned and inspected for Aquatic Invasive Species prior to being brought on site). To ensure the success of the postconstruction seeding efforts, include post construction mitigation for non-natives that are introduced/become established. There is a substantial population of invasive knapweed (Centaurea stoebe) in the area that could benefit from this disturbance and potentially have a negative effect on postconstruction seeding.	**July 11, 2025**: Two committed conservation measures currently in the Plan-EIS have been added to the BA for clarification. These measures state that "All equipment would be cleaned of soil, seeds, vegetation matter, and other debris prior to entering or reentering the project area to avoid any introduction of non-native plants or weeds. “and "Prior to stocking the proposed reservoir with fish, a management plan will be developed to ensure that nonnative fish species do not escape from the reservoir into the EFVR." It should be noted that no construction activities would occur within the EFVR. This would greatly reduce the potential for the introduction of non-native species into the river.
		August 18, 2025: Please send an updated draft of the Biological Assessment with these changes. As the project includes stocking of non-native fish in the proposed reservoir, a fish management plan that adequately mitigates for potential introduction into the East Fork of the Virgin River and its tributaries must be developed and included in the NEPA analysis. This plan should meet nonnative stocking and control requirements set in other plans such as the Virgin Spinedace Conservation Agreement and Strategy and other relevant plans and agreements.	**February 2026:** Updated BA sent
		March 6, 2026: Comment remains unresolved. There is mention of a fish	**August 2026:** The NPS will have an opportunity

Table 2. NPS Comments on the Biological Assessment			
Comment Number	**Location**	**Comment**	**Response**
		management plan which will be made prior to the proposed action in the EIS. Will the NPS have an opportunity to review and comment on this future plan?	to review the fish management plan prior to its finalization. All references to the fish monitoring plan have been updated to state this.
7	4.2.3 page 5	**May 15, 2025:** Include specific details on conservation measures to prevent the introduction of stocked non-native salmonids (fish and eggs) from entering the East Fork of the Virgin River.	**July 11, 2025:** Additional information has been added as requested. A measure that is currently in the Plan-EIS has been added to the BA. This measure states that, "Prior to stocking the proposed reservoir with fish, a management plan will be developed to ensure that nonnative fish species do not escape from the reservoir into the EFVR". It should also be noted that several actions would be taken to prevent non-natives from entering the EFVR. These include a fish screen at the proposed reservoir intake with a 1-inch maximum pore opening that would prevent fish and debris from entering the pipeline to the Orderville hydroelectric power plant. The hydroelectric facility utilizes two Turgo Impulse turbines, which focus the water through small nozzles at high pressure and velocity into the turbines. The combination of the small nozzle size, high velocity, and sudden pressure drop would make it highly unlikely that any fish that might make it into the pipeline would survive. This information has been added to Section 2.2.1 (Project Measures for clarification.
		August 18, 2025: Please send an updated draft of the Biological Assessment with these changes. As the project includes stocking of non-native fish in the proposed reservoir, a fish management plan that adequately mitigates for potential introduction into the East Fork of the Virgin River and its tributaries must be developed and included in the NEPA analysis. This plan should meet requirements set in other relevant plans and agreements.	**February 2026:** Updated BA sent

Table 2. NPS Comments on the Biological Assessment			
Comment Number	**Location**	**Comment**	**Response**
		March 6, 2026: Comment remains unresolved. Further, information provided on the fish screen was not included in the BA or the EIS. There is mention of a fish management plan which will be made prior to the proposed action in the EIS. Will the NPS have an opportunity to review and comment on this future plan?	**August 2026:** The NPS will have an opportunity to review the fish management plan prior to its finalization. All references to the fish monitoring plan have been updated to state this. Information on the Fish Screen has been added to the Watershed Plan-EIS however it was already included in the BA under Section 2.2.1 (Project Measures)
10	4.2.3 page 5	**May 15, 2025:** Include conservation measures that are specific to California condors. For example, to reduce microtrash ingestion by condors, all trash at the construction site should be cleaned up daily.	**July 11, 2025**: No effects have been identified for the California condor resulting from project development. The Long Valley portion of the Action Area is the only place where surface disturbance would occur. It is not considered to be condor habitat due a to lack of habitat. However, additional committed conservation measures found in the Plan-EIS relating to plants and animals (including the condor), have been added to the BA
		August 18, 2025: There is evidence from condors fixed with GPS units utilizing the project area on lands managed by the National Park Service and therefore should be included in the analyses.	**February 2026:** Updated BA sent
		March 6, 2026: Table 5 still states that California Condors are not present within the Action Area. The NPS has provided NRCS data to support they are found within the Action Area. Please correct this statement.	**August 2026:** Table 5 states "The [California Condor] is present in ZNP and may visit other parts of the Action Area." UNHP data did not identify any known occurrences of the species in the Action Area which remains an accurate statement. No text changes are required.
13	3.4.1 page 6	**May 15, 2025:** Reference to action area should still include downstream locations. It would appear that the identified wetlands and streams are only for the area of surface disturbance. Further, does “two additional sites bisect the proposed pipeline” refer to two additional streams? Please clarify.	**July 11, 2025:** Because no surface disturbance would occur outside of the Long Valley area, it is not necessary to identify downstream wetlands and streams beyond the EFVR and the Virgin River. Text has been changed to clarify the discussion regarding intermittent streams in

Table 2. NPS Comments on the Biological Assessment			
Comment Number	**Location**	**Comment**	**Response**
			Long Valley.
		August 18, 2025: Changes in flow regime, specifically a reduction in base flows during the period of diversion outside of spring snowmelt (NovemberMarch), has the potential to impact the total area of riparian and aquatic habitat. Riparian and aquatic habitat rely upon consistent base flow conditions to sustain populations. Lower base flows mean less wetted perimeter. The July 2024 Water Model report cites the potential for an 11.6 cfs (-21% average discharge) decrease in flow at the USGS East Fork of the Virgin River Near Springdale gage (USGS 09404900) in December. Please provide an analysis of impacts changes in flow regime for aquatic and riparian habitat at various locations within habitat of ESA and candidate species in the Action Area during high, low, and average water years. This analysis will likely extend beyond the Ordinary High Water Mark cited as the Washington County Action Area therefore the action area for Washington County should include an approximately 50 foot buffer beyond the Ordinary High Water Mark.	**February 2026**: Updated BA sent
		March 6, 2026: The February 2026 Updated Draft Preliminary BA includes a new Section 5.0 - Water Model Results. Section 5.3 states, “Modeling shows that reservoir operations would cause only minor changes to EFVR flows (between 15 to 25 cfs added or between 12.6 to 22.2 cfs removed) which is extremely small compared to natural river variability.” While it is accurate to state that increases to discharge from summer releases would be “extremely small	**August 2026:** Data presented in Tables 6, 7, and 8 represent annual changes in flow, depth, and width, whereas the structure of the Water Model Report evaluates changes on a monthly level. These two analyses operate at different temporal scales, which explains the apparent discrepancies. As described in Chapter 5.5, "The project shifts water to periods when flows are naturally low [so that] seasonal timing of flows would become more aligned with

Table 2. NPS Comments on the Biological Assessment			
Comment Number	**Location**	**Comment**	**Response**
		compared to natural river variability," it is inaccurate to make that statement on diversions during the winter and spring based on data from the July 2024 Water Model Report. Please describe the location of the analysis point described in Tables 6, 7 and 8. Date from Tables 6, 7 and 8 conflict with data presented in the July 2024 Water Model Report. In the Cove Reservoir Average Annual Simulation, in an average year, it is modeled that there will be an 11.6 cfs decrease in river flow in November, an 11.7 cfs decrease in flow in December, a 10.2 cfs decrease in flow in January, a 7.0 cfs decrease in February, a 4.3 cfs decrease in flow in March, a 2.4 cfs decrease in flow in April, and a 5.7 cfs decrease in flow in May. While the analysis point from the Average Annual Simulation is also undisclosed, it is unclear how the NRCS can state there will only be a 1.7 cfs decrease in EFVR flow during the "low" scenario. Further, for a comprehensive analysis of impacts to the flow regime, multiple analysis points must be made along the EFVR through the Action Area as the flow regime changes considerably throughout the river from the site of the proposed reservoir diversion to the USGS East Fork of the Virgin River near Springdale Gage (09404900). The NPS provided NRCS a discharge measurement taken from the EFVR near Mt. Carmel Junction on 12/15/25 where flows were calculated at 11.99 cfs. Under planned diversions of the Cove Reservoir, discharge would be diminished to a minimum of 2 cfs to be maintained below the diversion. Therefore, flows would be reduced at this site	ecological needs." Monthly changes (particularly during winter storage periods) are expected to be more pronounced, but the annual high and low flow conditions are expected to change by less than 5%, as shown in tables 6-8. These values are derived directly from the 2025 Water Model report (pg. 13-15). Regarding the single discharge measurement provided by NPS from 12/15/2025, we appreciate the additional data point. However, a single measurement cannot characterize the full range of seasonal or interannual variability at that location. The modeled minimum flow of 2 cfs would occur only during the winter storage period. This reduction is seasonal and temporary, consistent with the project's purpose of shifting water timing to better match natural seasonal demand. During summer months, releases from Cove Reservoir would increase flows to support ecological needs, including riparian and wetland recruitment processes. We acknowledge the importance of evaluating flow changes at multiple points along the East Fork Virgin River, however the scope only includes the use of readily available data. The installation of additional gauge points is out of the scope of this project. The text has been updated to add a discussion on annual and monthly changes.

Table 2. NPS Comments on the Biological Assessment			
Comment Number	**Location**	**Comment**	**Response**
		by 83%, as an example. At the USGS East Fork of the Virgin River near Springdale Gage (09404900), the Water Model Report (July 2024) cites a 21% decrease in discharge, as another example. 83% and 21% of flow is not “extremely small” as the NRCS concludes here. A comprehensive analysis of changes to the flow regime under a variety of flow conditions must be made at several locations within the Action Area and those effects must be quantified in an analysis on impacts to riparian and wetland species, including recruitment. As we have stated in the past, the NPS remains available to assist the NRCS with this effort.	
31	3.4.3 page 3	**March 6, 2026:** Spotted Knapweed (Centaurea stoebe) is also prevalent in that area. It is listed as Class 2 on the Utah Noxious Weeds List. Please add Spotted Knapweed to Table 2	**Augsut 2026**: Spotted Knapweed has been added to Table 2 as requested.
32	5.4 page 25	**March 6, 2026:** New Section 5.4 states, “Overstory species, such as cottonwood and Russian olive, rely on groundwater, not surface flow. Their deep root systems, 10–15 feet for cottonwood (Greg 2026) and up to 40 feet for Russian olive (NRCS 2026), would not be affected by the minor changes in streamflow. Groundwater levels in the EFVR corridor are controlled primarily by regional hydrology and flood recharge, not by small changes in surface flow.” As described in Table 2, Comment 13, surface flow reduction is not expected to be “small”. Groundwater to surface water relationships vary by lithologic unit and its aquifer bearing properties and depth of channel fill, therefore cannot be broadly summarized across the entire Action Area here as it is in this statement. Analysis	**August 2026:** The statements in Section 5.4 are based on the best available data regarding rooting depth, groundwater dependence, and hydrologic controls within the EFVR corridor. Overstory species such as Fremont cottonwood and Russian olive rely primarily on groundwater stored within deeper alluvial deposits. Their documented rooting depths—10–15 feet for cottonwood (Greg 2026) and up to 40 feet for Russian olive (NRCS 2026)—extend well below the zone influenced by short-term or seasonal fluctuations in surface flow. As described in Section 5.4, groundwater levels in this reach are governed predominantly by regional hydrology, basin-scale recharge, and episodic flood events rather than by incremental changes in baseflow. The hydrologic analysis presented in Tables 6–8 reflects annual changes in flow magnitude,

Table 2. NPS Comments on the Biological Assessment			
Comment Number	**Location**	**Comment**	**Response**
		should be made on incremental reaches along the EFVR through the Action Area. The proposed considerable decreases to surface water may influence on depth to groundwater. Further, overstory species reliant primarily on groundwater should not be the only riparian species analyzed in this document. Please provide a comprehensive analysis on impacts to riparian habitat in the Action Area, including recruitment. Related to recruitment, reducing river flows during spring recruitment events may inadvertently remove trees over time. This can be exacerbated by single aged stands. A sudden collapse of habitat could happen when trees, such as cottonwoods, reach maximum age with no or limited recruitment.	which remain below 5% for both high- and low-flow conditions. These values are derived directly from the 2025 Water Model Report. While monthly changes—particularly during winter storage periods—may appear more pronounced, these shifts represent seasonal redistribution of water rather than a net annual reduction. Because groundwater recharge in the EFVR corridor is driven primarily by large flood pulses and regional aquifer dynamics, the modeled seasonal adjustments in surface flow are not expected to meaningfully alter depth to groundwater. We agree that groundwater–surface water interactions can vary by lithologic unit, channel fill thickness, and local aquifer properties. However, the scope of this assessment is limited to the use of readily available hydrologic and geologic data. Reach-specific groundwater modeling or installation of additional monitoring wells is beyond the scope of this project. The analysis therefore focuses on the dominant hydrologic controls that operate across the Action Area and the scale at which project-related changes occur. Section 5.4 evaluates overstory species because they represent the habitat of the listed species analyzed in the BA. We acknowledge that riparian communities include a broader suite of species with varying recruitment strategies and moisture requirements. Recruitment of cottonwood and other native species is tied to spring snowmelt peaks and overbank inundation. These high-flow events are not expected to be substantially altered by the project, and therefore the processes that support seedling establishment and channel-margin recruitment are expected to

Table 2. NPS Comments on the Biological Assessment			
Comment Number	**Location**	**Comment**	**Response**
			remain intact. We recognize the concern regarding single-aged stands and long-term recruitment. However, the project would not meaningfully reduce peak spring flows or flood-driven channel migration processes, the mechanisms that create suitable germination sites are expected to persist. Seasonal reductions in winter baseflow do not coincide with the timing of cottonwood recruitment and therefore are not anticipated to impede regeneration or lead to long-term stand collapse. While we acknowledge the value of reach-specific groundwater–surface water studies, such analyses fall outside the scope of this assessment. Based on the available data, the project is not expected to cause measurable changes to groundwater levels or to adversely affect riparian recruitment processes within the Action Area. The text has been updated to provide additional detail on this analysis.

Table 3. NPS Comments on the Water Model			
Comment Number	**Location**	**Comment**	**Response**
6	Section A. d page 7	**NPS 4/21/23 Comment 6**: Please cite and provide a copy of this agreement. Please clarify which months this minimum flow is to be maintained below the OIC diversion. "When neither MCIC or the OIC are diverting water for irrigation purposes," is unclear since it is noted here company water rights allow for year-round irrigation.	**NRCS 11/21/24 Response to Comment 6:** Attached is the agreement.
		NPS 3/7/25 Response to NRCS Response to Comment 6: The agreement noted was not actually attached when the response to comment was sent to the NPS. We look forward to receiving a copy of this agreement. Please clarify which months this	**NRCS 3/27/25 Response to Comment 6:** The agreement was attached with the original response but may have not been forwarded to you. It is attached again for your use. The report that is being quoted from did not continue with the remainder of the sentence which stated,

Table 3. NPS Comments on the Water Model			
Comment Number	**Location**	**Comment**	**Response**
		minimum flow is to be maintained below the OIC diversion. “When neither MCIC nor the OIC are diverting water for irrigation purposes,” is unclear since it is noted here company water rights allow for year-round irrigation. Further, please include a description of how these minimum flows will be measured below the OIC.	"typically during the winter". Winter is defined as December to February which is the verbiage used in the memorandum. The minimum flows are measured with a parshall flume at the diversion dam.
		NPS 3/6/26 Response to Comment 6: This agreement, which provides a significant mitigation on impacts to native fish and their habitat immediately below the diversion, is only in place so long as the hydroelectric power plant is in operation (Term 11) which is not included in this project proposal. Is there a plan to amend this agreement to include this project so if the hydroelectric power plant is decommissioned the agreement and terms are still in effect?	**August 2026:** The hydroelectric plant referenced in the 2001 MOU is the existing Orderville Hydroelectric Plant which was constructed after this agreement was executed. The agreement establishes baseflow requirements below the OIC diversion dam, and these flows were used as a reference in the development of the water model. There are no plans to decommission the hydroplant or amend this agreement to include this project. The hydroplant will continue to generate power with releases to the WCWCD or when there is excess in the Cove Reservoir available for release. All releases will be in accordance with the ZNP Agreement. This project incorporates its own mitigation measures to minimize impacts to native fish and their habitat including the continued monitoring of water levels by the Utah Water Marshal and the development of a Fish Management Plan prior to construction. These measures are described in detail throughout the Biological Assessment and Watershed Plan-Environmental Impact Statement. Based on this, no revisions to the water model text are necessary.
9	Section D. page 12	**NPS 4/21/23 Comment 9:** Generally, this section on modeled impacts the USGS East Fork of the Virgin River at Springdale gage needs to be expanded. Add an analysis of changes to wetted perimeter at this site as	*Section revised as requested*

Table 3. NPS Comments on the Water Model			
Comment Number	**Location**	**Comment**	**Response**
		well as impacts to water quality including turbidity and water temperature. The NPS needs a tabulation of modeled impacts to discharge at this gage under high, normal and low water years for each month of the year. Also, please add units to Table 1.	
		NPS 3/7/25 Response to Comment 9: No response was given on this comment but some changes were made to this section, including units added to the table, in the July 2024 version of the Water Model Report. Add an analysis or evaluation of changes to wetted perimeter at this site as well as impacts to water quality including turbidity and water temperature within the Environmental Impact Statement. The NPS needs a tabulation of modeled impacts to discharge at this gage under high, normal and low water years for each month of the year for the Environmental Impact Statement.	**NRCS 3/27/25 Response to Comment 9:** We believe there is adequate information in the Water Model Report included in pages 12 to 15 to analyze the effects of the project. For tabulated information on a month by month basis, please refer to Appendix A of the model. The Virgin River highly variable flows with or without the project (see attached memo dated February 8, 2025). The project is part of the Zion National Park Settlement Agreement and is being constructed in accordance with that agreement and no further documentation should be necessary.
		NPS 3/6/26 Response to Comment 9: Please clarify if the "Change in River" column in the "Cove Reservoir Average Annual Simulation" refers to changes as seen at the East Fork of the Virgin River near Springdale, UT gage or just downstream of the release from reservoir? The information presented in Appendix A only shows modeled impacts in average years, the NPS would like to see the impacts during the driest and wettest years as well. We believe an assessment of impacts to wetted perimeter (which can be calculated easily with the water depth information provided), water temperature and turbidity are reasonable requests.	**August 2026**: The water model has been updated to include additional analysis per this request.

From:	Bradybaugh, Jeffrey S
To:	Paris, Emily; Henderek, Robyn L; Dempsey, Erin C.
Cc:	Hamilton, Derek - FPAC-NRCS, UT; Hoffmann, Tara - FPAC-NRCS, UT; Fillerup, Anders - FPAC-NRCS, UT; Boswell, Ammon - FPAC-NRCS, UT; Parker, Brian; Bolander, Ronald
Subject:	Re: [EXTERNAL] Cove East Fork Virgin River Project Update and Request for Comments
Date:	Monday, August 31, 2026 5:10:43 PM
Attachments:	Outlook-y1dtyn0v.png

Emily, thanks for the update!

We appreciate the updated comment matrix addressing our earlier comments. We have no further comments at this time. We appreciate your efforts and keeping us looped in as a cooperating agency.

Jeff Bradybaugh (he/him)
Superintendent
Zion National Park
State Highway Route 9
Springdale, UT 84767
phone: 435-772-0140
e-mail: jeff_bradybaugh@nps.gov

"Optimism is true moral courage"
Sir Ernest Shackleton, 1874-1922
shipwrecked Antarctic Explorer

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From: Paris, Emily <EParis@eocene.com>
Sent: Tuesday, August 18, 2026 10:57 AM
To: Bradybaugh, Jeffrey S <Jeff_Bradybaugh@nps.gov>; Henderek, Robyn L <robyn_henderek@nps.gov>; Dempsey, Erin C. <Erin_Dempsey@nps.gov>
Cc: Hamilton, Derek - FPAC-NRCS, UT <derek.hamilton@usda.gov>; Hoffmann, Tara - FPAC-NRCS, UT <tara.hoffmann@usda.gov>; Fillerup, Anders - FPAC-NRCS, UT <anders.fillerup@usda.gov>; Boswell, Ammon - FPAC-NRCS, UT <ammon.boswell@usda.gov>; Parker, Brian <bparker@eocene.com>; Bolander, Ronald <rbolander@eocene.com>
Subject: [EXTERNAL] Cove East Fork Virgin River Project Update and Request for Comments

This email has been received from outside of DOI - Use caution before clicking on links, opening attachments, or responding.

Good morning,

The Preliminary Draft Watershed Plan Environmental Impact Statement (Plan-EIS) for the Cove Reservoir East Fork Virgin River Project has been sent to the National Watershed Management Center for review. We are currently planning for the 45-day public comment period to begin in September and would like to provide you with an opportunity to submit any final comments before that process begins.

Below is a link to the updated Draft Plan-EIS, our comment response matrix from you February 2026 comments (revised by the NPS July letter), and the appendices. To ensure comments can be incorporated into the Draft Plan-EIS prior to public release, we kindly request that any feedback be submitted by **September 1st, 2026**.

NPS Response Package 2026 0818
Password: 1dt7f8bhXQX7
https://transconenvironmental.egnyte.com/fl/wtWtXxj67t6F

Thank you for your time and consideration. We appreciate your review and input.

Sincerely,

Emily Paris
Project Manager

Eocene Environmental Group

Reno, Nevada 89503
MOBILE 775.296.0819
EMAIL eparis@eocene.com

EPA Coordination

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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December 22, 2020

Ref: 8ORA-N

Norm Evenstad, Water Resources Coordinator
US Department of Agriculture,
Natural Resources Conservation Service
Wallace F. Bennett Federal Building, Room 4420
125 South State Street
Salt Lake City, Utah 84138-1100
(Transmitted by email)

Dear Mr. Evenstad:

The U.S. Environmental Protection Agency Region 8 has reviewed the USDA Natural Resource Conservation Service's November 25, 2020, Draft Plan Environmental Assessment (EA) for the Cover Reservoir Watershed Project. The NRCS has prepared a Draft Plan EA primarily to address summer agricultural irrigation shortages for nearby farms in the watershed. The Draft Plan EA identifies two alternatives for consideration; the Preferred Alternative to construct a dam at the Cove Reservoir site with a 6,055 acre-feet storage capacity and the No Action alternative. In accordance with our responsibilities under the National Environmental Policy Act (NEPA), we are providing the following comments on purpose and need, water quality and aquatic resources, as well as general feedback for consideration as you move into the next phase of NEPA development.

Project Purpose and Need:

The Draft Plan EA identifies that the primary purpose of the project is to capture high winter flows in storage in order to fulfill the need to provide additional water to irrigators during low-flow summer months. The ancillary purposes of this project based on the preferred alternative selection are to create recreation opportunities, relocate and upgrade the Glendale hydroelectric power plant, and generate consistent summer flows to enhance downstream habitat for threatened and endangered species. The Draft Plan EA discusses alternatives that were considered but screened out, leaving construction of a new dam at the Cove Reservoir site as the single preferred action. Because the Draft Pan EA identifies that Cove Reservoir will likely require a Clean Water Act (CWA) Section 404 individual permit for impacts to waterbodies in the proposed reservoir footprint, we recommend that 404 processes and NEPA be merged to increase efficiency. As such, 404 permitting requires that all feasible alternatives be evaluated to determine that the selected alternative is the least environmentally damaging practicable alternative (LEDPA).

Our review indicates at least one feasible alternative that would provide approximately 3,000

acre-feet of storage was screened out from evaluation in the Draft Plan EA due to cost, and other alternatives, including non-construction actions (e.g. conservation and modified irrigation practices), were not considered as they did not meet water storage requirements of the purpose and need. We recognize that some alternatives were screened out due to unfavorable conditions, but we recommend that all feasible alternatives be evaluated if they can meet the primary goal of providing additional water needs for existing agriculture activity in the project area. Providing this information will increase the efficiency of CWA 404 permitting in addition to completing a robust analysis for NEPA purposes.

We recommend that discussions on purpose and need clearly indicate that the Cove Reservoir location has already been purchased by the Kane County Water Conservation District (proponent). It is not immediately clear in the documentation how the existing land acquisition is factored in the alternatives screening cost evaluation. This information will be relevant for CWA 404 permitting and determining if the preferred alternative is the LEDPA.

Water Quality and Aquatic Resources:

Cove Reservoir would utilize diversion of peak flows from the East Fork Virgin River (East Fork) during winter to fill the pool. The East Fork is classified by the State of Utah as a Category 1 high functioning surface waterbody under its antidegradation policy and is currently assessed as unimpaired. As such, activities in or near the waterbody that could result in degradation should be scrutinized and avoided. The Draft Plan EA determines that no change in water quality would occur as a result of Cove Reservoir. Our review of the Draft Plan EA resulted in the following observations that we recommend be addressed to evaluate that determination:

- The Draft Plan EA identifies that the diversion and retention of water in Cove Reservoir will provide a beneficial use due to annual releases of up to 882 acre-feet downstream to protect federally-listed Virgin River chub and woundfin species at Pah Tempe Hot Springs. Additionally, the Draft Plan EA identifies the potential for increased riparian habitat growth to benefit the listed southwestern willow flycatcher. The Draft Plan EA states that “up to” 882 acre-feet will be discharged but does not elaborate on what criteria will be established to determine flows aside from the agreement between the proponent and Zion National Park to not exceed certain flows rates. We recommend the document analyze and discuss the potential for adverse effects on listed (state and federal) and non-listed species. We further recommend the document outline whether beneficial flows would be curtailed due to a priority to meet irrigation needs should there be a drought year (or years) and the reservoir does not fill to capacity. As both irrigation and storage and beneficial flows are identified as project purposes, we recommend that the document identify if they will have equal weight. Recreation is also a project purpose, and the document should address ability to meet recreational needs under similar conditions and identify if specific purposes will outweigh others should conditions occur where the pool cannot be filled during the high flows season.
- The Draft Plan EA does not analyze or discuss the possibility of nutrients or other potential constituents that could accumulate in the reservoir and be released downstream. We recommend evaluating soils and land uses upgradient of the reservoir location to

assist in anticipating potential water quality issues. Due to the sensitive and protected nature of the East Fork, we recommend that identification and anticipation of any potential impairments in the East Fork resulting from the reservoir be evaluated so they can be fully disclosed, mitigated or avoided.

- The Cumulative Effects section (4.4.2.2.) identifies that Jackson Flat Reservoir and the proposed Cove Reservoir would collectively provide irrigation water for Kane County agriculture. The Draft Plan EA introduction identifies in section 1.4 that there is currently no water storage structure available for irrigators in the area, but this information appears to contradict that. It is unclear from this section how the water from both sources will be collectively utilized. For clarity, we recommend the document elaborate on this collective use and how it is factored in the water needs projections. If there are plans to combine and convey water from both reservoirs, we recommend the document analyze the potential in-reservoir and downstream water quality effects that could occur if water is shared between reservoirs. If the reservoirs are independently utilized, that clarification will be beneficial to avoid confusion.
- The Draft Plan EA highlights that the reservoir will increase water quality in the East Fork by retaining some sediments from high water or flash flood events. It is unclear in the Draft Plan EA if there are anthropogenic sources of increased sediment or if the sediment is part of the natural regime of the watershed. For clarification, we recommend that the document identify if the capturing of sediments will alleviate anthropogenic influences on sediment loads in the watershed and East Fork or if the capture of sediments may alter the natural sediment regime.
- The Draft Plan EA identifies that construction activity will require traffic at crossings of the East Fork. We appreciate the proponent's construction BMPs to mitigate impacts to the waterbody, and strongly encourage investigation of any alternate routes that could further minimize or avoid, if possible, directly impacting the East Fork.
- Recreation is identified as one of the project purposes. We note that the project area is in proximity to Lake Powell and other state reservoirs that provide recreation opportunities. These reservoirs, especially Lake Powell, provide education, inspections, and requirements to prevent introduction of quagga and zebra mussel invasive species into the reservoirs. We recommend that the proponent identify and commit to measures to avoid introduction of invasive species by recreational watercraft usage of the reservoir. This is especially important due to the high quality of the downstream water and federally-listed species in addition to the maintenance of the irrigation and power-generating infrastructure associated with the project.
- The Draft Plan EA identifies that the beneficial summer flows would increase riparian habitat for the southwestern willow flycatcher. This statement implies certainty of a benefit. Due to the flash flood regime of the watershed, the document would benefit the reader with an analysis and discussion as to whether potentially new habitat growth would remain established in the downstream environment. If the habitat is not sustainable the beneficial impact may not be as effective as the Draft Plan EA proposes.

General:

The Draft Plan EA identifies the development of an approximately 4.1-acre recreation area. We recommend that BMPs be incorporated to prevent water quality impacts from disturbance and impacts to the watershed, reservoir and surrounding area by increased recreational activity.

The maps (Figures 1-2 and 1-3) would benefit from inclusion of the jurisdictional waterbodies in relationship to the proposed infrastructure. If any of the comments above warrant additional analysis and discussion (i.e. collective use of Jackson Flat and Cove Reservoirs), maps of the involved infrastructure and waterbodies would be useful for the reviewers.

Lastly, due to the general unknowns regarding the impacts (positive and negative) to the East Fork immediately downstream of the reservoir project infrastructure, the waterbody Category 1 designation, downstream federally-listed species and proximity to the Wild and Scenic designated segment of the Virgin River in Zion National Park, we recommend that the NRCS work with the proponent and other stakeholders (particularly Zion National Park, USFWS and the State of Utah) to develop a monitoring plan to ensure the high functioning nature of the East Fork and Virgin River is maintained should the Preferred Alternative be selected.

Closing

We appreciate your consideration of our comments. These comments are intended to help ensure a thorough assessment of the project's environmental impacts and an informed decision-making process. If further explanation of our comments is desired, please contact me at (303) 312-6704, or your staff may contact Matt Hubner at (303) 312-6500 or hubner.matt@epa.gov.

Sincerely,



Philip S. Strobel
Chief, NEPA Branch
Office of the Regional Administrator

cc: Emily Fife, NRCS State Conservation Engineer
Derek Hamilton, NRCS Water Resources Coordinator
Sue Nall, US Army Corps of Engineers
Brian Parker, Transcon Environmental

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04/26/2022

Ref: ORA-N

Norm Evenstad, Water Resources Coordinator
U.S. Department of Agriculture
Natural Resources Conservation Service
Wallace F. Bennett Federal Building, Room 4420
125 South State Street
Salt Lake City, Utah 84138-1100
Docket ID: NRCS-2022-0002
(Transmitted by email)

Dear Mr. Evenstad,

The U.S. Environmental Protection Agency Region 8 has completed a review of the Notice of Intent (NOI) for the Cove-East Fork Virgin River Watershed Plan Project Environmental Impact Statement (EIS) prepared by the USDA Natural Resources Conservation Service (NRCS). The following scoping comments were prepared in accordance with our responsibilities under the National Environmental Policy Act (NEPA).

The Project purpose is identified "to increase and maintain a reliable supply of water for local agricultural use and existing storage needs, increase water conservation, and improve water delivery efficiency in the Upper Virgin Watershed…" in Kane and Washington Counties, Utah. The Project proposes three alternatives, including the No Action Alternative. The other Proposed Alternatives include the construction of Cove Reservoir and construction of an alternative reservoir site.

EPA has identified the following key topics we recommend evaluating in the Draft EIS to fully understand the potential impacts to public health and the environment: (1) purpose and need, (2) alternatives, (3) water resources, (4) air resources, (5) mitigation, (6) threatened and endangered species, (7) construction and failure response, and (8) environmental justice and NHPA.

We appreciate your consideration of the enclosed comments. We are providing a copy of our December 22, 2020, Cove Reservoir Environmental Assessment (EA) comment letter. These comments remain valid for the NRCS to consider as it develops the Draft EIS with Cove Reservoir construction identified as the Preferred Alternative.

We value the opportunity to review and provide comments on the NOI. We look forward to working with you and will continue to provide Project assistance on the NEPA process and Clean Water Act (CWA) Section 404 guidelines related to the development of the Draft EIS. If further explanation of our comments is desired, please contact me at (303) 312-6500 or hubner.matt@epa.gov or Philip Strobel, Branch Chief, at (303) 312-6704 or strobel.philip@epa.gov.

Sincerely,

Matthew Hubner

Matthew "Matt" Hubner
Lead Reviewer, NEPA Branch

Enclosures

cc: Emily Fife, NRCS State Conservation Engineer
Derek Hamilton, NRCS Water Resources Coordinator
Jason Gipson, US Army Corps of Engineers
Brian Parker, Transcon Environmental

Enclosure 1. EPA Detailed Comments
Cove-East Fork Virgin River Watershed Plan Project

(1) Purpose and Need

We are pleased to see a better-defined purpose and need statement and the inclusion of an additional alternative in the NOI. We reiterate some of the following information to aid the NRCS in development of the EIS. The previous Cove Reservoir Environmental Assessment (EA) and current NOI documents indicate this Project will require a Clean Water Act Section 404 permit for impacts to aquatic resources. For the purpose of complying with both the CWA and NEPA, EPA recommends ensuring that the purpose and need statement is broad enough to encompass an appropriate range of both "reasonable" (per NEPA) and "practicable" (per CWA Section 404) alternatives to meet the basic (i.e., underlying) project purpose, including the proposed action and other available water supply and management options. A broad purpose and need statement allows for the analysis of a range of water supply alternatives without eliminating less environmentally damaging alternatives that may be considered practicable under the CWA Section 404 implementing regulations (e.g., water conservation and identification of existing nearby water supply sources). Developing an agency-coordinated purpose and need statement is critical prior to establishing subsequent screening criteria or identification of alternatives. Efforts to develop a purpose and need statement that meets the requirements of both NEPA and CWA Section 404 can provide for a more efficient regulatory process, while the use of a narrow project purpose to determine the scope of studies has the potential to result in the need to prepare additional NEPA documentation to meet NEPA and CWA Section 404 requirements.

When creating the Project purpose and need statement, we recommend that the Draft EIS describe the quantity of water that is needed above the current supply and the reasoning behind the need. The NOI Preferred Alternative identifies two different volumes for Cove Reservoir, which could be considered two independent alternatives should the impacts vary. Important considerations further include identifying project participants and recent growth projections (e.g., per State Demographer information) in the demand analysis and documenting existing use by each entity utilizing consistent methodology (e.g., gallons per day *or* gallons per capita). It is informative to describe current community master planning build-out scenarios (i.e., recreational, industrial, residential, or agricultural development plans) and boundaries and estimate demand for these scenarios. If available, it is also helpful to provide similar community-type demand estimates or ranges for comparison purposes. We also recommend quantifying potential reductions to current demand through the implementation of water resource infrastructure improvements and conservation measures within both the description of need and the proposed Project alternatives.

(2) Project Alternatives

For an alternative to be practicable, it must be reasonably available or obtainable and may include options beyond the authority of the lead agency. To assure that an alternative is permittable, it is essential that the Draft EIS include a range of alternatives with the goal of avoiding and minimizing impacts to waters of the U.S. while meeting the basic purpose of the action. We recommend that the Draft EIS summarize the regulatory criteria and processes utilized to develop the reasonable and practicable alternatives, including any environmental, logistical, technological, and cost criteria applied to identify and screen potential alternatives. Details of the reasoning used to screen or eliminate alternatives is valuable for understanding the decision process. As required by regulation, the rationale must be consistent with the practicability definition and criteria outlined in the preamble language of the CWA 404(b)(1) Guidelines (40 CFR § 230.10).

EPA recommends exploring a suite of structural and non-structural options to meet the underlying project purpose when considering a range of alternatives. A combination of non-structural and structural components could serve to meet the basic project purpose, and together may reflect a practicable alternative that is potentially less damaging than a single larger structural option. For example, assess to what extent the need for supplemental water supply could be reduced or resolved through conservation and for any remaining need, if it could be partially or fully met through temporary or permanent agreements for use of agricultural water rights, drought time water use restrictions, water reuse, conjunctive use of groundwater and surface water supplies, alternative development of additional storage, alternative storage sites within the basin, purchase of other water rights that may be less damaging to aquatic resources, blending raw water, regulating development in a service area, or a combination of these ideas. Because non-structural options (e.g., conservation, water rights leasing) may individually contribute less towards meeting the Project purpose than structural options (e.g., new or expanded reservoir storage), we recommend designing screening criteria so that these non-structural components are not eliminated solely on the basis of their potentially smaller individual contributions to meeting the Project purpose and need.

Baseline Environmental Conditions

When evaluating effects of alternatives, we recommend using existing environmental conditions as the baseline for comparison of impacts across all alternatives, including the No-action Alternative. Comparing the alternatives to existing conditions is important for understanding and quantifying each Alternative's impacts and potential benefits. This is especially true when there are environmental protections in place that are based on current conditions or special designations of downstream waterbodies such as the Wild and Scenic designation of the Virgin River in Zion National Park. EPA recommends that the NEPA analysis compare and present impacts to resources against the existing conditions baseline using a consistent method to measure project impacts on these critical resources for all alternatives. We recommend that NRCS consider the following when defining baseline conditions:

- Verify whether historical data (e.g., data 5 years or older) are representative of current conditions.
- Provide a detailed hydrologic analysis in diverted waterways and storage areas to adequately assess the Project's potential biological and geomorphic impacts. At a minimum, include wet, average, and dry year analyses at a daily time-step. Also consider potential influences of temperature and precipitation trends on future hydrology.
- Include resources directly impacted by the Project footprint within the geographic scope of analysis (i.e., reservoir locations and pipeline, canal and road routes), as well as the resources indirectly (or secondarily) impacted by the Project. These indirectly impacted areas may include downstream segments, source streams where water diversions will occur and any other resource areas which may be affected by changes in water management or operations.

(3) Water Resources

Analysis of Water Supply Reliability

We recommend including information on safe yields from streams and groundwater, water demand, and drought management. Reviewing previously conducted studies by the Institute for Water Resources of the Corps of Engineers may be useful (See "An Evaluation of the Risk of Water Shortages in the Lower Peninsula, Virginia," Revised Report, August 15, 2001, IWR Special Study, U.S. Army Corps of Engineers).

An evaluation of potential influences of climate change on the proposed Project is also a valuable

component for assessing water supply reliability. The Utah Department of Natural Resources has made projections on climate change attributed changes to annual temperatures and precipitation over the next century that would apply to the Project area (Khatri, K.B. and Strong, C., 2020 Climate Change, Water Resources, and Potential Adaptation Strategies in Utah. Utah Department of Natural Resources, https://water.utah.gov/water-data/water-reports/). Climate change influences on the Project may translate into modified design and operational assumptions for determining resource supplies, system demands, system performance requirements, and operational constraints (Brekke, L.D., Kiang, J.E., Olsen, J.R., Pulwarty, R.S., Raff, D.A., Turnipseed, D.P., Webb, R.S., and White, K.D., 2009 Climate change and water resources management – A federal perspective: U.S. Geological Survey Circular 1331, p.65). We recommend including an analysis of how climate change vulnerabilities have been incorporated into alternative selection and design in the Draft EIS and if or what additional work may be needed to address these points in the future within the watershed.

Water Quality Impacts

Should the Project modify water resources through operational changes, construction activities, placement of new infrastructure, increased diversion of water, or introduction of new water sources, we recommend the Draft EIS include an analysis of water quality that evaluates the following areas:

- Current and post-project water quality at a critical flow condition and expected changes to assimilative capacity or permit limits for any National Pollutant Discharge Elimination System (NPDES) or state discharge permits downstream of the diversion or impoundment. This analysis should include:
    - A comparison of current water quality, post-project water quality, and the applicable water quality standard (i.e., nutrient loads and temperature changes downstream in the East Fork Virgin River);
    - The utilization of state methods to assess water quality and determine water quality-based effluent limits;
    - An account of changes in background water quality for water quality modeling and determinations of assimilative capacity;
    - Water quality impairments per State CWA Section 303(d) lists, draft or established Total Maximum Daily Loads (TMDLs) and potentially affected dischargers;
    - Details of any water quality-limited segments within the affected area;
    - Source Water Protection Areas and an explanation of how the Project will be consistent with Source Water Protection planning measures;
    - Direct or indirect effects from the proposed borrow pit(s) on BLM land; and
    - Potentially affected water treatment providers and possible changes to treatment processes.

Groundwater

In assessing the potential impacts of an alternative on groundwater systems in the region of the Project site, EPA recommends that the Draft EIS examine the potential for changes in the volume, storage, flow and quality of ground water through data obtained from ground water resource characterization efforts and ground water use. Projected construction, operation, or maintenance of a project and its associated infrastructure may have significant impact on groundwater resources. EPA therefore recommends highlighting potential impacts to:

- Spring and seep emergences and their associated discharge rates and quality;
- Regional subsidence associated with groundwater withdrawal;
- Sensitive aquifers, sole source aquifers, drinking water well yield and quality; and

- Regional aquifer quality, aquifer quality near potential underground storage areas, and areas of groundwater/surface water exchange.

EPA recommends the NEPA analysis identify and discuss how groundwater will be protected or impacted by project activities and any changes in the system that may result from the implementation of an alternative. If the Project will impact groundwater, we recommend the analysis consider mitigation measures that:

- Avoid impacts on groundwater;
- Limit the degree or magnitude of impacts on groundwater;
- Reduce impacts by long-term maintenance operations;
- Repair or restore groundwater resources; and/or
- Compensate for groundwater impacts by replacement or substitution.

The EPA recommends the NEPA analysis include:

- A list of Best Management Practices (BMPs) that will be required to protect water resources;
- A discussion of the circumstances under which the BMPs would be applied (e.g., proximity to surface water resources, presence of erosive soils, slope, sensitive aquifers, spring emergences, etc.); and
- An explanation of how NRCS or another government entity would ensure that the BMPs would be monitored to ensure timely and correct implementation.

Streamflow

EPA recommends that the analysis of each alternative, with respect to the affected stream system(s), account for alterations of streamflow quantityand subsequent impacts to aquatic life. In order to understand Project effects on streams, include in the analysis any stream resources in the immediate Project area, downstream of the Project area, and any areas that would be affected by inundation, diversions, or operational modifications within the scope of the impact analysis. For the impact analysis we recommend selecting reaches based upon their representativeness of geographic scope and the type of modification.

To ensure that critical resources are considered and the scope of analysis is appropriate, we recommend conducting interagency coordination when selecting stream reaches. For example, it would be valuable to include consideration of species recovery areas, recreational areas, critical habitat for threatened or endangered species, Wild and Scenic designated segments, segments impaired per Section 303(d) of the CWA, segments for which TMDLs have been established, receiving waters for permitted dischargers, and source water protection areas for surface water intakes. We also recommend considering stream impacts regionally within the context of the cumulative analysis portion of the review. If an alternative will alter in-stream flow quantity, we recommend that the Draft EIS include analysis of the following:

- Quantify any existing diversions diversions into or out of the water sources affected by the Project;
- Present and compare pre- and post-project flows as characterized in Table 1 on the next page.
- Assess impacts to the flow regime with an emphasis on the implications of changes to channel complexity, channel maintenance, aquatic habitat availability, and life history adaptations which includes; and,
- Assess the cumulative effect to streams of past diversions, project diversions, and any reasonably foreseeable future diversions.

Table 1. Recommended flow metrics for pre- and post-project comparison		
Flow Type	**Description**	**Hydrologic Parameters**
Low-flow	Baseflow or dominant flow condition	Mean and median values for each month
High-flow Pulses	Flows during rainstorms or brief periods of snowmelt when flows exceed low-flow levels but are less than bankfull	Mean and median values of high flow pulse event: • Duration (days) • Peak flow (maximum flow during event) • Frequency (occurrence throughout water year)
Small Floods	Flows equal to or greater than bankfull flows (2-year flood) but less than the 10-year flood; these floods overtop the main channel but do not include more extreme, less frequent floods	Mean and median values of high flow pulse event: • Duration (days) • Peak flow (maximum flow during event) • Frequency (occurrence throughout water year)
Large Floods	Floods equal to or greater than the 10-year flood	Mean and median values of high flow pulse event: • Duration (days) • Peak flow (maximum flow during event) • Frequency (occurrence throughout water year)

- Impacts to stream morphology and sediment transport due to reservoir construction/expansion, changes in stream flow, or changes in land use including:
    - Identify affected riffle-pool complexes; and
    - Assess impacts from pre- and post-project flows to sediment transport, channel maintenance and channel complexity.
- Impacts to resident fish species and invertebrate assemblages which includes:
    - Baseline data regarding functional species composition, diversity, evenness, abundance, and, for macroinvertebrates, %EPT (Ephemeroptera, Plecoptera, and Trichoptera) and some characterization of flow preference. EPA's rapid bioassessment protocol, or a state-specific method, may be used to describe baseline habitat quality;
    - Characterization of shifts in species composition, impacts to less tolerant species, and changes in functional composition between current baseline and post-project environment;
    - Impacts to physical habitat, including availability, heterogeneity, connectivity, and long-term habitat maintenance;
    - Consideration of multiple metrics or factors that influence habitat such as loss of flushing flows, reduced floodplain connectivity, temperature, and changes to ecologically significant flows;
    - Analysis of aquatic resource impacts, which integrate any results from flow, stream morphology and water quality analyses;

- Impacts associated with reservoir construction/expansion and subsequent inundation and include quantification of lost aquatic and riparian habitat areas and impacts of conversion from lotic to lentic habitat types; and
- A description of mitigation measures for potentially adverse impacts to stream resources and aquatic life.

Protection of Wetlands and Riparian Areas

The protection and restoration of wetlands and riparian areas is a high priority. These resources increase landscape and species diversity, support many species of wildlife, and are critical to the protection of water quality and designated beneficial water uses. To illustrate effects to wetlands in the area, we recommend that the Draft EIS specifically include the following analyses or descriptions:

- Description of impacts under individual or nationwide permits authorizing the discharge of fill or dredge materials to waters of the U.S.;
- Clear maps, including wetland delineation and regional water features;
- Wetland delineation and descriptions, including ecological function analysis if there is any potential that an alternative will cause impacts;
- Analysis of the direct, indirect, and cumulative impacts to all wetlands in the geographic scope, including impacts to wetlands from changes in hydrology even if these wetlands are spatially removed from the construction footprint. Include in the analysis the indirect impacts to wetlands from loss of hydrology from water diversion/transfers and the cumulative impacts to wetlands from future development scenarios based on population and growth estimates;
- Detailed analysis of potentially adverse impacts to aquatic resources from reasonably foreseeable development;
- Impacts associated with infrastructure and reservoir construction/expansion and subsequent inundation with a quantification of lost aquatic and riparian habitat areas
- Specific and scientifically-derived evidence to support downstream increases to riparian habitat resulting from reservoir development as described in the EA; and
- An evaluation of specific mitigation requirements and BMPs applicable for construction, maintenance, and reclamation activities to prevent adverse impacts to aquatic resources downslope of the Project site.

We recommend that the Draft EIS demonstrate that the destruction, degradation, and modification of all wetlands, both jurisdictional and non-jurisdictional, is being avoided and minimized on federal land as outlined in EO 11990. It is the responsibility of NRCS to comply with EO 11990 for impacts on federal lands if any of the project alternatives cross into the surrounding BLM lands. This would involve mapping all wetlands within the project site, including springs and seeps, and assuring all avoidance measures are incorporated into the Project. If non-jurisdictional wetlands on federal lands are going to be impacted, offsetting mitigation efforts will also need to be incorporated.

(4) Air Resources

Protection of air quality is important to address in the Draft EIS. We recommend that the amount of stationary, mobile, and non-road source emission activities associated with construction, including hazardous air pollutants, be quantified and disclosed. We recommend evaluating and disclosing any air quality impacts and if necessary, identifying mitigation steps that will be taken to minimize associated adverse impacts. Components to be presented in the documentation include the existing air quality conditions in the Project vicinity, and an assessment of any impacts on National Ambient Air Quality Standards, Prevention of Significant Deterioration standards, and air quality related values or Air Quality Related Values. Also, to be addressed are particulate emissions from construction and ongoing

operation of maintenance or access roadways.

(5) Mitigation

EPA recommends that each alternative in the Draft EIS identify appropriate mitigation where impacts to water quality, air quality, stream morphology, or aquatic life are expected. The higher the uncertainty surrounding project impacts, the more emphasis there should be on providing mitigation details (including adaptive management) to assure protection of resources. At a minimum, include the following mitigation information in the Draft EIS:

- Identify the entity responsible for implementing each mitigation commitment;
- Define a mitigation effectiveness monitoring plan, including baseline monitoring if data are lacking;
- Define specific management decision points based upon protecting the minimum desired environmental conditions (thresholds) in the Project area which would trigger modification or improvement actions;
- Identify funding sources to sustain mitigation commitments.
- Establish mechanisms for public disclosure of the analysis and management decisions; and
- Ensure that mitigation details presented are consistent with the 2008 Rule on Compensatory Mitigation for Losses to Aquatic Resources for related impacts if a CWA 404 permit will be required.

(6) Special-Status and Threatened and Endangered Species

The Project area contains special status species, including the Virgin River chub and woundfin species at Pah Tempe Hot Springs, as well as the southwestern willow flycatcher. EPA recommends engaging the U.S. Fish and Wildlife Service (FWS) as early in the analysis as possible to assure that the proposed alternatives responsibly account for or are in compliance with the following:

- River restoration, flow and channel modifications, wetlands, and habitat fragmentation regarding species' habitat requirements;
- Migratory Bird Treaty Act;
- A management plan for surrounding land uses (e.g., pesticide, nutrient, weed, and recreation management), for new reservoir construction alternatives; and

To best inform decision-makers and the public, we recommend the Draft EIS:

- Summarize the status and trends of the Project area for threatened, endangered, and sensitive (TES) species and potential suitable habitat acreage;
- Disclose of any impacts to TES species and habitat resources (including habitat fragmentation) associated with the proposed Project;
- Include design criteria, mitigation, and monitoring measures developed in coordination with the FWS and State to ensure the proposed Project and resulting development do not negatively impact habitat for migratory birds, bald eagles, or other species; and
- Any FWS recommendations to reduce potential impacts to TES species from the proposed Project.

Invasive species

The EPA recommends that the Draft EIS analyze the Project's potential to increase the spread of invasive species. Invasive species in aquatic environments [i.e., zebra (*Dreissena polymorpha*) and quagga (*Dreissena bugensis*) mussels, tamarisk (*Tamarix* spp.), New Zealand mudsnail (*Potamopyrgus antipodarum),* and rusty crayfish (*Orconectes rusticus*)] have been documented across the United States and may apply to any new lands being converted into additional water storage. If the Project has the

potential to facilitate spread of invasive species, we recommend evaluation of the impacts to Special-Status and TES species as well as incorporating measures to prevent or mitigate those effects.

Proposed Alternative Construction
We recommend including specific information about water resource storage construction so that anticipated impacts can be considered when selecting between alternatives. These details include a description of the following factors:

- Structural specifications, materials, and locations;
- Anticipated support facilities including pipelines, canals, structural yards, maintenance buildings and roads, construction camps and materials sites;
- Anticipated temporary land use locations;
- Sensitive plant and animal life in the construction area; and
- Topography, geology, and surficial hydrology in the vicinity of each structure.

Based on these criteria, we recommend choosing structure locations and aesthetics for each alternative in cooperation with the municipalities of Kane and Washington Counties and any other relevant state or federal land managers.

Failure Response
We recommend the Draft EIS include an evaluation of potential adverse impacts from the structural failure of the potential constructed water storage alternatives. This evaluation should include potential adverse impacts to surface waters, public or private water supplies, human health, economics, vegetation, and wildlife. In this part of the analysis, it would be useful to discuss the probabilities and likely frequencies of different types and volumes of potential failure events over the life of each alternative and we expect that this information will be useful in determining future emergency transportation corridor locations.

(8) Environmental Justice and National Historic Preservation Act (NHPA)
According to our review of EJScreen data (https://www.epa.gov/ejscreen), there are people of color, low-income and indigenous communities within the geographic scope of the planning area. Executive Order 12898 – *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* – applies to federal agencies that conduct activities that substantially affect human health or the environment. In addition, Executive Order 13985 – *Advancing Racial Equity and Support for Underserved Communities Through the Federal Government* – sets expectations for a whole government approach to advancing equity for all. Consistent with these executive orders and CEQ's Environmental Justice Guidance Under NEPA (available along with other environmental justice resources at https://www.epa.gov/environmentaljustice/environmental-justice-and-national-environmental-policy-act), the EPA recommends the Draft EIS:

- Identify communities described above within the geographic scope of the impact area, including the sources of data and a description of the methodology and criteria utilized; and
- Document meaningful engagement of such communities with respect to NRCS's decisions on the reservoir selection and Watershed Plan. In particular, and consistent with the *Memorandum on Tribal Consultation and Strengthening Nation-to-Nation Relationships*, we recommend initiating Tribal Consultation. We also recommend discussing the role in the decision-making process of the tribes and individuals in whose beneficial interest the land is held in trust and notifying the Tribal Historic Preservation Officer if cultural or historical artifacts are found in the Project area (see comment below for more information).
- Assess environmental justice and other socioeconomic concerns for any people of color, low-

income, and indigenous communities, including:

- A discussion of the potential direct, indirect and cumulative environmental impacts of the proposed Project on the health of these communities, with consideration of any existing disproportionate impacts being experienced (e.g., if this Project would adversely impact water quality, aquatic ecosystem functions or air quality);
- An evaluation of the socioeconomic impacts to the local communities, including the potential for any additional burden placed on local communities' abilities to provide necessary public services and amenities (e.g., reservoir construction affecting existing recreational, spiritual or small business uses for communities and individuals that utilize the East Fork Virgin River. Further, creation of a new major recreation area may place a financial burden on marginalized communities if costs to use the lake are prohibitive to their use by these populations); and
- A determination of whether and how there may be disproportionately high and adverse human health or environmental effects, including cumulative impacts, associated with the proposed Project on the identified communities.

- Identify mitigation measures or alternatives to avoid or reduce any disproportionate adverse impacts. We recommend involving the affected communities in developing the measures. The EPA recognizes the need for early involvement of the local communities and supports the meaningful participation of community representatives in the NEPA process.

NHPA Consultation

We recommend the USFS conduct consultation under the NHPA with the Tribes, as well as the Tribal and State Historical Preservation Offices. It has been our experience that these contacts change frequently and must be verified with each action. To ensure that consultation requirements are met, provided below are two resources which are updated and maintained online:

- The National Association of Tribal Historic preservation Officers – Find a THPO https://www.nathpo.org/thpos/find-a-thpo/; and

- The National Conference of State Historic Preservation Offices – Directory https://ncshpo.org/directory/

We recommend that an updated contact list for THPOs and SHPOs be cited in the Draft EIS to provide the public with full disclosure on the consultation requirements under the NHPA.

Enclosure 2. EPA Comments on Cove Reservoir Draft Plan EA

We are enclosing a copy of our December 22, 2020, letter providing EPA's comments on the Draft Plan EA for Cove Reservoir. The purpose for including this letter is to reiterate comments that may continue to be applicable for the NRCS to evaluate during Draft EIS development considering the NOI identification of Cove Reservoir construction as the Preferred Alternative.

July 11, 2025

Matt Hubner
NEPA Reviewer: Transportation Lead
U.S. Environmental Protection Agency Region 8
1595 Wynkoop Street
Denver, Colorado 80202-1129

Submitted by email to hubner.matt@epa.gov

Subject: Preliminary Draft Biological Assessment for Cove-East Fork Virgin River Watershed Plan

Dear Mr. Huber:

On behalf of the Natural Resources Conservation Service (NRCS) we appreciate the time, effort, and expertise you provided in reviewing the Preliminary Draft Biological Assessment for the Cove-East Fork Virgin River Watershed Plan. The consideration extended by a cooperating agency to review our documents significantly improves their quality and clarity.

After a thorough review of the comments, we incorporated the content, as applicable, into the Preliminary Draft Biological Assessment. A Comment Response Table with rationale for addressing the responses is attached to this letter.

Please contact me directly if you have any questions about this information at (775) 296-0819 or eparis@eocene.com.

Sincerely,



Emily Paris
Project Manager
Eocene Environmental Group, Inc.

CC: Derek Hamilton, NRCS

Attachment: Comment Response Table

ATTACHMENT

Comment Number	Location	Comment	Response
1	Section 2.2.1 Page 3	This point is challenging to follow, It is unclear if this is identifying that water from the Virgin River will be used to fill the proposed reservoir during the summer months? The 3rd bullet below identifies that the proposed action would comply with the 1996 ZNP agreement; however, the summary of the agreement above indicates that "Surface water diversions to new reservoirs described above shall not occur except during the period from November 1 and May 31..." This would appear to preclude summertime diversions. Alternatively, this sentence could be read to mean that water released from Cove Reservoir and conveyed through the Virgin river would be diverted by HCC? We recommend this point we worded more clearly so the reader can easily understand the project components and how they will fully comply with the ZNP Agreement.	Text has been clarified. Water would be diverted to the reservoir during the non-irrigation season, November 1 - May 31. Water releases from the reservoir would occur in the summer months for irrigation, and year-round for M&I. All water released from the proposed reservoir would be diverted from the Virgin River at the Quail Creek Reservoir Diversion.
2	Section 2.2.1 Page 3	Having an undetermined M&I water demand as part of the project does not provide a basis for the project purpose and need for 6,750 acre feet of storage. It is important to know what is actually needed and why, because the more water is diverted and stored, the higher the impacts to the aquatic environment. Having an adequately quantified need is important for determining the range of alternatives. Even though this is a BA for ESA purposes, and EPA recommends the most conservative analysis of	An array of alternatives was evaluated for the project, including a smaller (3,000 acre-foot) reservoir. This alternative would meet the project purpose and need by providing agricultural and M&I water and is evaluated in full detail in the Plan-EIS. However, the smaller reservoir has a lower benefit-cost ratio of 0.90 versus the larger reservoir at 1.09. Therefore, the 6,055-acre foot reservoir was selected as the preferred alternative. Washington County Water Conservancy

Comment Number	Location	Comment	Response
		water use to support the conclusions of this analysis (i.e., the full amount of water authorized under the ZNP Agreement), we want to ensure that the NEPA analysis for this project adequately evaluates all feasible alternatives that can meet the project purpose and need. We recommend that the gap between M&I supply and demand from Washington County be determined so that a reasonable range of alternatives to reduce that gap, including conservation and efficiencies, can be analyzed in the Draft EIS. This should be done for agricultural needs as well.	District has adopted an aggressive water conservation goal established by the State of Utah in 2019, targeting a 14 percent reduction in per capita water use by 2030 (WCWCD, 2021). The following conservation measures are already in place, and WCWCD will continue to increase water usage efficiencies wherever possible: - Reduction in system water loss - Improvements to existing water conservation rate structure - AMI Meter Installation - Weather based irrigation controller rebates - CII building retrofits/water audits - Policy compliance - Education and training - Residential leak devices/flow sensors Per USFWS regulations, the BA is only required to analyzed the Preferred Alternative; therefore the 3,000 acre-foot reservoir is not analyzed in this document.
3	Section 6.2 Page 22	Based on review of this draft BA, it is unclear if the Draft EIS will evaluate changes to water quality from proposed reservoir releases to the EFVR and in downstream critical habitat for the Virgin River chub and woundfin. As noted in the environmental baseline sections above, the Virgin River chub and woundfin have been impacted by changes to water quality as well as quantity as a result of dams, reservoirs and water diversions. The BA did not consider the	The BA and the Plan-EIS do not identify any significant changes in water quality in Virgin River chub and woundfin habitat as no new water sources would be introduced into the EFVR. The ZNP Agreement ensures that water quality would not be impacted by maintaining controlled flow rates that prevent excessive sedimentation, nutrient loading, or changes in water temperature that could degrade the river's water quality or aquatic

Comment Number	Location	Comment	Response
		impacts of the proposed reservoir(s) on water quality. This may be problematic considering the water released from a new reservoir may result in different temperature profiles immediately downstream and increased nutrient loads (as well as increased concentrations of other constituents) in the EFVR and downstream. It is unclear if these changes could result in additive degradation of the critical habitat for these species even if they are removed from the project action by 4.8 miles. Because these species are highly specialized to their habitat, it is imperative to fully comprehend the potential impacts of activities upstream, such as this project. We recommend the Draft EIS as well as this BA consider the impacts of this proposed project as well as other activities within the watershed(s) that my be forthcoming or have been established since the development of the USFWS analyses cited in this document to best determine if this project could result in further impacts to these species.	habitats. Water diverted from the EFVR would be held in the reservoir and then returned to EFVR as needed. Changes in flows would be minor as discussed in the BA. Finally, the habitat for these species is located approximately 55 river miles downstream from the proposed reservoir. Water diversions at the Quail Creek Reservoir Diversion, located above Virgin River chub and woundfin habitat, would not exceed authorized Cove Reservoir releases. Therefore, no changes in river flows in Virgin River chub and woundfin habitat would result from implementation of the proposed project. Because the species' habitat is 55 miles downstream from the proposed reservoir, no changes in water temperatures or nutrient loading is anticipated to occur within woundfin and Virgin River chub habitat. Text has been added to the BA and EIS to describe this.

August 18, 2026

Matt Hubner
NEPA Reviewer: Transportation Lead
Environmental Protection Agency Region 8
1595 Wynkoop Street
Denver, Colorado 80202

Submitted by email to hubner.matt@epa.gov, Jensen.amanda@epa.gov, and dorian.david.l@epa.gov

Subject: Environmental Protection Agency Comment Response Table for Cove-East Fork Virgin River Watershed Plan

Dear Mr. Hubner:

On behalf of the Natural Resource Conservation Service, we sincerely appreciate the time and effort that has been devoted to reviewing the Watershed Plan Environmental Impact Statement (Plan-EIS) for Cove-East Fork Virgin River Watershed Project. The collaboration and valuable feedback provided during your review have contributed significantly to improving the quality, accuracy and clarity of the document. Following a thorough review of all comments received throughout the life of the Project, we have incorporated the recommendations and revisions, as applicable, in the Plan-EIS. A Comment Response Table is attached to this letter and provides a summary of the comments reviewed, along with the response on how each comment was addressed.

Please contact me directly if you have any questions about this information at (775) 296-0819 or eparis@eocene.com.

Sincerely,

Emily Paris
Project Manager
Eocene Environmental Group, Inc.

Attachment: Comment Response Table

ATTACHMENT

Comment Number	Location	Comment	Response
1	Scoping Comments (April 2022)	The U.S. Environmental Protection Agency Region 8 has completed a review of the Notice of Intent (NOI) for the Cove-East Fork Virgin River Watershed Plan Project Environmental Impact Statement (EIS) prepared by the USDA Natural Resources Conservation Service (NRCS). The following scoping comments were prepared in accordance with our responsibilities under the National Environmental Policy Act (NEPA). The Project purpose is identified “to increase and maintain a reliable supply of water for local agricultural use and existing storage needs, increase water conservation, and improve water delivery efficiency in the Upper Virgin Watershed…” in Kane and Washington Counties, Utah. The Project proposes three alternatives, including the No Action Alternative. The other Proposed Alternatives include the construction of Cove Reservoir and construction of an alternative reservoir site. EPA has identified the following key topics we recommend evaluating in the Draft EIS to fully understand the potential impacts to public health and the environment: (1) purpose and need, (2) alternatives, (3) water resources, (4) air resources, (5) mitigation, (6) threatened and endangered species, (7) construction and failure response, and (8) environmental justice and NHPA. We appreciate your consideration of the enclosed comments. We are providing a copy of our December 22, 2020, Cove Reservoir Environmental Assessment (EA) comment letter. These comments remain valid for the NRCS to consider as it develops the Draft EIS with Cove Reservoir construction identified as the Preferred Alternative. We value the opportunity to review and provide comments on the NOI. We look forward to working with you and will continue to provide Project assistance on the NEPA process and Clean Water Act (CWA) Section 404 guidelines related to the development of the Draft EIS. If further explanation of our comments is desired, please contact me at (303) 312-6500 or hubner.matt@epa.gov or Philip Strobel, Branch Chief, at (303) 312-6704 or strobel.philip@epa.gov.	Substantial text changes have been made since publication of the Draft Plan-EA. Many of these changes address concerns identified by EPA comments. No text changes are necessary for this comment. We have reviewed the EPA December 22, 2020, Environmental Assessment comment letter and have responded to the comments contained in that letter. No additional text changes are necessary.
2	Scoping Comments (April 2022)	(1) Purpose and Need We are pleased to see a better-defined purpose and need statement and the inclusion of an additional alternative in the NOI. We reiterate some of the following information to aid the NRCS in development of the EIS. The previous Cove Reservoir Environmental Assessment (EA) and current NOI documents indicate this Project will require a Clean Water Act Section 404 permit for impacts to aquatic resources. For the purpose of complying with both the CWA and NEPA, EPA recommends ensuring that the purpose and need statement is broad	The Purpose and Need Section of the Plan-EIS has been revised to include the concerns identified in this comment. Additionally, alternatives analyzed in the Plan-EIS are detailed in Section 4.2. Those alternatives eliminated from detailed study

Comment Number	Location	Comment	Response
		enough to encompass an appropriate range of both “reasonable” (per NEPA) and “practicable” (per CWA Section 404) alternatives to meet the basic (i.e., underlying) project purpose, including the proposed action and other available water supply and management options. A broad purpose and need statement allows for the analysis of a range of water supply alternatives without eliminating less environmentally damaging alternatives that may be considered practicable under the CWA Section 404 implementing regulations (e.g., water conservation and identification of existing nearby water supply sources). Developing an agency-coordinated purpose and need statement is critical prior to establishing subsequent screening criteria or identification of alternatives. Efforts to develop a purpose and need statement that meets the requirements of both NEPA and CWA Section 404 can provide for a more efficient regulatory process, while the use of a narrow project purpose to determine the scope of studies has the potential to result in the need to prepare additional NEPA documentation to meet NEPA and CWA Section 404 requirements. When creating the Project purpose and need statement, we recommend that the Draft EIS describe the quantity of water that is needed above the current supply and the reasoning behind the need. The NOI Preferred Alternative identifies two different volumes for Cove Reservoir, which could be considered two independent alternatives should the impacts vary. Important considerations further include identifying project participants and recent growth projections (e.g., per State Demographer information) in the demand analysis and documenting existing use by each entity utilizing consistent methodology (e.g., gallons per day or gallons per capita). It is informative to describe current community master planning build-out scenarios (i.e., recreational, industrial, residential, or agricultural development plans) and boundaries and estimate demand for these scenarios. If available, it is also helpful to provide similar community-type demand estimates or ranges for comparison purposes. We also recommend quantifying potential reductions to current demand through the implementation of water resource infrastructure improvements and conservation measures within both the description of need and the proposed Project alternatives.	are discussed in Section 4.3. Nonstructural alternatives are discussed in Section 4.2.3. Substantial text changes have been made since publication of the Draft Plan-EA. Many of these changes address concerns identified by EPA comments. No text changes are necessary for this comment.
3	Scoping Comments (April 2022)	**(2) Project Alternatives** For an alternative to be practicable, it must be reasonably available or obtainable and may include options beyond the authority of the lead agency. To assure that an alternative is permittable, it is essential that the	The suggestions provided by this comment have been responded to and are discussed in the Plan-EIS. Alternatives analyzed in the

Comment Number	Location	Comment	Response
		Draft EIS include a range of alternatives with the goal of avoiding and minimizing impacts to waters of the U.S. while meeting the basic purpose of the action. We recommend that the Draft EIS summarize the regulatory criteria and processes utilized to develop the reasonable and practicable alternatives, including any environmental, logistical, technological, and cost criteria applied to identify and screen potential alternatives. Details of the reasoning used to screen or eliminate alternatives is valuable for understanding the decision process. As required by regulation, the rationale must be consistent with the practicability definition and criteria outlined in the preamble language of the CWA 404(b)(1) Guidelines (40 CFR § 230.10). EPA recommends exploring a suite of structural and non-structural options to meet the underlying project purpose when considering a range of alternatives. A combination of non-structural and structural components could serve to meet the basic project purpose, and together may reflect a practicable alternative that is potentially less damaging than a single larger structural option. For example, assess to what extent the need for supplemental water supply could be reduced or resolved through conservation and for any remaining need, if it could be partially or fully met through temporary or permanent agreements for use of agricultural water rights, drought time water use restrictions, water reuse, conjunctive use of groundwater and surface water supplies, alternative development of additional storage, alternative storage sites within the basin, purchase of other water rights that may be less damaging to aquatic resources, blending raw water, regulating development in a service area, or a combination of these ideas. Because non-structural options (e.g., conservation, water rights leasing) may individually contribute less towards meeting the Project purpose than structural options (e.g., new or expanded reservoir storage), we recommend designing screening criteria so that these non-structural components are not eliminated solely on the basis of their potentially smaller individual contributions to meeting the Project purpose and need.	Plan-EIS are detailed in Section 4.2. Those alternatives eliminated from detailed study are discussed in Section 4.3. Nonstructural alternatives are discussed in Section 4.2.3. Alternative dam site locations are restricted by the Zion National Park Agreement of 1996 which drives this project. The Cove Reservoir site is one of the sites approved in the Agreement. Substantial text changes have been made since publication of the Draft Plan-EA. many of these changes address concerns identified by EPA comments. No text changes are necessary for this comment.
4	Scoping Comments (April 2022)	**Baseline Environmental Conditions** When evaluating effects of alternatives, we recommend using existing environmental conditions as the baseline for comparison of impacts across all alternatives, including the No-action Alternative. Comparing the alternatives to existing conditions is important for understanding and quantifying each Alternative's impacts and potential benefits. This is	The existing environmental resource baseline is clearly identified in Section 3 of the Plan-EIS. (Affected Environment: Current and Future Conditions). It is made clear in

Comment Number	Location	Comment	Response
		especially true when there are environmental protections in place that are based on current conditions or special designations of downstream waterbodies such as the Wild and Scenic designation of the Virgin River in Zion National Park. EPA recommends that the NEPA analysis compare and present impacts to resources against the existing conditions baseline using a consistent method to measure project impacts on these critical resources for all alternatives. We recommend that NRCS consider the following when defining baseline conditions: • Verify whether historical data (e.g., data 5 years or older) are representative of current conditions. • Provide a detailed hydrologic analysis in diverted waterways and storage areas to adequately assess the Project's potential biological and geomorphic impacts. At a minimum, include wet, average, and dry year analyses at a daily time-step. Also consider potential influences of temperature and precipitation trends on future hydrology. • Include resources directly impacted by the Project footprint within the geographic scope of analysis (i.e., reservoir locations and pipeline, canal and road routes), as well as the resources indirectly (or secondarily) impacted by the Project. These indirectly impacted areas may include downstream segments, source streams where water diversions will occur and any other resource areas which may be affected by changes in water management or operations.	Section 3 text that this information serves as a baseline for impact analysis. Historical data identified in the Plan-EIS are relevant to current conditions. Wet, average, and dry years have been identified (see Water Model and other Reports prepared for the Plan-EIS) and applied to the impact analysis. Direct and indirect impacts have been identified. No additional text changes are required.
5	Scoping Comments (April 2022)	**(3) Water Resources** Analysis of Water Supply Reliability We recommend including information on safe yields from streams and groundwater, water demand, and drought management. Reviewing previously conducted studies by the Institute for Water Resources of the Corps of Engineers may be useful (See "An Evaluation of the Risk of Water Shortages in the Lower Peninsula, Virginia," Revised Report, August 15, 2001, IWR Special Study, U.S. Army Corps of Engineers). An evaluation of potential influences of climate change on the proposed Project is also a valuable component for assessing water supply reliability. The Utah Department of Natural Resources has made projections on climate change attributed changes to annual temperatures and precipitation over the next century that would apply to the Project area (Khatri, K.B. and Strong, C., 2020 Climate Change, Water Resources, and Potential Adaptation Strategies in Utah. Utah Department of Natural Resources, https://water.utah.gov/water-	The yields from streams and groundwater and been analyzed. No changes in groundwater is anticipated. A certain amount of EFVR stream flow would be diverted to the proposed reservoir during winter months but returned to the stream as needed. In compliance with an Executive Order, climate change discussions have either been removed from the Plan-EIS or modified to climate variations. No additional text changes are required.

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		data/water-reports/). Climate change influences on the Project may translate into modified design and operational assumptions for determining resource supplies, system demands, system performance requirements, and operational constraints (Brekke, L.D., Kiang, J.E., Olsen, J.R., Pulwarty, R.S., Raff, D.A., Turnipseed, D.P., Webb, R.S., and White, K.D., 2009 Climate change and water resources management – A federal perspective: U.S. Geological Survey Circular 1331, p.65). We recommend including an analysis of how climate change vulnerabilities have been incorporated into alternative selection and design in the Draft EIS and if or what additional work may be needed to address these points in the future within the watershed.	
6	Scoping Comments (April 2022)	**Water Quality Impacts** Should the Project modify water resources through operational changes, construction activities, placement of new infrastructure, increased diversion of water, or introduction of new water sources, we recommend the Draft EIS include an analysis of water quality that evaluates the following areas: • Current and post-project water quality at a critical flow condition and expected changes to assimilative capacity or permit limits for any National Pollutant Discharge Elimination System (NPDES) or state discharge permits downstream of the diversion or impoundment. This analysis should include: o A comparison of current water quality, post-project water quality, and the applicable water quality standard (i.e., nutrient loads and temperature changes downstream in the East Fork Virgin River); o The utilization of state methods to assess water quality and determine water quality-based effluent limits; o An account of changes in background water quality for water quality modeling and determinations of assimilative capacity; o Water quality impairments per State CWA Section 303(d) lists, draft or established Total Maximum Daily Loads (TMDLs) and potentially affected dischargers; o Details of any water quality-limited segments within the affected area; o Source Water Protection Areas and an explanation of how the Project will be consistent with Source Water Protection planning measures; o Direct or indirect effects from the proposed borrow pit(s) on BLM land; and o Potentially affected water treatment providers and possible changes to treatment processes.	Potential impacts to surface and ground water were analyzed in the Plan-EIS. The current status of EFVR water quality is described in Section 3.2.2.2. Section 5.2.2.2 identified potential impacts to water quality resulting from project development. No construction would occur within the EFVR/ No pollutants would enter the EFVR as a result of construction activities. Changes in flow during project operation would be minor and not affect water quality. Use of the borrow pits would not affect the EFVR. Coordination with the Utah Division of Water Quality has occurred throughout the Plan-EIS development process. No additional text changes are required.

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7	Scoping Comments (April 2022)	**Groundwater** In assessing the potential impacts of an alternative on groundwater systems in the region of the Project site, EPA recommends that the Draft EIS examine the potential for changes in the volume, storage, flow and quality of ground water through data obtained from ground water resource characterization efforts and ground water use. Projected construction, operation, or maintenance of a project and its associated infrastructure may have significant impact on groundwater resources. EPA therefore recommends highlighting potential impacts to: • Spring and seep emergences and their associated discharge rates and quality; • Regional subsidence associated with groundwater withdrawal; • Sensitive aquifers, sole source aquifers, drinking water well yield and quality; and • Regional aquifer quality, aquifer quality near potential underground storage areas, and areas of groundwater/surface water exchange. EPA recommends the NEPA analysis identify and discuss how groundwater will be protected or impacted by project activities and any changes in the system that may result from the implementation of an alternative. If the Project will impact groundwater, we recommend the analysis consider mitigation measures that: • Avoid impacts on groundwater; • Limit the degree or magnitude of impacts on groundwater; • Reduce impacts by long-term maintenance operations; • Repair or restore groundwater resources; and/or • Compensate for groundwater impacts by replacement or substitution. The EPA recommends the NEPA analysis include: • A list of Best Management Practices (BMPs) that will be required to protect water resources; • A discussion of the circumstances under which the BMPs would be applied (e.g., proximity to surface water resources, presence of erosive soils, slope, sensitive aquifers, spring emergences, etc.); and • An explanation of how NRCS or another government entity would ensure that the BMPs would be monitored to ensure timely and correct implementation.	Groundwater was a concern identified during scoping. However, it was determined that there would be no measurable change to ground water resources resulting from Project development. It is further made clear that all federal, state, and local laws/regulations pertaining to pollution and contamination of the environment would be followed to prevent pollution of surface water, groundwater, soil, and air with any hazardous materials. No additional text changes are necessary.
8	Scoping Comments (April 2022)	**Streamflow** EPA recommends that the analysis of each alternative, with respect to the affected stream system(s), account for alterations of streamflow quantity and subsequent impacts to aquatic life. In order to understand Project	A Water Model has been developed for the Proposed Project. It has been determined that any changes in streamflow

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		effects on streams, include in the analysis any stream resources in the immediate Project area, downstream of the Project area, and any areas that would be affected by inundation, diversions, or operational modifications within the scope of the impact analysis. For the impact analysis we recommend selecting reaches based upon their representativeness of geographic scope and the type of modification. To ensure that critical resources are considered and the scope of analysis is appropriate, we recommend conducting interagency coordination when selecting stream reaches. For example, it would be valuable to include consideration of species recovery areas, recreational areas, critical habitat for threatened or endangered species, Wild and Scenic designated segments, segments impaired per Section 303(d) of the CWA, segments for which TMDLs have been established, receiving waters for permitted dischargers, and source water protection areas for surface water intakes. We also recommend considering stream impacts regionally within the context of the cumulative analysis portion of the review. If an alternative will alter in-stream flow quantity, we recommend that the Draft EIS include analysis of the following: • Quantify any existing diversions into or out of the water sources affected by the Project; • Present and compare pre- and post-project flows as characterized in Table 1 on the next page. • Assess impacts to the flow regime with an emphasis on the implications of changes to channel complexity, channel maintenance, aquatic habitat availability, and life history adaptations which includes; and, • Assess the cumulative effect to streams of past diversions, project diversions, and any reasonably foreseeable future diversions.	would be minor. As a result, it has been determined that threatened or endangered species (and their habitat), recreation areas, wild and scenic rivers, etc. would not be significantly affected. Close consultation with USFWS has been maintained throughout the Plan-EIS development process. Present and post-project flows have been identified in the Water Model. Cumulative effects to the EFVR have been determined to be minor. No additional text changes are necessary.
9	Scoping Comments (April 2022)	Include analysis of the following: - SEE TABLE OF FLOW METRICS • Impacts to stream morphology and sediment transport due to reservoir construction/expansion, changes in stream flow, or changes in land use including: o Identify affected riffle-pool complexes; and o Assess impacts from pre- and post-project flows to sediment transport, channel maintenance and channel complexity. • Impacts to resident fish species and invertebrate assemblages which includes: o Baseline data regarding functional species composition, diversity,	The issues identified in this comment have been analyzed and discussed in the Plan-EIS as appropriate. Because only minor changes in EFVR streamflow are anticipated, impacts would not rise to the level requiring in depth analysis of some of the issues identified here. For example, it is not anticipated that there would be any changes in stream

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		evenness, abundance, and, for macroinvertebrates, %EPT (Ephemeroptera, Plecoptera, and Trichoptera) and some characterization of flow preference. EPA's rapid bioassessment protocol, or a state specific method, may be used to describe baseline habitat quality; o Characterization of shifts in species composition, impacts to less tolerant species, and changes in functional composition between current baseline and post-project environment; o Impacts to physical habitat, including availability, heterogeneity, connectivity, and long term habitat maintenance; o Consideration of multiple metrics or factors that influence habitat such as loss of flushing flows, reduced floodplain connectivity, temperature, and changes to ecologically significant flows; o Analysis of aquatic resource impacts, which integrate any results from flow, stream morphology and water quality analyses; • Impacts associated with reservoir construction/expansion and subsequent inundation and include quantification of lost aquatic and riparian habitat areas and impacts of conversion from lotic to lentic habitat types; and • A description of mitigation measures for potentially adverse impacts to stream resources and aquatic life.	morphology. riffle-pool complexes, channel complexity, macroinvertebrates, etc. Because the reservoir would be constructed off stream, no impacts are anticipated to any aquatic or riparian resources during construction. In depth analyses of resident fish species and other rare species are contained in the Plan-EIS. Substantial text changes have occurred since publication of the Draft Plan-EA. No additional text changes are necessary.
10	Scoping Comments (April 2022)	The protection and restoration of wetlands and riparian areas is a high priority. These resources increase landscape and species diversity, support many species of wildlife, and are critical to the protection of water quality and designated beneficial water uses. To illustrate effects to wetlands in the area, we recommend that the Draft EIS specifically include the following analyses or descriptions: • Description of impacts under individual or nationwide permits authorizing the discharge of fill or dredge materials to waters of the U.S.; • Clear maps, including wetland delineation and regional water features; • Wetland delineation and descriptions, including ecological function analysis if there is any potential that an alternative will cause impacts;	Wetlands and riparian areas have been identified in the Plan-EIS and potential impacts have been analyzed in section 3.2.2.4 and section 5.2.4. The preferred alternative would impact approximately 0.274 acres of jurisdictional wetlands and/or waters of the U.S. Impacts to riparian vegetation are discussed in Section 3.2.4.7 and

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		• Analysis of the direct, indirect, and cumulative impacts to all wetlands in the geographic scope, including impacts to wetlands from changes in hydrology even if these wetlands are spatially removed from the construction footprint. Include in the analysis the indirect impacts to wetlands from loss of hydrology from water diversion/transfers and the cumulative impacts to wetlands from future development scenarios based on population and growth estimates; • Detailed analysis of potentially adverse impacts to aquatic resources from reasonably foreseeable development; • Impacts associated with infrastructure and reservoir construction/expansion and subsequent inundation with a quantification of lost aquatic and riparian habitat areas • Specific and scientifically-derived evidence to support downstream increases to riparian habitat resulting from reservoir development as described in the EA; and • An evaluation of specific mitigation requirements and BMPs applicable for construction, maintenance, and reclamation activities to prevent adverse impacts to aquatic resources downslope of the Project site. We recommend that the Draft EIS demonstrate that the destruction, degradation, and modification of all wetlands, both jurisdictional and non-jurisdictional, is being avoided and minimized on federal land as outlined in EO 11990. It is the responsibility of NRCS to comply with EO 11990 for impacts on federal lands if any of the project alternatives cross into the surrounding BLM lands. This would involve mapping all wetlands within the project site, including springs and seeps, and assuring all avoidance measures are incorporated into the Project. If non-jurisdictional wetlands on federal lands are going to be impacted, offsetting mitigation efforts will also need to be incorporated.	Section 5.4.7. Consultation with the USACE has been ongoing throughout the life of the project and is documented throughout the Plan-EIS. No text changes are required. .
11	Scoping Comments (April 2022)	**(4) Air Resources** Protection of air quality is important to address in the Draft EIS. We recommend that the amount of stationary, mobile, and non-road source emission activities associated with construction, including hazardous air pollutants, be quantified and disclosed. We recommend evaluating and disclosing any air quality impacts and if necessary, identifying mitigation steps that will be taken to minimize associated adverse impacts. Components to be presented in the documentation include the existing air quality conditions in the Project vicinity, and an assessment of any impacts on National Ambient Air Quality Standards, Prevention of Significant Deterioration standards, and air quality related values or Air	Air Quality is discussed in detail in the Plan-EIS, particularly potential impacts that could occur during construction. No impacts are anticipated during operational or maintenance activities. It was determined that due to the short construction duration and the implementation of best management practices, no state or federal air quality

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		Quality Related Values. Also, to be addressed are particulate emissions from construction and ongoing operation of maintenance or access roadways.	standards would be violated. Section 3.2.3 discusses the current air quality of the Project area and Section 5.3 address potential impacts to air quality resulting from project development. No additional text changes are necessary.
12	Scoping Comments (April 2022)	**(5) Mitigation** EPA recommends that each alternative in the Draft EIS identify appropriate mitigation where impacts to water quality, air quality, stream morphology, or aquatic life are expected. The higher the uncertainty surrounding project impacts, the more emphasis there should be on providing mitigation details (including adaptive management) to assure protection of resources. At a minimum, include the following mitigation information in the Draft EIS: • Identify the entity responsible for implementing each mitigation commitment; • Define a mitigation effectiveness monitoring plan, including baseline monitoring if data are lacking; • Define specific management decision points based upon protecting the minimum desired environmental conditions (thresholds) in the Project area which would trigger modification or improvement actions; • Identify funding sources to sustain mitigation commitments. • Establish mechanisms for public disclosure of the analysis and management decisions; and • Ensure that mitigation details presented are consistent with the 2008 Rule on Compensatory Mitigation for Losses to Aquatic Resources for related impacts if a CWA 404 permit will be required.	Appropriate mitigation has been incorporated as part of the proposed action. Additionally, best management practices and applicant committed conservation measures have been included in the Plan-EIS. Impact analysis assumes that all these measures will be incorporated into Project development.
13	Scoping Comments (April 2022)	**(6) Special-Status and Threatened and Endangered Species** The Project area contains special status species, including the Virgin River chub and woundfin species at Pah Tempe Hot Springs, as well as the southwestern willow flycatcher. EPA recommends engaging the U.S. Fish and Wildlife Service (FWS) as early in the analysis as possible to assure that the proposed alternatives responsibly account for or are in compliance with the following: • River restoration, flow and channel modifications, wetlands, and habitat fragmentation regarding species' habitat requirements; • Migratory Bird Treaty Act;	Consultation has been maintained with USFWS throughout the Plan-EIS development process. The USFWS IPaC site was accessed to identify listed species and migratory birds that may occur within the Project area. A biological assessment has been prepared and is in the process of

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		• A management plan for surrounding land uses (e.g., pesticide, nutrient, weed, and recreation management), for new reservoir construction alternatives; and To best inform decision-makers and the public, we recommend the Draft EIS: • Summarize the status and trends of the Project area for threatened, endangered, and sensitive (TES) species and potential suitable habitat acreage; • Disclose of any impacts to TES species and habitat resources (including habitat fragmentation) associated with the proposed Project; • Include design criteria, mitigation, and monitoring measures developed in coordination with the FWS and State to ensure the proposed Project and resulting development do not negatively impact habitat for migratory birds, bald eagles, or other species; and • Any FWS recommendations to reduce potential impacts to TES species from the proposed Project.	being submitted to USFWS. Identification and analysis of listed threatened, endangered, and other sensitive plant and animal species are found in Sections 3.2.4 and 5.4. Other USFWS related discussions are found in Sections 6.5.1.1, 7.1.2 and in Table 7.1. No additional text changes are required.
14	Scoping Comments (April 2022)	**Invasive species** The EPA recommends that the Draft EIS analyze the Project's potential to increase the spread of invasive species. Invasive species in aquatic environments [i.e., zebra (Dreissena polymorpha) and quagga (Dreissena bugensis) mussels, tamarisk (Tamarix spp.), New Zealand mudsnail (Potamopyrgus antipodarum), and rusty crayfish (Orconectes rusticus)] have been documented across the United States and may apply to any new lands being converted into additional water storage. If the Project has the potential to facilitate spread of invasive species, we recommend evaluation of the impacts to Special-Status and TES species as well as incorporating measures to prevent or mitigate those effects.	Invasive plant and animal species are identified and discussed in the Plan-EIS. Invasive species are identified in Section 3.2.4.5 and 3.2.4.7 and potential invasive species impacts are discussed in Section 5.4.5. No additional text changes are required.
15	Scoping Comments (April 2022)	**Proposed Alternative Construction** We recommend including specific information about water resource storage construction so that anticipated impacts can be considered when selecting between alternatives. These details include a description of the following factors: • Structural specifications, materials, and locations; • Anticipated support facilities including pipelines, canals, structural yards, maintenance buildings and roads, construction camps and materials sites; • Anticipated temporary land use locations; • Sensitive plant and animal life in the construction area; and • Topography, geology, and surficial hydrology in the vicinity of each	Specific information regarding construction, support facilities and locations, and temporary land use locations (e.g. borrow pits) locations have all been added to the Plan-EIS discussion (See Section 4.2.2.1). Sensitive plant and animal species that may occur within the Project area are also identified and analyzed (See Sections 3.2.4 and 5.4). Visual

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		structure. Based on these criteria, we recommend choosing structure locations and aesthetics for each alternative in cooperation with the municipalities of Kane and Washington Counties and any other relevant state or federal land managers.	resources are discussed and analyzed in Sections 3.2.5.4 and 5.5.4. No additional text changes are required.
16	Scoping Comments (April 2022)	**Failure Response** We recommend the Draft EIS include an evaluation of potential adverse impacts from the structural failure of the potential constructed water storage alternatives. This evaluation should include potential adverse impacts to surface waters, public or private water supplies, human health, economics, vegetation, and wildlife. In this part of the analysis, it would be useful to discuss the probabilities and likely frequencies of different types and volumes of potential failure events over the life of each alternative and we expect that this information will be useful in determining future emergency transportation corridor locations.	Potential structural failure response discussion is included in the Plan_EIS. The discussion includes identification of inundation zones, number of homes, other building, agricultural areas, and roads that would be at risk have all been identified.
17	Scoping Comments (April 2022)	**(8) Environmental Justice and National Historic Preservation Act (NHPA)** According to our review of EJ Screen data (https://www.epa.gov/ejscreen), there are people of color, low-income and indigenous communities within the geographic scope of the planning area. Executive Order 12898 – Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations – applies to federal agencies that conduct activities that substantially affect human health or the environment. In addition, Executive Order 13985 – Advancing Racial Equity and Support for Underserved Communities Through the Federal Government – sets expectations for a whole government approach to advancing equity for all. Consistent with these executive orders and CEQ's Environmental Justice Guidance Under NEPA (available along with other environmental justice resources at https://www.epa.gov/environmentaljustice/environmental-justice-and-national-environmental-policy-act), the EPA recommends the Draft EIS: • Identify communities described above within the geographic scope of the impact area, including the sources of data and a description of the methodology and criteria utilized; and • Document meaningful engagement of such communities with respect to NRCS's decisions on the reservoir selection and Watershed Plan. In particular, and consistent with the Memorandum on Tribal Consultation and Strengthening Nation-to-Nation Relationships, we recommend initiating Tribal Consultation. We also recommend discussing the role in	Current guidance (Executive orders 14148, 14173, and 14151) prohibits an Environmental Justice discussion in the Plan-EIS; therefore, that discussion has been removed from the document. Consultation between the Natural Resources Conservation Service (NRCS), Individual Tribal Nations, Utah State Historic Preservation Officer (SHPO) regarding compliance with Section 106 of the National Historic Preservation Act has occurred. See Sections 3.2.5.1 and 5.5.1 for details. No text changes are required.

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		the decision-making process of the tribes and individuals in whose beneficial interest the land is held in trust and notifying the Tribal Historic Preservation Officer if cultural or historical artifacts are found in the Project area (see comment below for more information). • Assess environmental justice and other socioeconomic concerns for any people of color, low-income, and indigenous communities, including: o A discussion of the potential direct, indirect and cumulative environmental impacts of the proposed Project on the health of these communities, with consideration of any existing disproportionate impacts being experienced (e.g., if this Project would adversely impact water quality, aquatic ecosystem functions or air quality); o An evaluation of the socioeconomic impacts to the local communities, including the potential for any additional burden placed on local communities' abilities to provide necessary public services and amenities (e.g., reservoir construction affecting existing recreational, spiritual or small business uses for communities and individuals that utilize the East Fork Virgin River. Further, creation of a new major recreation area may place a financial burden on marginalized communities if costs to use the lake are prohibitive to their use by these populations); and o A determination of whether and how there may be disproportionately high and adverse human health or environmental effects, including cumulative impacts, associated with the proposed Project on the identified communities. • Identify mitigation measures or alternatives to avoid or reduce any disproportionate adverse impacts. We recommend involving the affected communities in developing the measures. The EPA recognizes the need for early involvement of the local communities and supports the meaningful participation of community representatives in the NEPA process.	
18	Scoping Comments (April 2022)	**NHPA Consultation** We recommend the USFS conduct consultation under the NHPA with the Tribes, as well as the Tribal and State Historical Preservation Offices. It has been our experience that these contacts change frequently and must be verified with each action. To ensure that consultation requirements are met, provided below are two resources which are updated and maintained online: • The National Association of Tribal Historic preservation Officers – Find a THPO https://www.nathpo.org/thpos/find-a-thpo/, and	See response to comment 17 above. Consultation between the Natural Resources Conservation Service (NRCS), Individual Tribal Nations, Utah State Historic Preservation Officer (SHPO) regarding compliance with Section 106 of the National Historic Preservation Act has occurred. See Sections 3.2.5.1

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		• The National Conference of State Historic Preservation Offices – Directory https://ncshpo.org/directory/ We recommend that an updated contact list for THPOs and SHPOs be cited in the Draft EIS to provide the public with full disclosure on the consultation requirements under the NHPA.	and 5.5.1 for details. No text changes are required.
19	Scoping Comments (April 2022)	**Enclosure 2. EPA Comments on Cove Reservoir Draft Plan EA** We are enclosing a copy of our December 22, 2020, letter providing EPA's comments on the Draft Plan EA for Cove Reservoir. The purpose for including this letter is to reiterate comments that may continue to be applicable for the NRCS to evaluate during Draft EIS development considering the NOI identification of Cove Reservoir construction as the Preferred Alternative. The U.S. Environmental Protection Agency Region 8 has reviewed the USDA Natural Resource Conservation Service's November 25, 2020, Draft Plan Environmental Assessment (EA) for the Cover Reservoir Watershed Project. The NRCS has prepared a Draft Plan EA primarily to address summer agricultural irrigation shortages for nearby farms in the watershed. The Draft Plan EA identifies two alternatives for consideration; the Preferred Alternative to construct a dam at the Cove Reservoir site with a 6,055 acre-feet storage capacity and the No Action alternative. In accordance with our responsibilities under the National Environmental Policy Act (NEPA), we are providing the following comments on purpose and need, water quality and aquatic resources, as well as general feedback for consideration as you move into the next phase of NEPA development.	The comments from the December 22, 2020, letter have been reviewed and responded to. An additional alternative (a 3,000 acre-foot reservoir) has been added to the Plan-EIS for analysis. No additional text changes are necessary.
20	Scoping Comments (April 2022)	**Project Purpose and Need:** The Draft Plan EA identifies that the primary purpose of the project is to capture high winter flows in storage in order to fulfill the need to provide additional water to irrigators during low-flow summer months. The ancillary purposes of this project based on the preferred alternative selection are to create recreation opportunities, relocate and upgrade the Glendale hydroelectric power plant, and generate consistent summer flows to enhance downstream habitat for threatened and endangered species. The Draft Plan EA discusses alternatives that were considered but screened out, leaving construction of a new dam at the Cove Reservoir site as the single preferred action. Because the Draft Plan EA identifies that Cove Reservoir will likely require a Clean Water Act (CWA)	See response to Comment #2. Additionally, a 3,000-acre-foot reservoir alternative has been added to the Plan-EIS for analysis. See response to Comment #2. Additionally, a 3,00-acre-foot reservoir alternative has been added to the Plan-EIS for analysis. The Plan-EIS clearly identifies the status of project site land purchases by KCWCD. No

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		Section 404 individual permit for impacts to waterbodies in the proposed reservoir footprint, we recommend that 404 processes and NEPA be merged to increase efficiency. As such, 404 permitting requires that all feasible alternatives be evaluated to determine that the selected alternative is the least environmentally damaging practicable alternative (LEDPA). Our review indicates at least one feasible alternative that would provide approximately 3,000 acre-feet of storage was screened out from evaluation in the Draft Plan EA due to cost, and other alternatives, including non-construction actions (e.g. conservation and modified irrigation practices), were not considered as they did not meet water storage requirements of the purpose and need. We recognize that some alternatives were screened out due to unfavorable conditions, but we recommend that all feasible alternatives be evaluated if they can meet the primary goal of providing additional water needs for existing agriculture activity in the project area. Providing this information will increase the efficiency of CWA 404 permitting in addition to completing a robust analysis for NEPA purposes. We recommend that discussions on purpose and need clearly indicate that the Cove Reservoir location has already been purchased by the Kane County Water Conservation District (proponent). It is not immediately clear in the documentation how the existing land acquisition is factored in the alternatives screening cost evaluation. This information will be relevant for CWA 404 permitting and determining if the preferred alternative is the LEDPA.	additional text changes are necessary.
21	Scoping Comments (April 2022)	**Water Quality and Aquatic Resources:** Cove Reservoir would utilize diversion of peak flows from the East Fork Virgin River (East Fork) during winter to fill the pool. The East Fork is classified by the State of Utah as a Category 1 high functioning surface waterbody under its antidegradation policy and is currently assessed as unimpaired. As such, activities in or near the waterbody that could result in degradation should be scrutinized and avoided. The Draft Plan EA determines that no change in water quality would occur as a result of Cove Reservoir. Our review of the Draft Plan EA resulted in the following observations that we recommend be addressed to evaluate that determination: •The Draft Plan EA identifies that the diversion and retention of water in	The impact analysis in the Plan-EIS is a significant upgrade fromthe analysis in the draft Plan-EA. No construction activities would occur near the EFVR, and it is not anticipated that any water quality degradation would occur. A Water Model developed for the Proposed Project has been prepared. It has been determined that changs in water

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		Cove Reservoirwill provide a beneficial use due to annual releases of up to 882 acre-feet downstream toprotect federally-listed Virgin River chub and woundfin species at Pah Tempe HotSprings. Additionally, the Draft Plan EA identifies the potential for increased riparianhabitat growth to benefit the listed southwestern willow flycatcher. The Draft Plan EAstates that “up to” 882 acre-feet will be discharged but does not elaborate on what criteriawill be established to determine flows aside from the agreement between the proponentand Zion National Park to not exceed certain flows rates. We recommend the document analyze and discuss the potential for adverse effects on listed (state and federal) and non-listed species. We further recommend the document outline whether beneficial flows would be curtailed due to a priority to meet irrigation needs should there be a drought year (or years) and the reservoir does not fill to capacity. As both irrigation and storage and beneficial flows are identified as project purposes, we recommend that the document identify if they will have equal weight. Recreation is also a project purpose, and the document should address ability to meet recreational needs under similar conditions and identify if specific purposes will outweigh others should conditions occur where the pool cannot be filled during the high flows season. •The Draft Plan EA does not analyze or discuss the possibility of nutrients or other potential constituents that could accumulate in the reservoir and be released downstream. We recommend evaluating soils and land uses upgradient of the reservoir location to assist in anticipating potential water quality issues. Due to the sensitive and protected nature of the East Fork, we recommend that identification and anticipation of any potential impairments in the East Fork resulting from the reservoir be evaluated so they can be fully disclosed, mitigated or avoided.	flows would be minor. The Plan-EIS text has been updated to more clearly discuss potential impacts to listed threatened and endangered species located downstream from the proposed reservoir site. Consultation with the USFWS has been maintained throughout the Plan-EIS development process and a biological assessment has been prepared. No impacts to non-listed rare species are expected to occur. The Plan-EIS analysis, based on Water Quality studies prepared for the Project, does not anticipate that any impairments to water quality would occur
22	Scoping Comments (April 2022)	•The Cumulative Effects section (4.4.2.2.) identifies that Jackson Flat Reservoir and the proposed Cove Reservoir would collectively provide irrigation water for Kane County agriculture. The Draft Plan EA introduction identifies in section 1.4 that there is currently no water storage structure available for irrigators in the area, but this information appears to contradict that. It is unclear from this section how the water from both sources will be collectively utilized. For clarity, we recommend the document elaborate on this collective use and how it is factored in the water needs projections. If there are plans to combine and convey water from both reservoirs, we recommend the document analyze the potential in-reservoir and downstream water quality effects that could occur if	Text has been updated to make clear that the two reservoirs are not inter-connected and serve different areas of Kane County. There is currently no water storage structure available for the Long Valley portion of Kane County. One purpose and need of this action is to provide water storage capability for the Orderville and Mt. Carmel

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		water is shared between reservoirs. If the reservoirs are independently utilized, that clarification will be beneficial to avoid confusion.	agricultural areas of Kane County.
23	Scoping Comments (April 2022)	•The Draft Plan EA highlights that the reservoir will increase water quality in the East Fork by retaining some sediments from high water or flash flood events. It is unclear in the Draft Plan EA if there are anthropogenic sources of increased sediment or if the sediment is part of the natural regime of the watershed. For clarification, we recommend that the document identify if the capturing of sediments will alleviate anthropogenic influences on sediment loads in the watershed and East Fork or if the capture of sediments may alter the natural sediment regime. •The Draft Plan EA identifies that construction activity will require traffic at crossings of the East Fork. We appreciate the proponent's construction BMPs to mitigate impacts to the waterbody, and strongly encourage investigation of any alternate routes that could further minimize or avoid, if possible, directly impacting the East Fork.	No significant anthropogenic sources for sediment have been identified. Sediment in the EFVR most often comes from significant weather events resulting in flash floods as discussed in the Plan-EIS. No additional access to the two borrow pits that would avoid the EFVR are available. One access has a concrete base and the other is a well define access road. Sediment resulting from using these access points would be minor. This is addressed in the Plan-EIS. No additional text changes is necessary.
24	Scoping Comments (April 2022)	•Recreation is identified as one of the project purposes. We note that the project area is in proximity to Lake Powell and other state reservoirs that provide recreation opportunities. These reservoirs, especially Lake Powell, provide education, inspections, and requirements to prevent introduction of quagga and zebra mussel invasive species into the reservoirs. We recommend that the proponent identify and commit to measures to avoid introduction of invasive species by recreational watercraft usage of the reservoir. This is especially important due to the high quality of the downstream water and federally-listed species in addition to the maintenance of the irrigation and power-generating infrastructure associated with the project.	Invasive plant and animal species are identified and discussed in the Plan-EIS. Invasive species are identified in Section 3.2.4.5 and 3.2.4.7 and potential invasive species impacts are discussed in Section 5.4.5. BMPs have been identified and would be implemented during construction and operation to prevent the spread of invasive species in compliance with Executive Order 13112. A fish management plan would also be developed to address the potential invasion of quagga mussels. No additional text changes are necessary.
25	Scoping Comments	•The Draft Plan EA identifies that the beneficial summer flows would increase riparian habitat for the southwestern willow flycatcher. This	No new riparian habitat is anticipated from project

Comment Number	Location	Comment	Response
	(April 2022)	statement implies certainty of a benefit. Due to the flash flood regime of the watershed, the document would benefit the reader with an analysis and discussion as to whether potentially new habitat growth would remain established in the downstream environment. If the habitat is not sustainable the beneficial impact may not be as effective as the Draft Plan EA proposes	development. The BA text now states that changes in stream flows in southwestern willow flycatcher habitat resulting from project development would be minor and would not alter riparian vegetation beyond that which has been occurring for several years. Additionally, it should be noted that the EFVR riparian vegetation is adapted to flash flooding that has been occurring for years. No changes in flash flood occurrence or intensity is anticipated.
26	Scoping Comments (April 2022)	The Draft Plan EA identifies the development of an approximately 4.1-acre recreation area. We recommend that BMPs be incorporated to prevent water quality impacts from disturbance and impacts to the watershed, reservoir and surrounding are by increased recreational activity. The maps (Figures 1-2 and 1-3) would benefit from the inclusion of the jurisdictional waterbodies in relationship to the proposed infrastructure. If any of the comments above warrant additional analysis and discussion (i.e. collective use of Jackson Flat and Cove Reservoirs), maps of the involved infrastructure and waterbodies would be useful for the reviewers. Lastly, due to the general unknowns regarding the impacts (positive and negative) to the East Fork immediately downstream of the reservoir project infrastructure, the waterbody Category 1 designation, downstream federally-listed species, and proximity to the Wild and Scenic designated segment of the Virgin River in Zion National Park, we recommend that the NRCS work with the proponent and other stakeholders (particularly ZNP, USFWS and the State of Utah) to develop a monitoring plan to ensure the high functioning nature of the East Fork and Virgin River is maintained should the Preferred Alternative be selected.	It is not anticipated that any impacts on water quality would result from activity associated with the project recreation facilities. No OHV use would be authorized. Access to the reservoir would be by a concrete boat ramp. No additional jurisdictional water bodies are located within the Project area. Downstream impacts have been clearly identified and analyzed including potential impacts to threatened and endangered fish species, wild and scenic rivers, etc. No surface disturbance would occur outside of the proposed reservoir site and changes in streamflow would be minor. Therefore, no significant downstream impacts are anticipated. Impact analysis has been reviewed and upgraded following publication of the Draft

Comment Number	Location	Comment	Response
			Plan-EA. No additional text changes are necessary.
27	Biological Assessment Comments (July 2025)	This point is challenging to follow, It is unclear if this is identifying that water from the Virgin River will be used to fill the proposed reservoir during the summer months? The 3rd bullet below identifies that the proposed action would comply with the 1996 ZNP agreement; however, the summary of the agreement above indicates that "Surface water diversions to new reservoirs described above shall not occur except during the period from November 1 and May 31..." This would appear to preclude summertime diversions. Alternatively, this sentence could be read to mean that water released from Cove Reservoir and conveyed through the Virgin river would be diverted by HCC? We recommend this point we worded more clearly so the reader can easily understand the project components and how they will fully comply with the ZNP Agreement.	Text has been clarified. Water would be diverted to the reservoir during the non-irrigation season, November 1 - May 31. Water releases from the reservoir would occur in the summer months for irrigation, and year-round for M&I. All water released from the proposed reservoir would be diverted from the Virgin River at the Quail Creek Reservoir Diversion.
28	Biological Assessment Comments (July 2025)	Having an undetermined M&I water demand as part of the project does not provide a basis for the project purpose and need for 6,750 acre feet of storage. It is important to know what is actually needed and why, because the more water is diverted and stored, the higher the impacts to the aquatic environment. Having an adequately quantified need is important for determining the range of alternatives. Even though this is a BA for ESA purposes, and EPA recommends the most conservative analysis of water use to support the conclusions of this analysis (i.e., the full amount of water authorized under the ZNP Agreement), we want to ensure that the NEPA analysis for this project adequately evaluates all feasible alternatives that can meet the project purpose and need. We recommend that the gap between M&I supply and demand from Washington County be determined so that a reasonable range of alternatives to reduce that gap, including conservation and efficiencies, can be analyzed in the Draft EIS. This should be done for agricultural needs as well.	Additional detail on the M&I need in Washington County has been added to the Project purpose and need under Section 2.2.3. Potential impacts to listed species are fully analyzed in the Plan-EIS and BA. The Preferred Alternative would meet the project purpose and need by providing agricultural and M&I water and is evaluated in full detail in the Plan-EIS. Therefore, no text changes are necessary. The Washington County Water Conservancy District has adopted an aggressive water conservation goal established by the State of Utah in 2019, targeting a 14 percent reduction in per capita water use by 2030 (WCWCD, 2021). The following conservation measures are already in place, and WCWCD will continue to increase water

Comment Number	Location	Comment	Response
			usage efficiencies wherever possible: - Reduction in system water loss - Improvements to existing water conservation rate structure - AMI Meter Installation - Weather based irrigation controller rebates - CII building retrofits/water audits - Policy compliance - Education and training - Residential leak devices/flow sensors Per USFWS regulations, the BA is only required to analyzed the Preferred Alternative; therefore the 3,000 acre-foot reservoir is not analyzed in this document.
29	Biological Assessment Comments (July 2025)	Based on review of this draft BA, it is unclear if the Draft EIS will evaluate changes to water quality from proposed reservoir releases to the EFVR and in downstream critical habitat for the Virgin River chub and woundfin. As noted in the environmental baseline sections above, the Virgin River chub and woundfin have been impacted by changes to water quality as well as quantity as a result of dams, reservoirs and water diversions. The BA did not consider the impacts of the proposed reservoir(s) on water quality. This may be problematic considering the water released from a new reservoir may result in different temperature profiles immediately downstream and increased nutrient loads (as well as increased concentrations of other constituents) in the EFVR and downstream. It is unclear if these changes could result in additive degradation of the critical habitat for these species even if they are removed from the project action by 4.8 miles. Because these species are highly specialized to their habitat, it is imperative to fully comprehend the potential impacts of activities upstream, such as this project. We recommend the Draft EIS as well as this BA consider the impacts of this proposed project as well as other activities within the watershed(s) that my be forthcoming or have been established since the development of the USFWS analyses cited in this document to best determine if this project could result in further impacts to these species.	The BA and the Plan-EIS do not identify any significant changes in water quality in Virgin River chub and woundfin habitat as no new water sources would be introduced into the EFVR. Changes to water quality are discussed in detail in Sections 3.2.2.2 and Section 5.2.2. The ZNP Agreement ensures that water quality would not be impacted by maintaining controlled flow rates that prevent excessive sedimentation, nutrient loading, or changes in water temperature that could degrade the river's water quality or aquatic habitats. Water diverted from the EFVR would be held in the reservoir and then returned to EFVR as needed. Changes in flows would be minor as discussed in the Plan-

Comment Number	Location	Comment	Response
			EIS and BA. Finally, the habitat for these species is located approximately 55 river miles downstream from the proposed reservoir. Water diversions at the Quail Creek Reservoir Diversion, located above Virgin River chub and woundfin habitat, would not exceed authorized Cove Reservoir releases. Therefore, minor changes in river flows in Virgin River chub and woundfin habitat would result from implementation of the proposed project. Because the species' habitat is 55 miles downstream from the proposed reservoir, no changes in water temperatures or nutrient loading is anticipated to occur within woundfin and Virgin River chub habitat. Due to the anticipated minor changes in water flows in the EFVR, no loss or alteration of adjacent riparian vegetation that provides habitat for threatened and endangered species would occur. Text has been added to the BA and EIS.

BLM Coordination

IN REPLY REFER TO: LLUTP020000

February 17, 2026

Re: Comments on BLM Preliminary Draft Watershed Plan - Environmental Impact Statement for Cove-East Fork Virgin River Watershed Project

Please see the following comments regarding the Draft Watershed Plan -EIS for Cove -East Fork Virgin River Watershed Project.

Page 28 of the Biological Assessment (4.2.3 Environmental Baseline) mentions that activities such as livestock grazing, timber cutting, and energy development do not occur within the Parunuweap Canyon WSA and Zion National Park portion of the Action area. However, BLM land in this area is a permitted grazing allotment where livestock grazing can occur.

Sincerely,

Whit Bunting
Field Office Manager
Bureau of Land Management, Kanab Office

August 18, 2026

Whit Bunting
Kanab Field Office Manager
Bureau of Land Management
669 S. Hwy 89A
Kanab, Utah 84 741

Submitted by email to lchurch@blm.gov and tbanks@blm.gov

Subject: Bureau of Land Management Comment Response Table for Cove-East Fork Virgin River Watershed Plan

ATTN: Kanab Field Office Manager

On behalf of the Natural Resource Conservation Service, we sincerely appreciate the time and effort that has been devoted to reviewing the Watershed Plan Environmental Impact Statement (Plan-EIS) for Cove-East Fork Virgin River Watershed Project. The collaboration and valuable feedback provided during your review have contributed significantly to improving the quality, accuracy and clarity of the document. Following a thorough review of all comments received, we have incorporated the recommendations and revisions as appropriate in the Plan-EIS. A Comment Response Table is attached to this letter and provides a summary of the comments reviewed, along with the response on how each comment was addressed.

Please contact me directly if you have any questions about this information at (775) 296-0819 or eparis@eocene.com.

Sincerely,

Emily Paris
Project Manager
Eocene Environmental Group, Inc.

Attachment: Comment Response Table

ATTACHMENT

Comment Number	Location	Comment	Response
1	Biological Assessment; Section 4.2.3 Page 28	Page 28 of the Biological Assessment (4.2.3 Environmental Baseline) mentions that activities such as livestock grazing, timber cutting, and energy development do not occur within the Parunuweap Canyon WSA and Zion National Park portion of the Action area. However, BLM land in this area is a permitted grazing allotment where livestock grazing can occur.	Text has been corrected to remove the mention of livestock grazing as requested.

PLPCO Coordination

State of Utah

SPENCER J. COX
Governor

DEIDRE M. HENDERSON
Lieutenant Governor

Department of Natural Resources

JOEL FERRY
Executive Director

Public Lands Policy Coordinating Office

REDGE B. JOHNSON
Director

October 17, 2024

Submitted via electronic mail: derek.hamilton@usda.gov, bparker@eocene.com, *and* EParis@eocene.com

Derek Hamilton
Water Resource Coordinator
USDA-NRCS
125 South State Street – Room 4010
Salt Lake City, UT 84138

Emily Paris
Project Manager
Eocene Environmental Group
Reno, NV 89503

Subject: **Cove Reservoir -East Fork Virgin River Watershed Project EIS – Admin Draft Chapters 1 and 2 Comments**

Dear Mr. Hamilton and Ms. Paris:

The State of Utah (State), through the Public Lands Policy Coordinating Office (PLPCO), appreciates the opportunity to review and provide Cooperating Agency comments on the draft chapters 1 and 2, which cover the watershed planning background and the purpose and need for the proposed project. The State has provided comments previously. Those comments are incorporated herein by reference. While a comprehensive assessment is contingent upon review of the complete Plan-EIS (Chapters 3-8), the State is grateful that, based on its initial review and prior communications, the State's concerns appear to be accurately addressed in these initial chapters. In collaboration with the Utah Division of Wildlife Resources (DWR) and the Division of Water Resources (DWRe), the State offers the following comments for your consideration.

Priority water right dates and subsequent impacts must comply with state water law. The State appreciates particularly the recognition of this project's significance for water resource

management in Long Valley and Hurricane. The potential for enhanced agricultural efficiency and strategic water use planning is a critical benefit for the region. Furthermore, the State commends the acknowledgment of recreation as a component of the plan, recognizing its contribution to the economic development of these communities.

Division of Wildlife Resources

In addition to the objective of complying with the Zion National Park Water Right Settlement of 1996, DWR encourages coordination with the Virgin River Program. The program includes efforts to protect native species and their habitat while ensuring the availability of the recreational and consumptive water required for the growing human population in the Virgin River Basin.

One of the long-term benefits identified in the EIS is "added recreation opportunities for Kane County and the surrounding communities." If the establishment of a community fishery is considered, the State recommends coordination with DWR's Southern Region Aquatic Manager, Mike Hadley.

If you have wildlife resource questions, please contact the DWR's Impact Analysis Biologist in our Cedar City office, Jessica Kinross, at jessicavan@utah.gov or 435-691-2372.

The State anticipates reviewing Chapters 3 through 8 and requests to be kept informed of any recommendations from other cooperating agencies.

Division of Water Resources

From page nine of the report, one of the objectives of this project is "to maximize sustainable economic development." One of the biggest issues for the Virgin River Watershed is that it is experiencing and will continue to experience significant water stress.

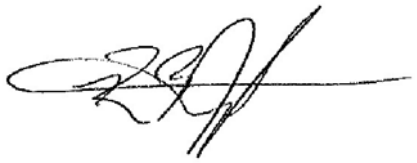
This project seeks to shore up the reliability of irrigation water to improve crop production. From an agricultural engineering standpoint, whenever you increase crop production, you also consume more water which will increase the water stress in this area. Another competing objective is to provide "M&I water for Washington County".

The conflict between agricultural water use and municipal demand has often been solved in the Washington County Water Conservancy District by purchasing the water rights of the agricultural users which may be the ultimate result some years hence for the water users proposing this project. When agricultural water rights are purchased in an area whose economy is dependent on that agricultural production, the economy of that area often suffers.

The State would like to express concern regarding the significant delays in communication between cooperating agencies on this project. The extended periods without updates were not explained to the State, leading to concerns regarding the Natural Resources Conservation Service's (NRCS) commitment to this initiative. The State kindly requests more consistent and transparent communication moving forward to ensure effective collaboration.

Thank you for the opportunity to participate in this important project. Call to discuss any further questions or concerns.

Sincerely,



Redge B. Johnson
Director

State of Utah

SPENCER J. COX
Governor

DEIDRE M. HENDERSON
Lieutenant Governor

Department of Natural Resources

JOEL FERRY
Executive Director

Public Lands Policy Coordinating Office

REDGE B. JOHNSON
Director

May 8, 2025

Submitted via electronic mail: *derek.hamilton@usda.gov* *and* *EParis@eocene.com*

Derek Hamilton
Water Resources Coordinator
USDA-NRCS
125 South State Street – Room 4010
Salt Lake City, UT 84138

Emily Paris
Project Manager
Eocene Environmental Group
444 South Main Street, Suite A6
Cedar City, UT 84720

Subject: **Cove-East Fork Virgin River Watershed Project EIS – Preliminary Draft Biological Assessment**

Dear Mr. Hamilton and Ms. Paris:

The state of Utah (State), through the Public Lands Policy Coordinating Office (PLPCO), appreciates the opportunity to review and submit comments on the Cove-East Fork Virgin River Watershed Environmental Impact Statement (EIS) project's *Preliminary Draft Biological Assessment*. In collaboration with the Utah Division of Wildlife Resources (DWR), the State submits the following comments for your consideration.

Utah Division of Wildlife Resources

To ensure woundfin and Virgin River chub populations are not adversely affected, continued coordination between the DWR, Washington County Water Conservancy District (WCWCD), and program partners is critical to ensure water requirements for these species are met in downstream critical habitat.

In the Water Model Report: Cove Reservoir by Alpha Engineering Draft Revised 3-1-2023, it describes the release of water from the reservoir to WCWCD as follows:

> "An analysis was completed to determine the downstream effects to the East Fork of the Virgin River at Springdale as a result of the project, specifically analyzing water release from Cove Reservoir downstream to the WCWCD *during June, July, and August*. The following are modeled stream stage and width changes expected as a result of changes in winter diversion of water and *summer release.*"

This conflicts with the statement in the Biological Assessment on page 3 in 2.2.2, where it states, "[w]ater committed to Washington County for irrigation and MR purposes could be released any time during the year to meet demand, but *would most likely be during the fall and winter months*." DWR requests clarification on this issue as the summer release of water described in the report would be more beneficial to native fish, in particular, the Virgin spinedace, than water released during the fall and winter months.

In Table 2 on page 8, reference is made to the Utah Sensitive Species List. The Utah Sensitive Species List was repealed on October 1, 2020. DWR recommends referencing the Utah Wildlife Action Plan (WAP), which serves as Utah's guiding document for the conservation of native species. The WAP identifies species of greatest conservation need (SGCN), key habitats, and threats to those habitats and SGCNs. Utah encourages parties to use the WAP in their environmental planning, as it provides a conservation framework to prevent future listings under the ESA. The 2025-2035 WAP is replacing the 2015- 2025 WAP and will include updated species of greatest conservation need when published in the near future.

Additionally, DWR notes the following in Table 2:

- Speckled dace (*Rhinichthys osculus*) should be added to the list.
- Desert sucker's scientific name was recently changed to *Pantosteus clarkii.*
- Prairie rattlesnakes are typically not found in this area.
- The Wildlife Habitat Analysis Tool is now available and allows users to produce a report for species occurrence and wildlife habitats, including updated species of greatest conservation need status. We encourage the project to include information from the new tool.

Recent surveys by the DWR found the following distribution for Virgin River chub, which could be updated throughout the document to include:

"The Virgin River, upstream of the La Verkin Creek confluence, supports abundant Virgin River chub populations. Virgin River chub have also colonized habitat upstream of Pah Tempe Springs since the establishment of population maintenance flows below Quail Creek Diversion and currently occupy habitat between Pah Tempe Springs and the Quail Creek Diversion. Virgin River chub distribution currently extends upstream to the old diversion structure in Timpoweap Canyon (2 miles upstream from Pah Tempe Springs, and 4 miles upstream from the La Verkin Creek confluence)."

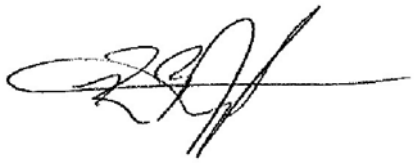
Woundfin distribution should also be updated to include the following:

"Woundfin regularly occupy habitat upstream of the La Verkin Creek confluence, and their distribution extends upstream to the Hurricane Hydro Electric Plant inflow approximately 1.6 miles upstream of the La Verkin Creek confluence."

If you have wildlife resource questions, please contact Jessica Kinross, the DWR's Impact Analysis Biologist at DWR's Cedar City office, at jessicavan@utah.gov or 435-691-2372.

Thank you for the opportunity to review the *Preliminary Draft Biological Assessment* and submit comments. Call to discuss any further questions or concerns.

Sincerely,



Redge B. Johnson
Director

July 11, 2025

Sindy Smith
RDCC Coordinator
Utah Public Lands Policy Coordinating Office
1594 W N Temple St., STE 320
Salt Lake City, UT 84116

Submitted by email to sindysmith@utah.gov

Subject: Preliminary Draft Biological Assessment for Cove-East Fork Virgin River Watershed Plan

Dear Ms. Smith:

On behalf of the Natural Resources Conservation Service (NRCS) we appreciate the time, effort, and expertise you provided in reviewing the Preliminary Draft Biological Assessment for the Cove-East Fork Virgin River Watershed Plan. The consideration extended by a cooperating agency to review our documents significantly improves their quality and clarity.

After a thorough review of the comments, we incorporated the content, as applicable, into the Preliminary Draft Biological Assessment. A Comment Response Table with rationale for addressing the responses is attached to this letter.

Please contact me directly if you have any questions about this information at (775) 296-0819 or eparis@eocene.com.

Sincerely,

Emily Paris
Project Manager
Eocene Environmental Group, Inc.

CC: Derek Hamilton, NRCS

Attachment: Comment Response Table

ATTACHMENT

Comment Number	Location	Comment	Response
1	General Comment	To ensure woundfin and Virgin River chub populations are not adversely affected, continued coordination between the DWR, Washington County Water Conservancy District (WCWCD), and program partners is critical to ensure water requirements for these species are met in downstream critical habitat.	We appreciate DWR's expertise and will continue to coordinate with them as the project continues. No text change is required for this comment.
2	Section 2.2.2 Page 3	In the Water Model Report: Cove Reservoir by Alpha Engineering Draft Revised 3-1-2023, it describes the release of water from the reservoir to WCWCD as follows: "An analysis was completed to determine the downstream effects to the East Fork of the Virgin River at Springdale as a result of the project, specifically analyzing water release from Cove Reservoir downstream to the WCWCD during June, July, and August. The following are modeled stream stage and width changes expected as a result of changes in winter diversion of water and summer release." This conflicts with the statement in the Biological Assessment on page 3 in 2.2.2, where it states, "[w]ater committed to Washington County for irrigation and MR purposes could be released any time during the year to meet demand, but would most likely be during the fall and winter months." DWR requests clarification on this issue as the summer release of water described in the report would be more beneficial to native fish, in particular, the Virgin spinedace, than water released during the fall and winter months.	Text has been clarified. Irrigation water would most likely be released during the summer months of June, July, and August, whereas M&I water would most likely be released during the fall and winter months. The water model only evaluates irrigation water, as the yearly amount of M&I water would be determined based on demand. Washington County has emphasized the need for flexibility in water timing to reduce losses in transport. Regardless of timing, all releases would be in compliance with the ZNP Agreement.

Comment Number	Location	Comment	Response
3	Page 8 Table 2	In Table 2 on page 8, reference is made to the Utah Sensitive Species List. The Utah Sensitive Species List was repealed on October 1, 2020. DWR recommends referencing the Utah Wildlife Action Plan (WAP), which serves as Utah's guiding document for the conservation of native species. The WAP identifies species of greatest conservation need (SGCN), key habitats, and threats to those habitats and SGCNs. Utah encourages parties to use the WAP in their environmental planning, as it provides a conservation framework to prevent future listings under the ESA. The 2025-2035 WAP is replacing the 2015- 2025 WAP and will include updated species of greatest conservation need when published in the near future.	Text change has been made as requested. The Utah Wildlife Action Plan is now referenced and the term Utah Sensitive Species List has been deleted.
4	Page 8 Table 2	Speckled dace (*Rhinichthys osculus*) should be added to the list.	The speckled dace has been added to the Table as requested.
5	Page 8 Table 2	Desert sucker's scientific name was recently changed to *Pantosteus clarkii*.	Change in scientific name has been made as requested.
6	Page 8 Table 2	Prairie rattlesnakes are typically not found in this area.	Prairie rattlesnake has been deleted from the Table as requested.
7	Page 8 Table 2	The Wildlife Habitat Analysis Tool is now available and allows users to produce a report for species occurrence and wildlife habitats, including updated species of greatest conservation	The Wildlife Habitat Analysis Tool is now being used for the Cove Reservoir BA and the Plan-EIS.

Comment Number	Location	Comment	Response
		need status. We encourage the project to include information from the new tool.	
8	General Comment	Recent surveys by the DWR found the following distribution for Virgin River chub, which could be updated throughout the document to include: “The Virgin River, upstream of the La Verkin Creek confluence, supports abundant Virgin River chub populations. Virgin River chub have also colonized habitat upstream of Pah Tempe Springs since the establishment of population maintenance flows below Quail Creek Diversion and currently occupy habitat between Pah Tempe Springs and the Quail Creek Diversion. Virgin River chub distribution currently extends upstream to the old diversion structure in Timpoweap Canyon (2 miles upstream from Pah Tempe Springs, and 4 miles upstream from the La Verkin Creek confluence).”	Text has been updated to reflect this recent information.
9	General Comment	Woundfin regularly occupy habitat upstream of the La Verkin Creek confluence, and their distribution extends upstream to the Hurricane Hydro Electric Plant inflow approximately 1.6 miles upstream of the La Verkin Creek confluence.	Text has been updated to reflect this recent information.

State of Utah

SPENCER J. COX
Governor

DEIDRE M. HENDERSON
Lieutenant Governor

Department of Natural Resources

JOEL FERRY
Executive Director

Public Lands Policy Coordinating Office

REDGE B. JOHNSON
Director

February 17, 2026

Submitted via electronic mail: derek.hamilton@usda.gov *and* EParis@eocene.com

Derek Hamilton
Water Resources Coordinator
USDA-NRCS
125 South State Street – Room 4010
Salt Lake City, UT 84138

Emily Paris
Project Manager
Eocene Environmental Group
444 South Main Street, Suite A6
Cedar City, UT 84720

Subject: **Cove-East Fork Virgin River Watershed Plan Preliminary Draft EIS**

Dear Mr. Hamilton and Ms. Paris:

The state of Utah (State), through the Public Lands Policy Coordinating Office (PLPCO), appreciates the opportunity to review and submit comments on the Cove-East Fork Virgin River Watershed Plan Preliminary Draft Environmental Impact Statement (EIS). The State, as a Cooperating Agency, has submitted comments throughout the project's process. Those comments are incorporated herein by reference. In collaboration with the Utah Division of Wildlife Resources (DWR) and the Division of Water Resources (DWRe), the State submits the following comments for your consideration.

There are multiple references throughout the document to the action area, project area, planning area, and focus area. Please further define the various types of "areas" early in the document and add a general map with the polygons to improve clarity and reader comprehension.

The State, through the DWR, is a member of the Virgin River Program (VRP) and strongly supports collaborative efforts to implement actions to recover, conserve, enhance, and protect native species in the Virgin River Basin. However, identifying the VRP and compliance with the program's purposes should not be included in Section 2.1, Purpose, or 2.1.2, Project Objectives. The state requests that any mention of the VRP be concentrated within sections of the EIS related to the Endangered Species Act (ESA) and Species of Greatest Conservation Needs (SGCN), including 3.2.4.6 – Fish and Wildlife and potentially Table 3.5. This State request is based on the need to avoid the impression that there is a "compliance" component of the VRP that could take precedence over the 1996 Agreement.

3.2.4, Opportunities, the document states that this project can provide long-term benefits, including "increased water availability for local agriculture and municipal users." The DWRe interpreted this to mean that water in Kane County and Washington County may be used for M&I. The state recommends splitting this sentence into two bullet points to separate agricultural benefits in Kane County from M&I (municipal) benefits in Washington County. The anticipated uses are articulated elsewhere in the document and could be cross-referenced within the opportunities section.

4.2.2.6, Wild and Scenic Rivers, the state requests that additional language be added to the EIS surrounding the designation of the Virgin River segments. These designations were made possible by the Omnibus Public Land Management Act of 2009 (OPLMA). It is very important to state in this EIS that OPLMA included a savings clause in Sec. 1976 to ensure that the new wild and scenic river designations on the Virgin River would not conflict with the 1996 agreement. "SAVINGS CLAUSE—The amendment made by subsection (a) does not affect the agreement among the United States, the State, the Washington County Water Conservancy District, and the Kane County Water Conservancy District entitled ''Zion National Park Water Rights Settlement Agreement'' and dated December 4, 1996."

4.2.5.2.5, Economy, the term overcrowding is used in the context of visitor use management. Overcrowding is highly subjective. The state recommends using terms like capacity rather than overcrowding. Secretarial Order 3424, *Strengthening Coordination with Gateway Communities* (June 25, 2025), is intended to require better coordination between the National Park Service and gateway communities like Orderville, Mt. Carmel, Kanab, Rockville, Springdale, and other locations within the action area.

6.2.6.2.1.1, Monitoring Requirements, there is a reference to the 2001 MOU for monitoring after the construction of the hydro plant in Orderville. Have the terms of that 2001 MOU been satisfied, and are those terms and conditions still relevant to this EIS for monitoring compliance? The monitoring was intended to be conducted for only three years after

construction (nearly two decades ago). The State supports reasonable monitoring during and after construction of the Cove Reservoir to ensure the viability of aquatic ecosystems.

6.3, Air contains a reference to the Gould Wash Project as an example for anticipated fugitive dust. Please identify where Gould Wash is located and how its soil and activity types are similar to those identified in the project area.

6.6.1.1, Lake Powell Pipeline, this paragraph gives the impression that the Lake Powell Pipeline project is likely to be implemented. It is extremely unlikely that the Cove Reservoir would be constructed at the same time as the Lake Powell Pipeline and that they would compete for materials, fuel, and labor.

Utah Division of Wildlife Resources

The term "state-sensitive species" is used throughout the document. The Utah Sensitive Species List was repealed on October 1, 2020. The Utah Wildlife Action Plan is now the guiding document for the conservation of native species, identifying Species of Greatest Conservation Need. The DWR recommends updating references to state-sensitive species to Species of Greatest Conservation Need.

Table S.2 Environmental Impacts and the Environmental Consequences from Invasive Species in 5.4.5 only highlights impacts from invasive plants and does not address potential risks of invasive animal species. Construction of a reservoir increases the risk of non-native fish and mollusks being illegally introduced, potentially affecting downstream fish populations. These impacts should be considered in the analysis.

Additionally, under floodplain management, it should be noted that high-pulse events (i.e., flash floods) can benefit the stream and associated riparian habitat. Willows are early successional plants that benefit from disturbances such as flash floods.

The East Fork River Instream Flow MOU is referenced in 6.2.6.2.1.1 Monitoring Requirements. The DWR encourages discussion of this MOU's reference in the EIS, as discussions may provide a better understanding of the MOU's relevance to the EIS.

If you have wildlife questions, contact Jessica Kinross, Impact Analysis Biologist in our Cedar City office, at jessicavan@utah.gov or 435-691-2372.

Division of Water Resources

Background

According to DWRe's water-related land-use data, crop acreage in the project area has declined by about 300 acres since 2009. The data shows the urban area has increased by about that same acreage. Using average net crop ET, the resulting water requirement is roughly 1000 acre-feet lower than the value shown in Table 2.1, due to the area's high elevation (5460 feet above sea level), lower temperatures, and higher evapotranspiration demand. While irrigated agriculture is slowly declining, the population during that same period increased by roughly 10%, according to the Utah Division of Water Rights' public water supply data. The area's beauty and proximity to national parks are driving that increase.

The area's main economic engine is tourism. These towns serve as "gateway communities" for millions of visitors traveling along US-89. The area has seen a massive surge in unique accommodations, ranging from high-end resorts like Zion Ponderosa Ranch Resort and Zion Mountain Ranch to boutique glamping sites and vacation rentals. Local businesses such as the Thunderbird Restaurant in Mt. Carmel and various rock shops and galleries in Orderville rely heavily on seasonal tourist traffic. Companies like East Zion Adventures provide canyoneering, Jeep tours, and horseback riding, creating a significant number of local service jobs.

An evolved agriculture, also partly dependent upon tourism, is the cultural backbone of Long Valley. Cattle ranching is still a visible and active industry, with many families maintaining large tracts of land for livestock. There is a growing trend toward "Agritourism," where working farms offer farm stays, local honey, medicinal herbs, and organic produce to visitors seeking an authentic rural experience.

GridET (a Division of Water Resources Program) estimates that the proposed Cove Reservoir's average net evaporation (potential evaporation minus precipitation) would be 19.7 inches per year, as opposed to Quail Creek Reservoir’s 39.0 inches and Sand Hollow’s 40.5 inches, which makes its storage relatively efficient for downstream and local uses.

The Utah Government Office of Planning and Budget estimates the population of the service area will increase by 26% by 2050. In 2023, the area reported 303 acre-feet of municipal and industrial water use to the Division of Water Rights. Between the two water providers in the area, Orderville and Glendale, they have rights to 2,241 acre-feet per year from wells and springs. Division of Water Rights data also indicates that none of the municipal supplies in that area depend on the East Fork of the Virgin River. All of this suggests that the proposed reservoir will not benefit local municipal water providers in Long Valley.

An envisioned county-operated park at Cove Reservoir would help reduce overcrowding in nearby states and national parks. A new reservoir could support a range of water-related activities, further enhancing the area's tourism and recreation opportunities.

With agriculture's declining economic impact in the Orderville area and the significant municipal demand in Washington County, the main beneficiary of the proposed reservoir may be the population of the Washington County Water Conservancy District (WCWCD).

The farmers who remain in the local service area can benefit by producing more crops with fewer water supply shortages, resulting in slightly less water downstream. However, the WCWCD has a history and the resources to acquire rights to agricultural land in its service areas and may ultimately do so here if critical shortages are foreseen in the Washington County area. The Washington County Water Conservancy District's 40-year plan submitted to the Division of Water Rights indicates that, even with water reuse, its demand is projected to outstrip supply. The 2023 WCWCD 40-year plan projects a shortage of 61,625 to 96,722 acre-feet per year by 2060, depending on the success of conservation efforts.

If the water rights in the local service area are ultimately purchased and transferred downstream, the project's benefits to other, more dominant local economic sectors could offset potential negative impacts.

The preliminary draft EIS notes that one benefit of a reservoir is that it can capture sediment that would otherwise flow into the East Fork of the Virgin River (page vi). Given the friable and erosive nature of the area's soils and geology, it is recommended that cost-effective measures be implemented to prevent sediment from entering the reservoir and to account for sediment removal. While the report indicates that the sedimentation accumulation rate in the reservoir is expected to be low, up-front consideration of sedimentation prevention can be cost-effective.

Below is a link to a recent study on the economics of sediment management that might be worth reviewing:

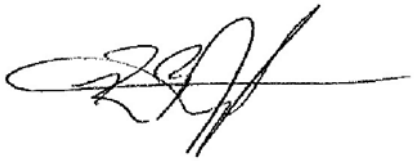
https://scholarsarchive.byu.edu/cgi/viewcontent.cgi?article=12012&context=etd

In summary, the proposed Cove Reservoir would provide much-needed water for agriculture and downstream municipal uses and would be a good fit for the recreational and tourism industries. This project can benefit the local agricultural service area and tourism

industry economically while providing greater flexibility and resilience for water supplies in the downstream basin.

Thank you for the opportunity to review the *Preliminary Draft EIS* and submit comments. Please call to discuss any further questions or concerns.

Sincerely,



Redge B. Johnson
Director

August 18, 2026

Redge Johnson
Director
Public Lands Policy Coordinating Office
1594 West North Temple St., Suite 320
Salt Lake City, Utah 84116

Submitted by email to sindysmith@utah.gov

Subject: Public Lands Coordinating Office Comment Response Matrix for Cove-East Fork Virgin River Watershed Plan

Dear Mr. Johnson:

On behalf of the Natural Resource Conservation Service, we sincerely appreciate the time and effort that has been devoted to reviewing the Watershed Plan Environmental Impact Statement (Plan-EIS) for Cove-East Fork Virgin River Watershed Project. The collaboration and valuable feedback provided during your review have contributed significantly to improving the quality, accuracy and clarity of the document. Following a thorough review of all comments received, we have incorporated the recommendations and revisions in the Plan-EIS. A Comment Response Table is attached to this letter and provides a summary of the comments reviewed, along with the response on how each comment was addressed.

Please contact me directly if you have any questions about this information at (775) 296-0819 or eparis@eocene.com.

Sincerely,



Emily Paris
Project Manager
Eocene Environmental Group, Inc.

Attachment: Comment Response Table

ATTACHMENT

eocene.com
866.875.5527

Comment Number	Location	Comment	Response
1	Chapters 2 and 3, Pages 9, 33, 35	There are multiple references throughout the document to the action area, project area, planning area, and focus area. Please further define the various types of “areas” early in the document and add a general map with the polygons to improve clarity and reader comprehension.	The planning area vs. project area vs. study area vs. APE are defined in chapter 1.4. The term "action area" has been revised throughout the document to "study area". "Focus area" is not a term used in the document. A figure has been created to show the different projects areas and is included in Appendix C.
2	Chapter 2. Page 15	The State, through the DWR, is a member of the Virgin River Program (VRP) and strongly supports collaborative efforts to implement actions to recover, conserve, enhance, and protect native species in the Virgin River Basin. However, identifying the VRP and compliance with the program’s purposes should not be included in Section 2.1, Purpose, or 2.1.2, Project Objectives. The state requests that any mention of the VRP be concentrated within sections of the EIS related to the Endangered Species Act (ESA) and Species of Greatest Conservation Needs (SGCN), including 3.2.4.6 – Fish and Wildlife and potentially Table 3.5. This State request is based on the need to avoid the impression that there is a “compliance” component of the VRP that could take precedence over the 1996 Agreement.	The Virgin River Program (VRP) language has been deleted from Section 2.1 and Section 2.1.2 as requested. Language regarding the VRP discussion was not changed in Section 3.2.4.6 as requested (page 35).
3	Chapter 2. page 26	2.2.4, Opportunities, the document states that this project can provide long-term benefits, including “increased water availability for local agriculture and municipal users.” The DWRe interpreted this to mean that water in Kane County and Washington County may be used for M&I. The state recommends splitting this sentence into two bullet points to separate agricultural benefits in Kane County from M&I (municipal) benefits in Washington County. The anticipated uses are articulated elsewhere in the document and could be cross-referenced within the opportunities section.	Text has been corrected as requested.
4	Chapter 3. Page 46	3.2.2.6, Wild and Scenic Rivers, the state requests that additional language be added to the EIS surrounding the designation of the Virgin River segments. These designations were made possible by the Omnibus Public Land Management Act of 2009 (OPLMA). It is very important to state in this EIS that OPLMA included a	The information contained in this comment has been added to Section 3.2.2.6 as requested.

Comment Number	Location	Comment	Response
		savings clause in Sec. 1976 to ensure that the new wild and scenic river designations on the Virgin River would not conflict with the 1996 agreement. “SAVINGS CLAUSE—The amendment made by subsection (a) does not affect the agreement among the United States, the State, the Washington County Water Conservancy District, and the Kane County Water Conservancy District entitled ‘‘Zion National Park Water Rights Settlement Agreement’’ and dated December 4, 1996.”	
5	Chapter 5. page 79	5.2.5.2.5, Economy, the term overcrowding is used in the context of visitor use management. Overcrowding is highly subjective. The state recommends using terms like capacity rather than overcrowding. Secretarial Order 3424, *Strengthening Coordination with Gateway Communities* (June 25, 2025), is intended to require better coordination between the National Park Service and gateway communities like Orderville, Mt. Carmel, Kanab, Rockville, Springdale, and other locations within the action area.	Text changes have been made as requested. A sentence also has been added regarding Secretarial Order 3424.
6	Chapter 5. Page 78	5.2.6.2.1.1, Monitoring Requirements, there is a reference to the 2001 MOU for monitoring after the construction of the hydro plant in Orderville. Have the terms of that 2001 MOU been satisfied, and are those terms and conditions still relevant to this EIS for monitoring compliance? The monitoring was intended to be conducted for only three years after construction (nearly two decades ago). The State supports reasonable monitoring during and after construction of the Cove Reservoir to ensure the viability of aquatic ecosystems.	We agree that the monitoring requirements within this MOU have expired; therefore, the discussion has been removed from the text. A correction has also been made in Section 3.2.2.1. A discussion regarding current monitoring efforts being conducted by the KCWCD has been added to the text.
7	Chapter 5. Page 98	5.3, Air contains a reference to the Gould Wash Project as an example for anticipated fugitive dust. Please identify where Gould Wash is located and how its soil and activity types are similar to those identified in the project area.	Text has been added clarifying where the Gould Wash Project is located and how soils and anticipated air quality impacts associated with that project compare with the proposed Cove Reservoir project.
8	Chapter 5	6.6.1.1, Lake Powell Pipeline, this paragraph gives the impression that the Lake Powell Pipeline project is likely to be implemented. It is extremely unlikely that the Cove Reservoir would be constructed at the same time as the Lake Powell Pipeline and that they would compete for materials, fuel, and labor.	As requested, text has been updated to eliminate the discussion regarding potential for competition for materials, fuel, and labor between the proposed Lake Powell Pipeline and Cove Reservoir project. A sentence stating that there would be no competition

Comment Number	Location	Comment	Response
			has been added.
9	Summary 5 vii 34, 38	**UDWR**. The term “state-sensitive species” is used throughout the document. The Utah Sensitive Species List was repealed on October 1, 2020. The Utah Wildlife Action Plan is now the guiding document for the conservation of native species, identifying Species of Greatest Conservation Need. The DWR recommends updating references to state-sensitive species to Species of Greatest Conservation Need.	Text change has been made as requested. The term State sensitive species has been replaced with Species of Greatest Conservation Need.
10	General	**UDWR.** Table S.2 Environmental Impacts and the Environmental Consequences from Invasive Species in 5.4.5 only highlights impacts from invasive plants and does not address potential risks of invasive animal species. Construction of a reservoir increases the risk of non-native fish and mollusks being illegally introduced, potentially affecting downstream fish populations. These impacts should be considered in the analysis.	A paragraph discussing invasive animal species has been added to the text as requested. Text analyzing potential invasive animal impacts has also been added.
11	Chapter 5. Page 79	**UDWR.** Additionally, under floodplain management, it should be noted that high-pulse events (i.e., flash floods) can benefit the stream and associated riparian habitat. Willows are early successional plants that benefit from disturbances such as flash floods.	The information presented in this comment has been added to the text in Sections 3.2.2.3 and 5.2.3.2.
12	Chapter 2. Page 11	**UDWR**. The East Fork River Instream Flow MOU is referenced in 6.2.6.2.1.1 Monitoring Requirements. The DWR encourages discussion of this MOU’s reference in the EIS, as discussions may provide a better understanding of the MOU’s relevance to the EIS.	Please refer to response to Comment 7. Since the monitoring requirements within the MOU have expired, we have deleted it from the Plan-EIS text as suggested above. A discussion regarding current monitoring efforts being conducted by the KCWCD has been added to the text. A correction has also been made in Section 3.2.2.1.
13	General	**Division of Water Resources.** According to DWRe's water-related land-use data, crop acreage in the project area has declined by about 300 acres since 2009. The data shows the urban area has increased by about that same acreage. Using average net crop ET, the resulting water requirement is roughly 1000 acre-feet lower than the value shown in Table 2.1, due to the area's high elevation (5460 feet above sea level), lower temperatures, and higher evapotranspiration demand. While irrigated agriculture is	The information provided in this comment has been inserted into Section 3.2.5.2.5

Comment Number	Location	Comment	Response
		slowly declining, the population during that same period increased by roughly 10%, according to the Utah Division of Water Rights' public water supply data. The area's beauty and proximity to national parks are driving that increase.	
14	General	**Division of Water Resources.** The area's main economic engine is tourism. These towns serve as "gateway communities" for millions of visitors traveling along US-89.	Section 3.2.5.2.5 has been updated to include this discussion.
15	General	**Division of Water Resources.** An evolved agriculture, also partly dependent upon tourism, is the cultural backbone of Long Valley.	Text has been added to Section 3.2.5.2.5 to clarify the importance of tourism for the area.
16	General	**Division of Water Resources.** GridET (a Division of Water Resources Program) estimates that the proposed Cove Reservoir's average net evaporation (potential evaporation minus precipitation) would be 19.7 inches per year, as opposed to Quail Creek Reservoir's 39.0 inches and Sand Hollow's 40.5 inches, which makes its storage relatively efficient for downstream and local uses.	This comment (with minor editing) has been entered into Section 6.1 of the Plan-EIS.
17	General	**Division of Water Resources.** The Utah Government Office of Planning and Budget estimates the population of the service area will increase by 26% by 2050. In 2023, the area reported 303 acre-feet of municipal and industrial water use to the Division of Water Rights. Between the two water providers in the area, Orderville and Glendale, they have rights to 2,241 acre-feet per year from wells and springs. Division of Water Rights data also indicates that none of the municipal supplies in that area depend on the East Fork of the Virgin River. All of this suggests that the proposed reservoir will not benefit local municipal water providers in Long Valley.	Thank you for the additional information. You are correct, the proposed municipal water benefits from the project would be for those in Washington County. In Long Valley, water would be provided for agricultural and recreation water. The information about estimated population of Orderville and Mt. Carmel was added to Section 3.2.5.2.1.
18	General	**Division of Water Resources.** An envisioned county-operated park at Cove Reservoir would help reduce overcrowding in nearby states and national parks. A new reservoir could support a range of water-related activities, further enhancing the area's tourism and recreation opportunities.	This is currently discussed in Section 5.5.2.2. Some additional discussion has been added to Sections 5.5.2.2.5 and 5.5.2.3.5.
19	General	**Division of Water Resources.** With agriculture's declining economic impact in the Orderville area and the significant municipal demand in Washington County, the main	Additional text has been added to Section 2.2.3 to further describe the 'need' of the project for municipal water users in

Comment Number	Location	Comment	Response
		beneficiary of the proposed reservoir may be the population of the Washington County Water Conservancy District (WCWCD).	Washington County.
20	General	**Division of Water Resources.** The farmers who remain in the local service area can benefit by producing more crops with fewer water supply shortages, resulting in slightly less water downstream. However, the WCWCD has a history and the resources to acquire rights to agricultural land in its service areas and may ultimately do so here if critical shortages are foreseen in the Washington County area. The Washington County Water Conservancy District's 40-year plan submitted to the Division of Water Rights indicates that, even with water reuse, its demand is projected to outstrip supply. The 2023 WCWCD 40-year plan projects a shortage of 61,625 to 96,722 acre-feet per year by 2060, depending on the success of conservation efforts.	Additional text has been inserted into Sections 5.2.5.1
21	General	**Division of Water Resources.** If the water rights in the local service area are ultimately purchased and transferred downstream, the project's benefits to other, more dominant local economic sectors could offset potential negative impacts	Thank you for the comment. There are no current plans to purchase or transfer water rights downstream as part of the project.
22	General	**Division of Water Resources.** The preliminary draft EIS notes that one benefit of a reservoir is that it can capture sediment that would otherwise flow into the East Fork of the Virgin River (page vi). Given the friable and erosive nature of the area's soils and geology, it is recommended that cost-effective measures be implemented to prevent sediment from entering the reservoir and to account for sediment removal. While the report indicates that the sedimentation accumulation rate in the reservoir is expected to be low, up-front consideration of sedimentation prevention can be cost effective.	The Plan-EIS notes that a Stormwater Pollution Prevention Plan containing erosion and sediment control/pollutant prevention BMPs would be required and implemented. Additionally, per a study conducted by RB&G Engineering, sedimentation in the proposed reservoir would be minimal and below the NRCS threshold for evaluation. This discussion was added to Section 5.1.1.2.
23	General	**Division of Water Resources.** Below is a link to a recent study on the economics of sediment management that might be worth reviewing: https://scholarsarchive.byu.edu/cgi/viewcontent.cgi?article=12012&context=etd	See response to Comment 23. A review of the referenced study did not require any text changes in the Plan-EIS. No additional text change is necessary.

Comment Number	Location	Comment	Response
24	General	**Division of Water Resources.** The proposed Cove Reservoir would provide much-needed water for agriculture and downstream municipal uses and would be a good fit for the recreational and tourism industries. This project can benefit the local agricultural service area and tourism industry economically while providing greater flexibility and resilience for water supplies in the downstream basin.	Thank you for your comment. See Section 5.5.2 in the Plan-EIS. No additional change in text is necessary.

Derek Hamilton
Water Resources Coordinator
USDA-NRCS
125 South State Street – Room 4010
Salt Lake City, UT 84138

Emily Paris
Project Manager
Eocene Environmental Group
444 South Main Street, Suite A6
Cedar City, Utah 84720

September 1, 2026

Submitted electronically: *derek.hamilton@usda.gov* *and* *EParis@eocene.com*

Subject: **Draft Watershed-Plan Environmental Impact Statement for the Cove-East Fork Virgin River Watershed Project**

Dear Mr. Hamilton and Ms. Paris:

The State of Utah (State), through the Public Lands Policy Coordinating Office (PLPCO), appreciates the opportunity to review and submit comments on the Draft Watershed-Plan Environmental Impact Statement for the Cove-East Fork Virgin River Watershed Project (EIS). The State appreciates how thoughtfully NRCS and Eocene have reviewed and incorporated our ongoing comments as a Cooperating Agency. In collaboration with the Utah Division of Wildlife Resources (DWR), the State submits the following comments for your consideration.

On page 139, Table 5.10, *Summary and Comparison of Alternatives*, the project objective is to "comply with the ZNP Water Right Settlement of 1996." Alternative 1 (no action alternative) states that "Alternative 1 would meet this project objective." It is the position of the State that the no-action alternative would **not** meet this project objective since the reservoir in question is one of the core conditions of the 1996 agreement.

Also on page 139, the total predicted cost for Alternative 2 is listed at $34,233,000 rather than $39,730,000.

Utah Division of Wildlife Resources

The terms “state sensitive fish” and “state sensitive species” are found on pages XV, 117, 125, and 162. The state’s sensitive species list was repealed by the legislature in 2020; therefore, the reference to sensitive species is no longer relevant and should be replaced with the Species of Greatest Conservation Need identified in the Utah Wildlife Action Plan. Virgin spinedace and flannelmouth sucker are species under conservation agreements. Desert sucker is a species of greatest conservation need.

For in-stream work or crossings within the wetted channel, please contact Christian Edwards, Native Aquatic Biologist, at the DWR’s Washington County Field Office at 435-216-6924, as soon as possible but at least 5 business days before the start of any construction activities that will impact the channel so the DWR can assess and move fish if needed.

If you have other wildlife resource questions, please contact Jessica Kinross, Impact Analysis Biologist at DWR’s Southern Region Office, at 435-691-2372.

Thank you for the opportunity to provide comments. The State looks forward to continuing to participate in this process. Please call to discuss any further questions or concerns.

Sincerely,



Redge Johnson
Director, Public Lands

Plan-EIS Comment Response Matrix Placeholder

Plan-EIS Comments Received Placeholder

Appendix B.

Watershed Project Maps

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Figure B-1
Vicinity Map

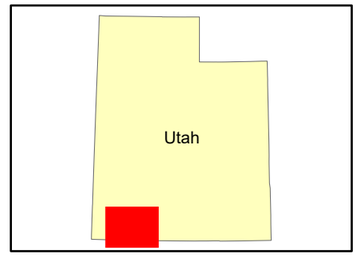
Cove - East Fork Virgin River Watershed Plan - EIS Project

Legend

- Watershed Area (97,449 acres)
- Headwaters East Fork Virgin River (33,414 acres)
- Lydias Canyon-East Fork Virgin River (40,747 acres)
- Muddy Creek (23,287 acres)
- Quail Creek Reservoir Diversion
- Pah Tempe Springs
- Virgin River
- US Highways and Interstates
- Municipal Boundary

Land Ownership

- BLM
- Forest Service
- Private
- Zion National Park



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Eocene Environmental Group

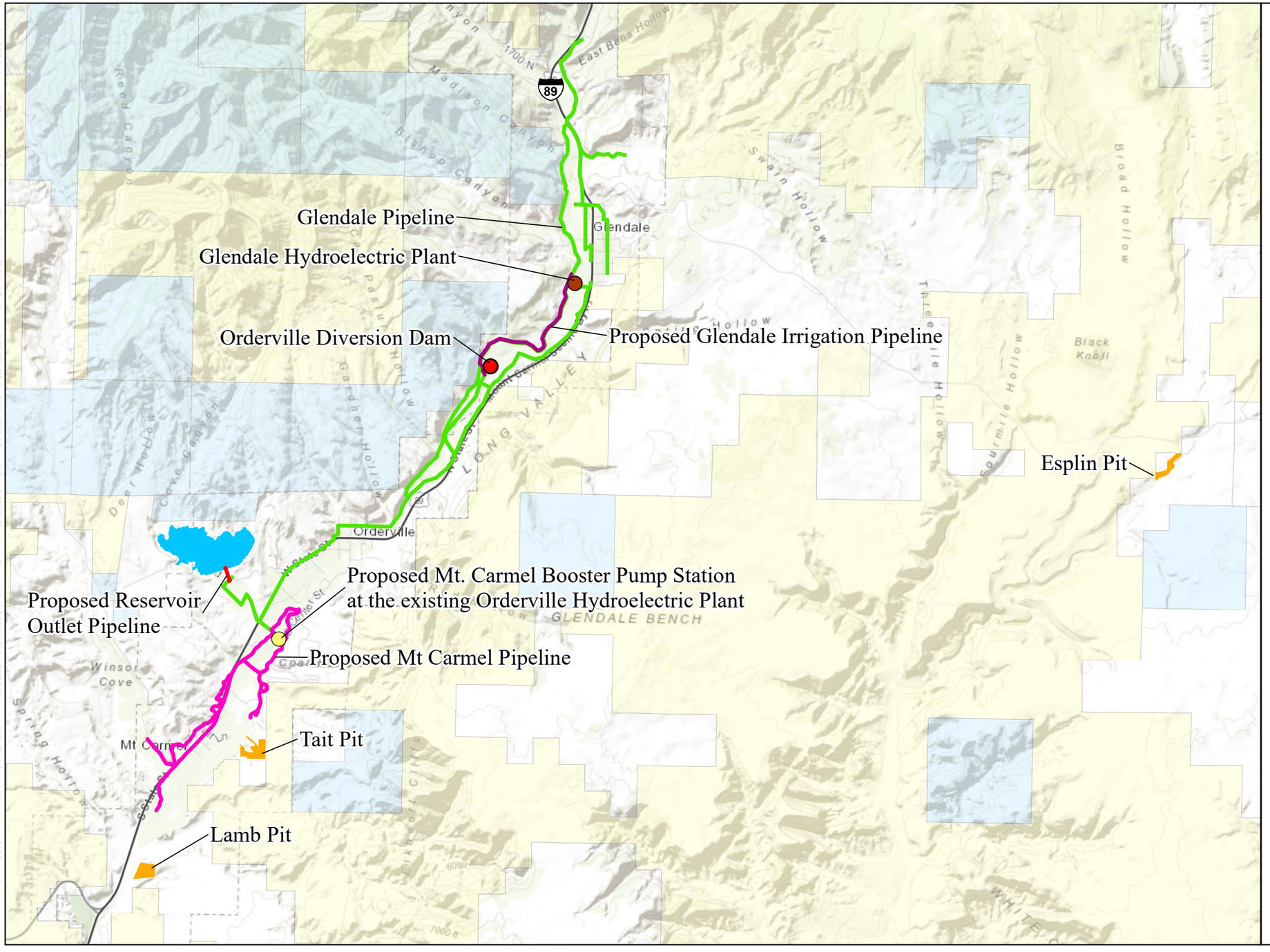


Figure B-2
Preferred Alternative Project Measures - Pipeline Overview

Cove - East Fork Virgin River Watershed Plan - EIS Project

Legend

Proposed Project Features

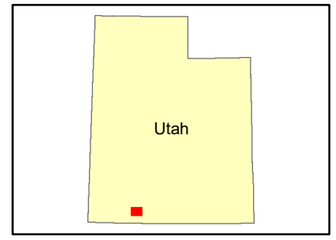
- Proposed Mt. Carmel Booster Pump Station at the existing Orderville Hydroelectric Plant
- Proposed Reservoir Outlet Pipeline
- Proposed Mt Carmel Irrigation Pipeline
- Proposed Glendale Irrigation Pipeline
- Proposed Cove Reservoir

Existing Project Features

- Glendale Hydroelectric Plant
- Orderville Diversion Dam
- Glendale Pipeline
- Borrow Pits

Land Ownership

- BLM
- Private
- SITLA



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Eocene Environmental Group

June 1, 2020
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May 29, 2026
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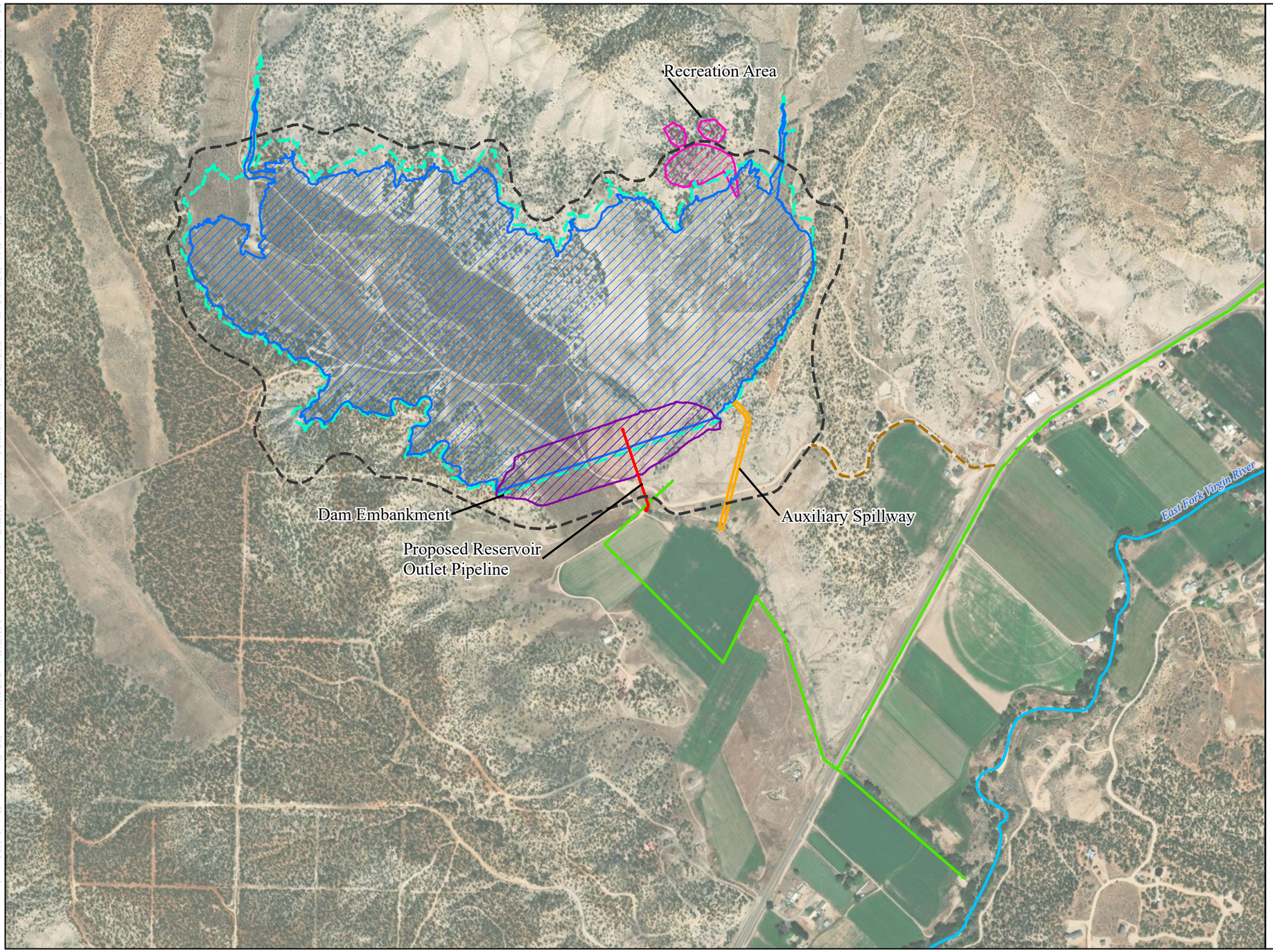
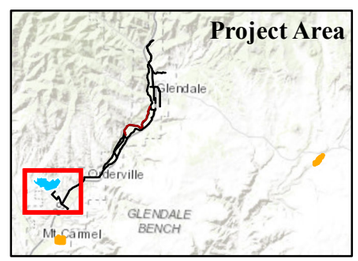


Figure B-3
Preferred Alternative
Project Measures
- Reservoir Detail

Cove - East Fork Virgin River
Watershed Plan - EIS Project

Legend

- Proposed Access Road
- Existing Road To Be Widened
- Proposed Reservoir Outlet Pipeline
- Auxiliary Spillway
- Existing Glendale Irrigation Pipeline
- East Fork Virgin River
- Dam Embankment
- High Water - Principal Spillway
- High Water - Auxiliary
- Recreation Area



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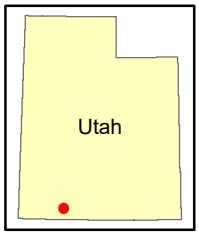

N

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Feet

Legend

- Access Rd
- Cove Reservoir
- Pavement
- Pavilion
- Primitive Camping (overnight)
- RV Camping (overnight)
- Restrooms

Figure B-4
Preferred Alternative
Project Measures
- Recreation Detail

Cove - East Fork Virgin River Watershed Plan - EIS Project

Eocene℠ Environmental Group

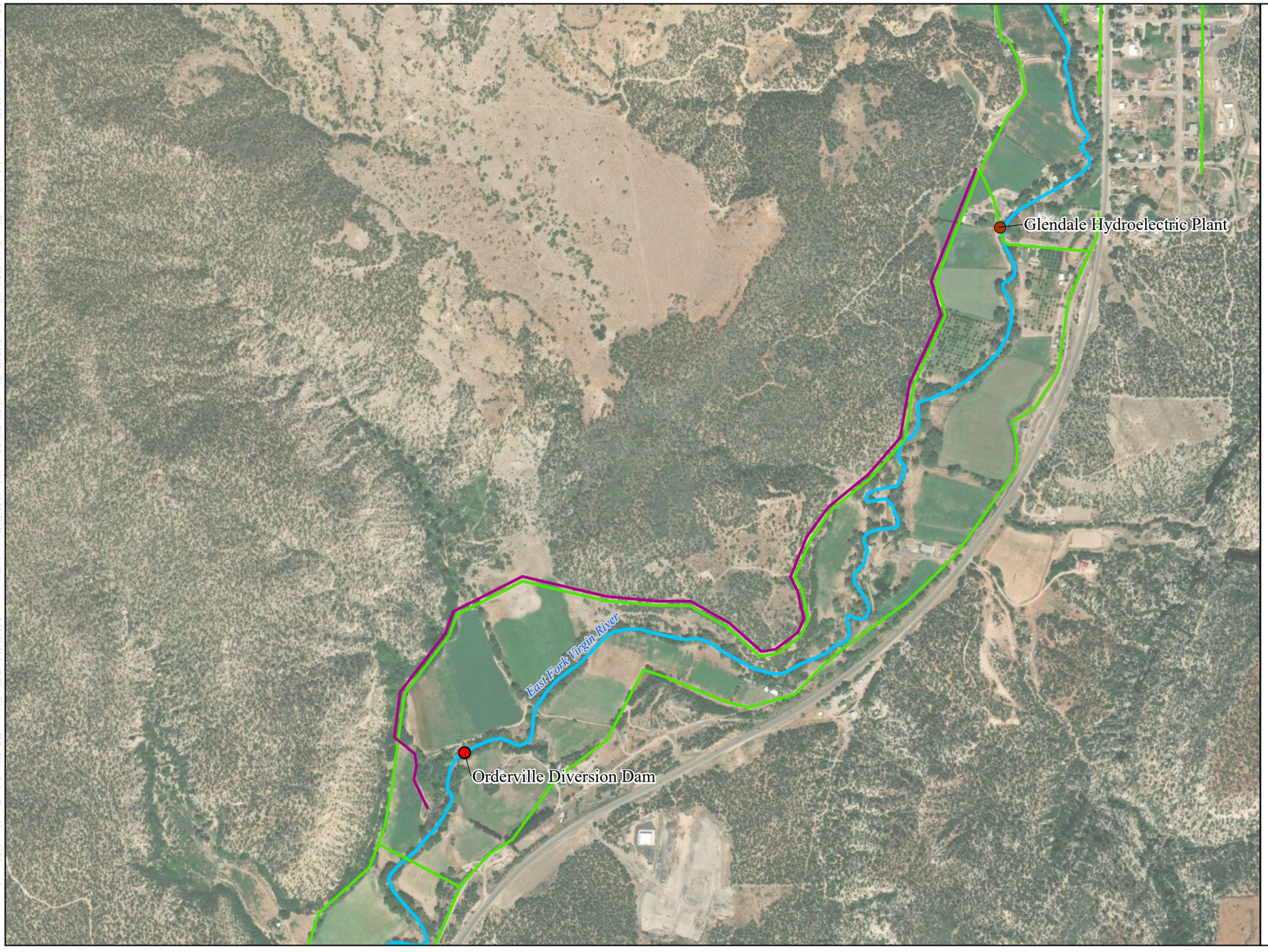
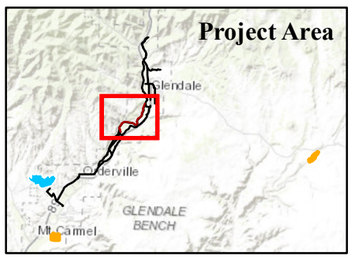


Figure B-5
Preferred Alternative Project Measures - Glendale Pipeline Detail

Cove - East Fork Virgin River Watershed Plan - EIS Project

Legend

- Orderville Diversion Dam
- Glendale Hydroelectric Plant
- Proposed Glendale Irrigation Pipeline
- Existing Glendale Irrigation Pipeline
- East Fork Virgin River



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Eocene Environmental Group

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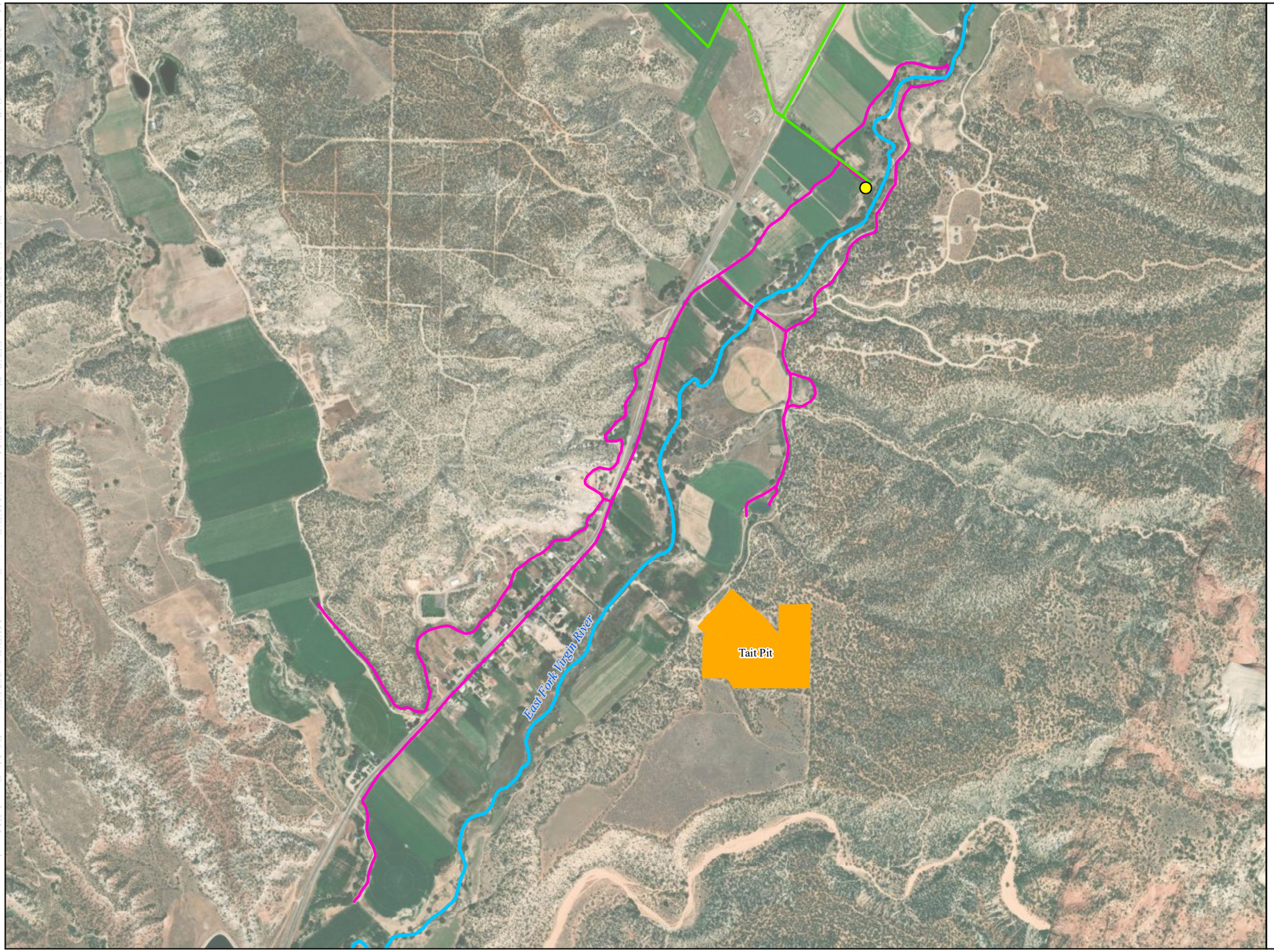
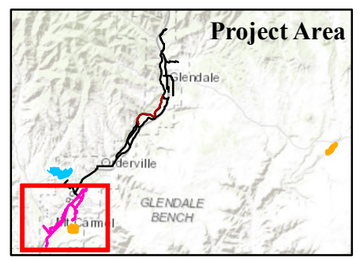


Figure B-6
Preferred Alternative Project Measures - Mt. Carmel Pipeline Detail

Cove - East Fork Virgin River Watershed Plan - EIS Project

Legend

- Proposed Mt Carmel Booster Pump Station at the existing Orderville Hydroelectric Plant
- Existing Glendale Irrigation Pipeline
- Proposed Mt Carmel Irrigation Pipeline
- Borrow Pits
- East Fork Virgin River



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Eocene Environmental Group

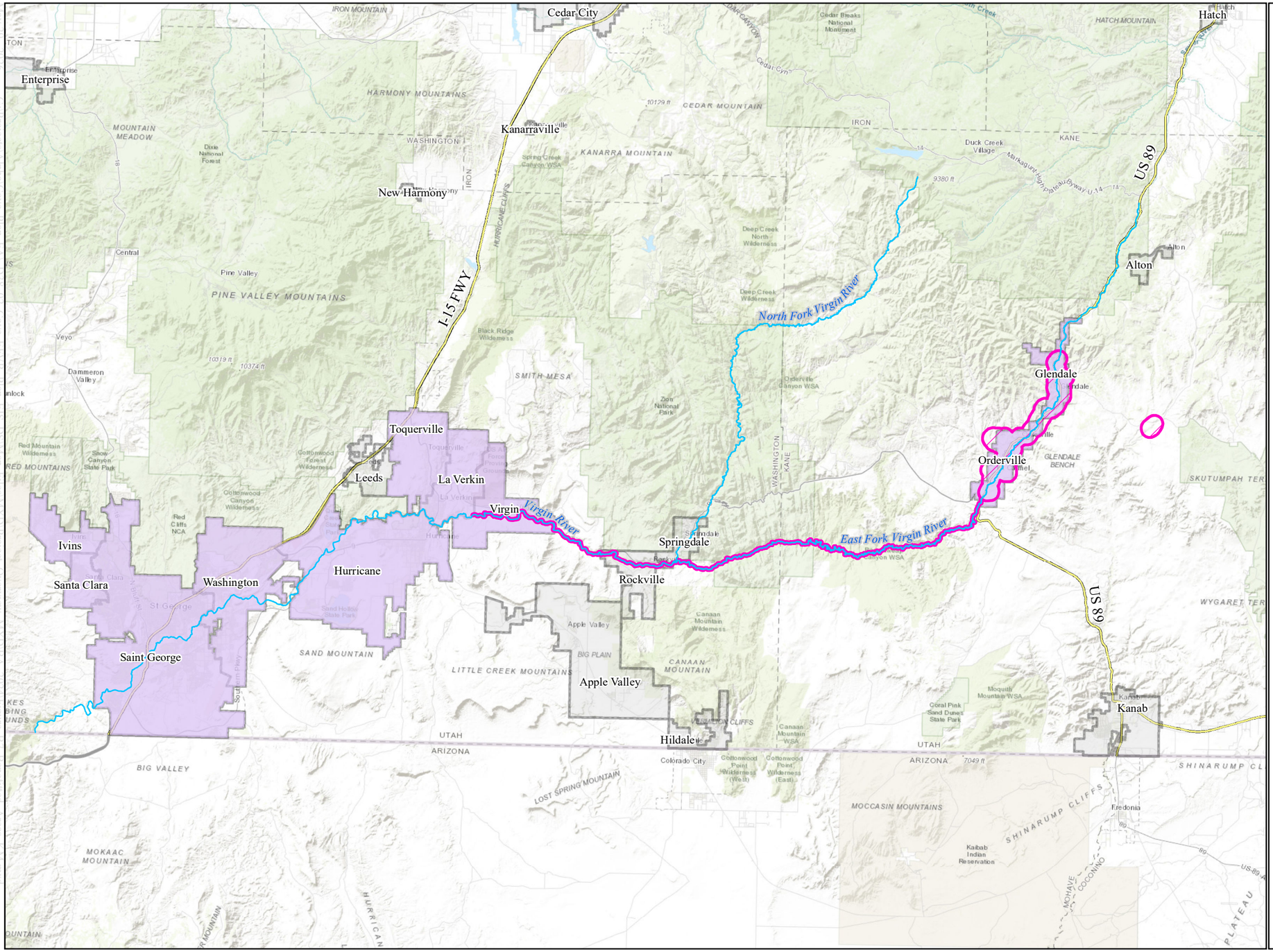


Figure B-7
Preferred Alternative
Benefitted Areas

Cove - East Fork Virgin River
Watershed Plan - EIS Project

Legend

- Virgin River
- US Highways and Interstates
- Study Area (13,973.08 Acres)
- Benefitted Areas (153,389.97 Acres)
- Municipal Boundary

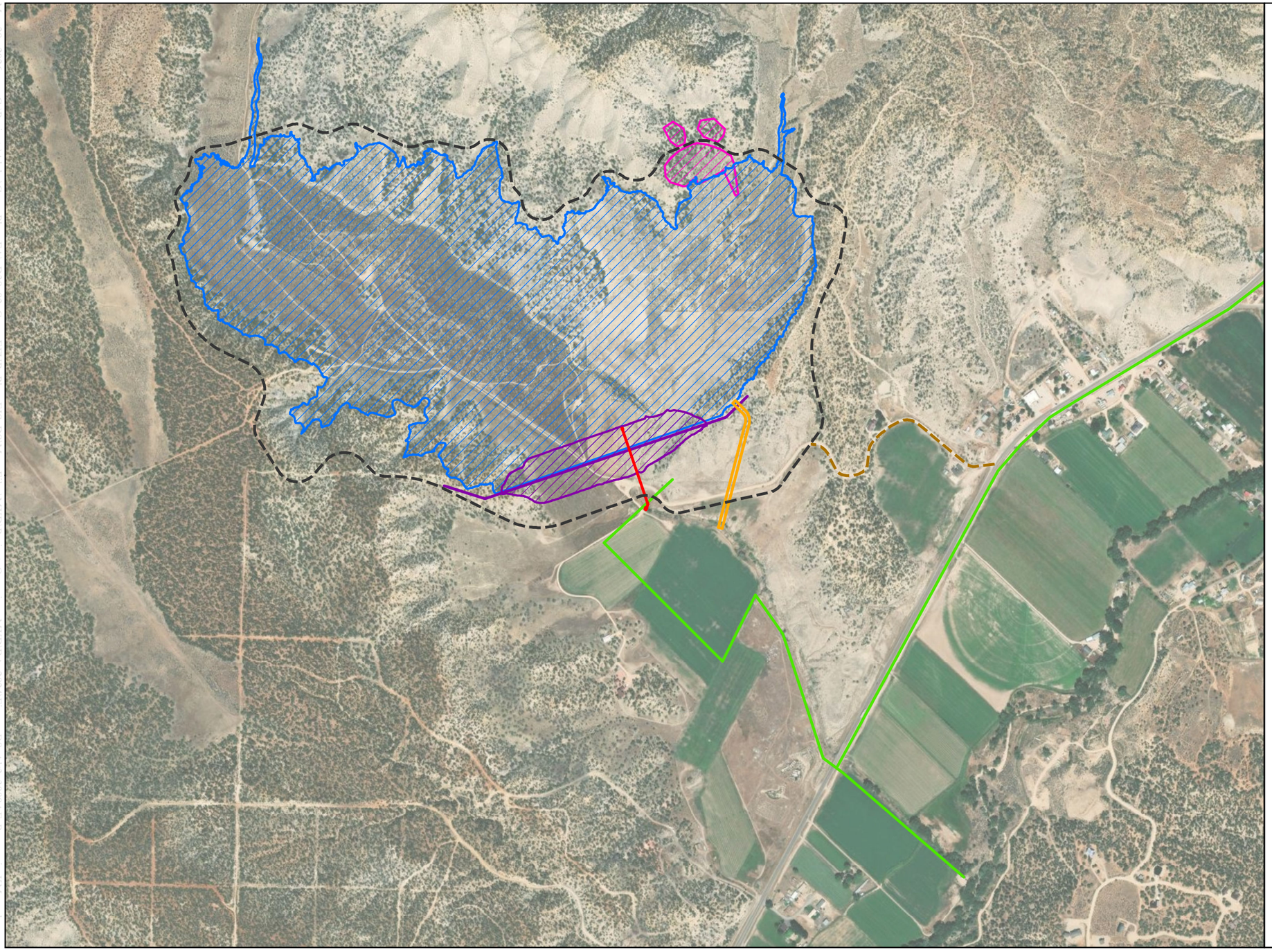
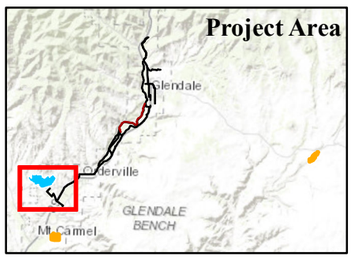


Figure B-8
Alternative 3 -
3,000-Acre-Foot Reservoir

Cove - East Fork Virgin River
Watershed Plan - EIS Project

Legend

- New Access Road
- Existing Road To Be Widened
- Reservoir Outlet Pipe
- Spillway
- Existing Glendale Irrigation Pipeline
- Dam Centerline
- Dam Outline
- High Water Elevation
- Recreation Area



N

0 0.3 Miles

Eocene Environmental Group

May 29, 2026
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Appendix C.

Support Maps

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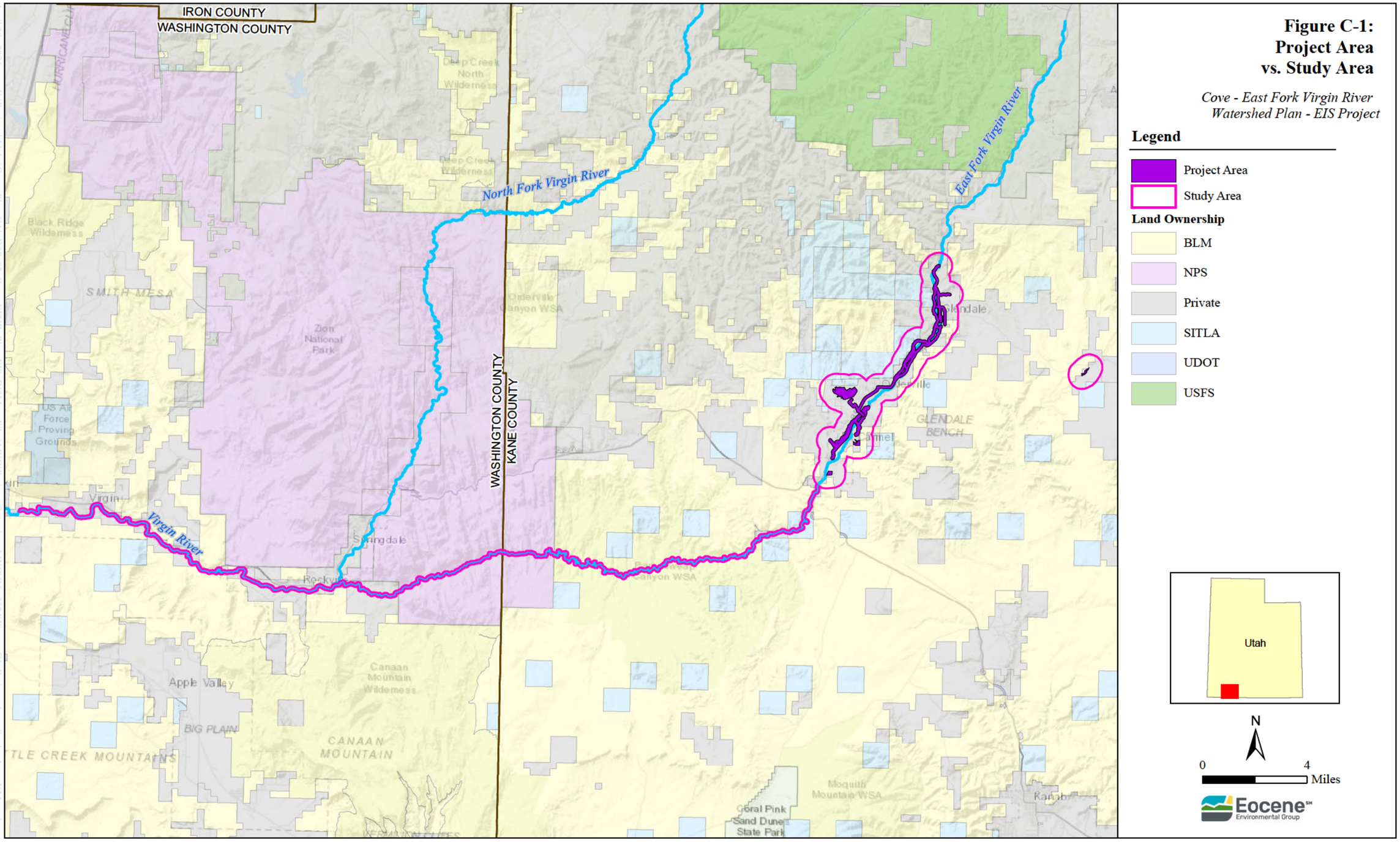


Figure C-1:
Project Area vs. Study Area

Cove - East Fork Virgin River Watershed Plan - EIS Project

Legend

- Project Area
- Study Area

Land Ownership

- BLM
- NPS
- Private
- SITLA
- UDOT
- USFS

KANE COUNTY

Glendale

Supplemental Survey

Black Knoll Pit
(Removed from Final Alternatives)

Bald Knoll Pits
(Removed from Final Alternatives)

Esplin Pit

Cove Reservoir

Orderville

GLENDALE BENCH

Mt. Carmel Irrigation Improvements

Tait Pit

Lamb's Pit

County Pit
(Removed from Final Alternatives)

THE SAND HILLS

Figure C-2: Project APEs

Cove - East Fork Virgin River

Watershed Plan - EIS Project

Legend

- Indirect APE
- Direct APE
- Visual APE
- Cultural Resources Survey Area

Land Ownership

- BLM
- Private
- SITLA
- UDOT

Utah

N

0 2 Miles

Eocene Environmental Group

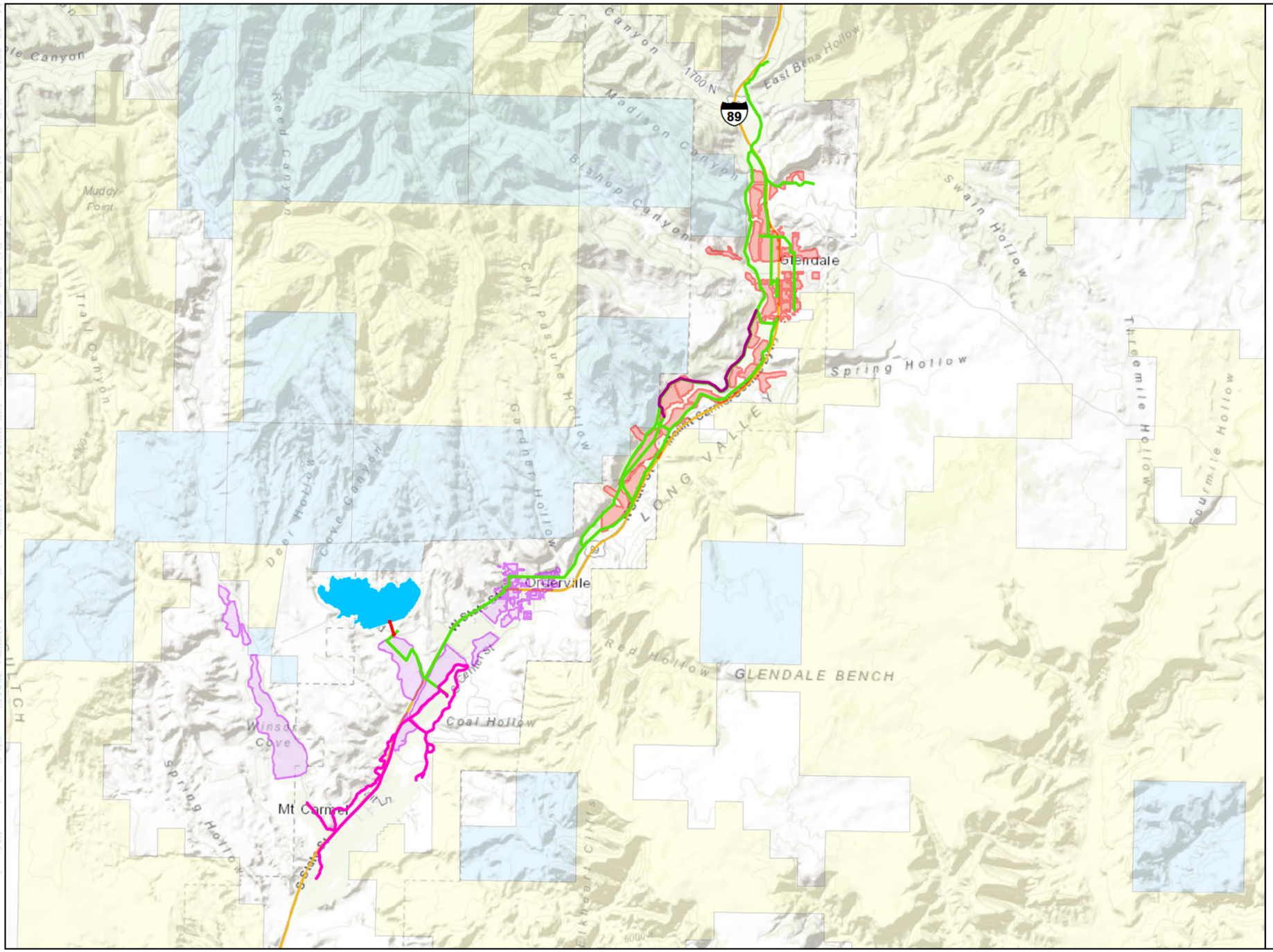


Figure C-3
Irrigation Company Service Areas

Cove - East Fork Virgin River Watershed Plan - EIS Project

Legend

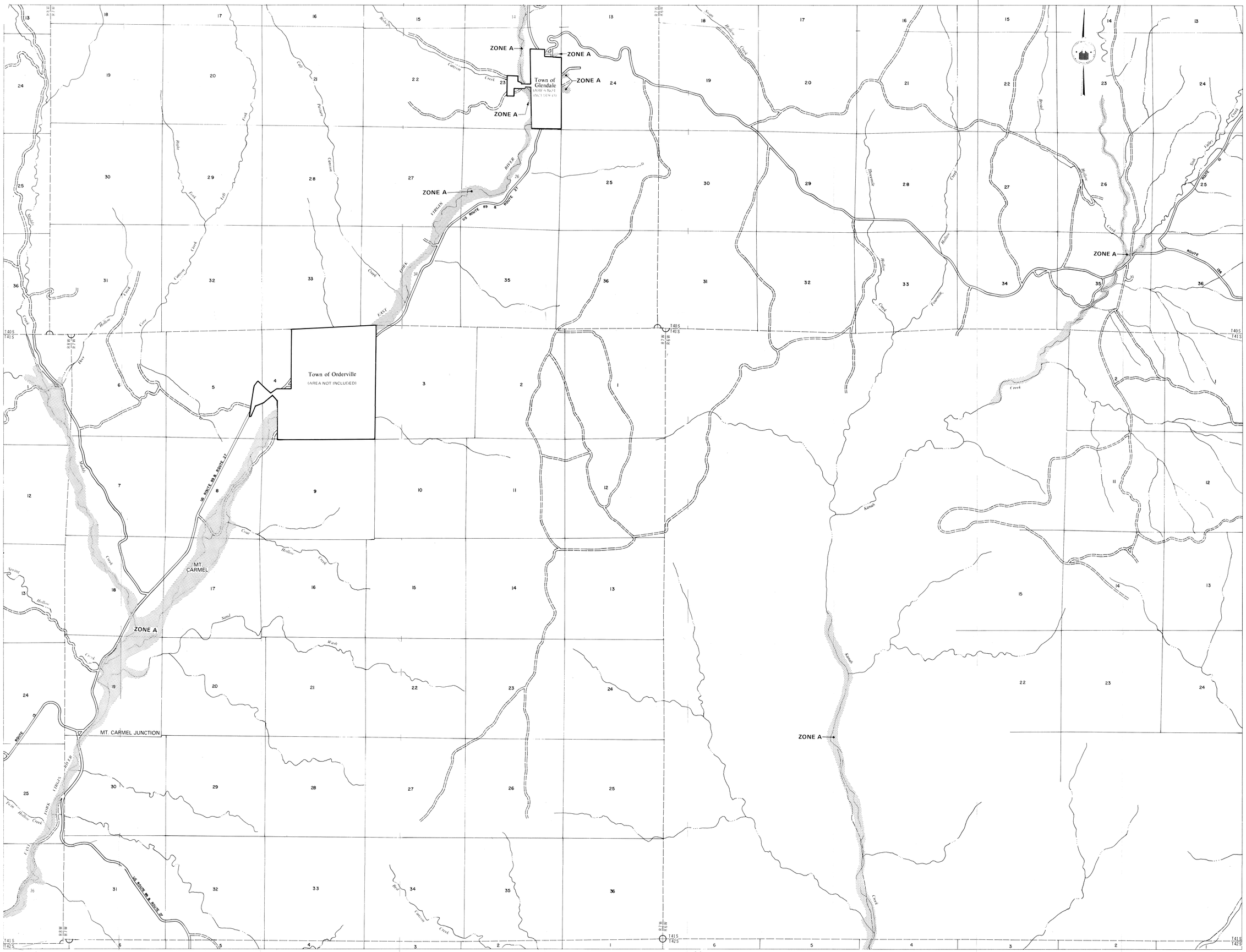
- Proposed Reservoir Outlet Pipeline
- Proposed Mt Carmel Irrigation Pipeline
- Proposed Glendale Irrigation Pipeline
- Glendale Pipeline
- Proposed Cove Reservoir
- Glendale Irrigation Co. Service Area
- Orderville Irrigation Co. Service Area

Land Ownership

- BLM
- Private
- SITLA

Eocene Environmental Group

May 29, 2026 G:\Projects\Alpha\Cove_Plan_EA_DS\6_02_Cove_EFVR_Plan_EIS_DS\Map_Files\MXD\Project_Overview_MXD\DA_2024\Figure_C3_Service_Areas_RM.mxd


ZONE A
Town of Glendale
(AREA NOT INCLUDED)
Town of Orderville
(AREA NOT INCLUDED)
MT. CARMEL
MT. CARMEL JUNCTION
ZONE A
ZONE A
ZONE A

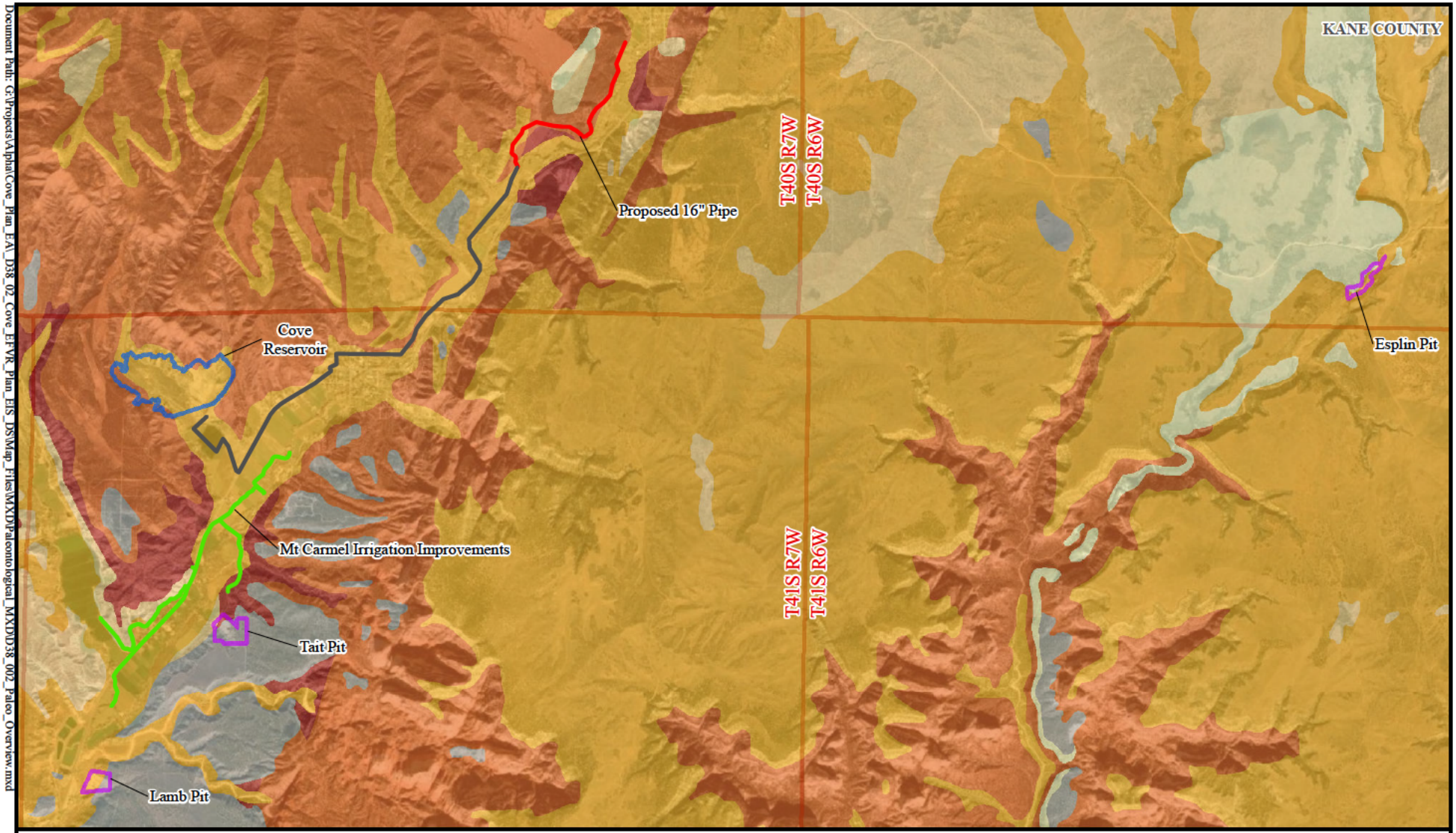


Figure C-5: Paleontological Overview

Alpha Engineering
Cove Reservoir Project

Date: 9/25/2024
Projection: NAD_1983_UTM_Zone_12N

Eocene Environmental Group

Document Path: G:\Projects\Alpha\Cove_Plan_EA_D38_02_Cove_EFVR_Plan_EIS_DSMap_Files\MXD\Paleontological_MXD\D38_002_Paleo_Overview.mxd

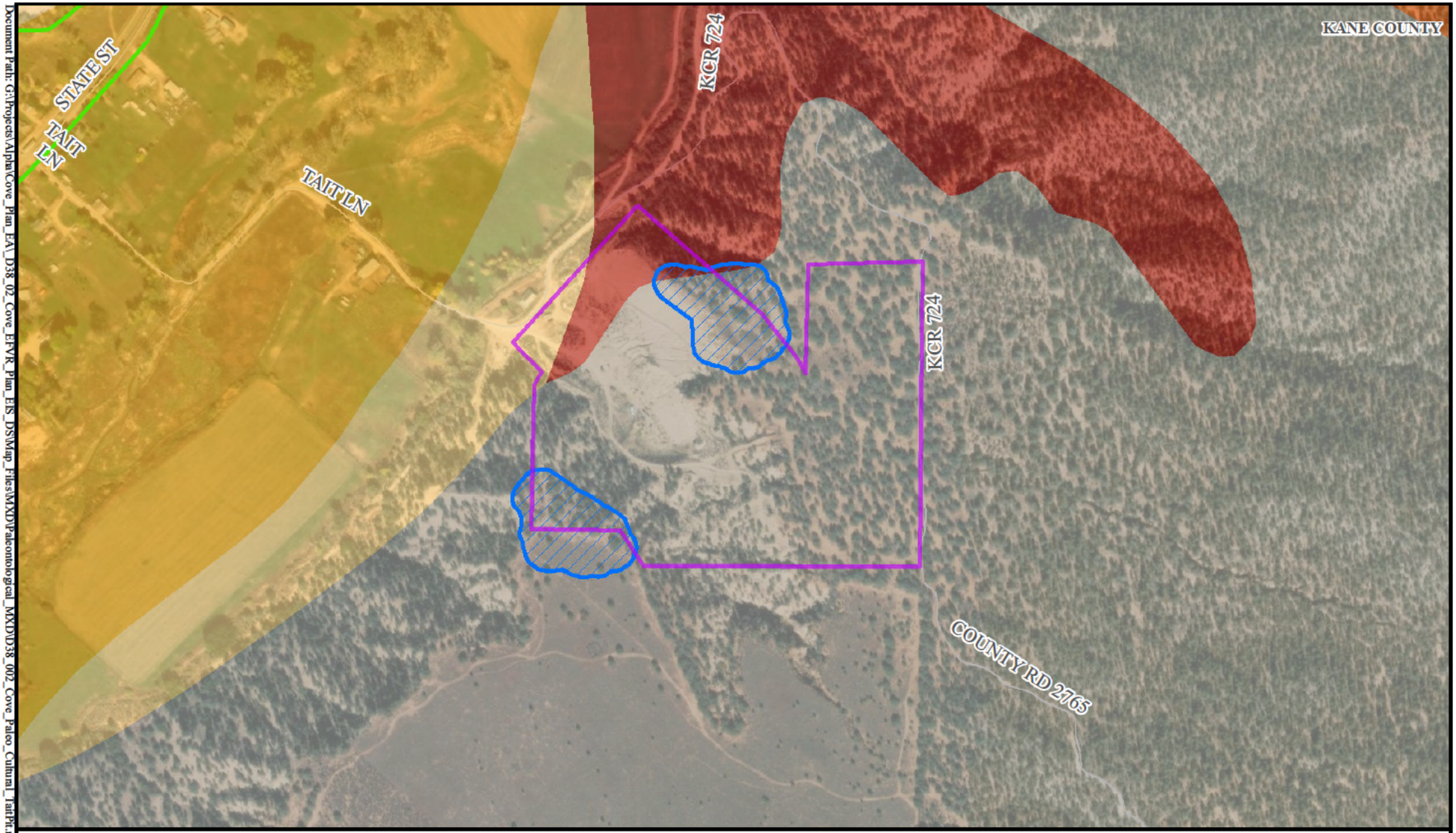


Figure C-6: Tait Pit Detail

Alpha Engineering
Cove Reservoir Project

Date: 12/13/2024
Projection: NAD_1983_UTM_Zone_12N

Eocene Environmental Group

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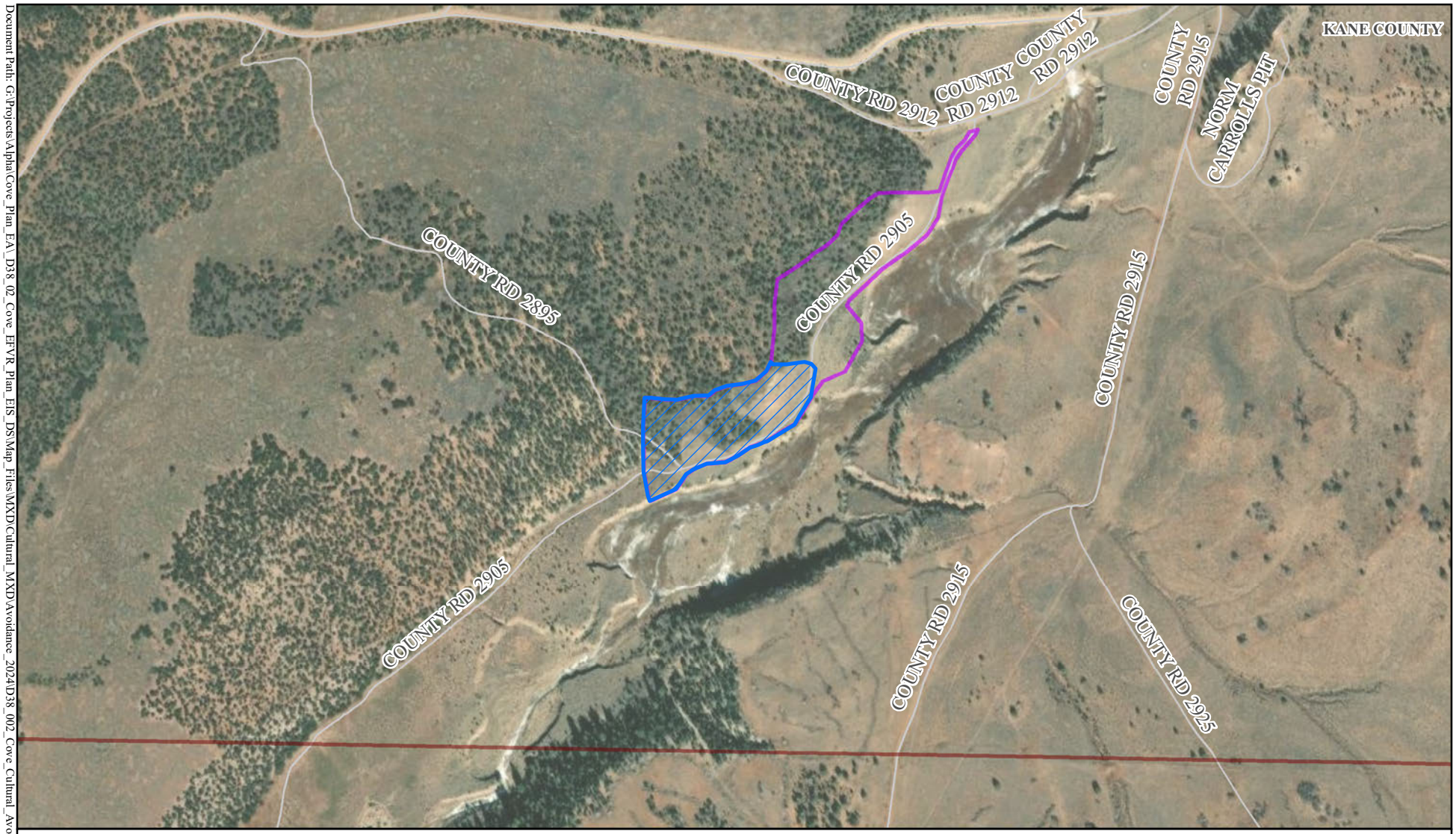

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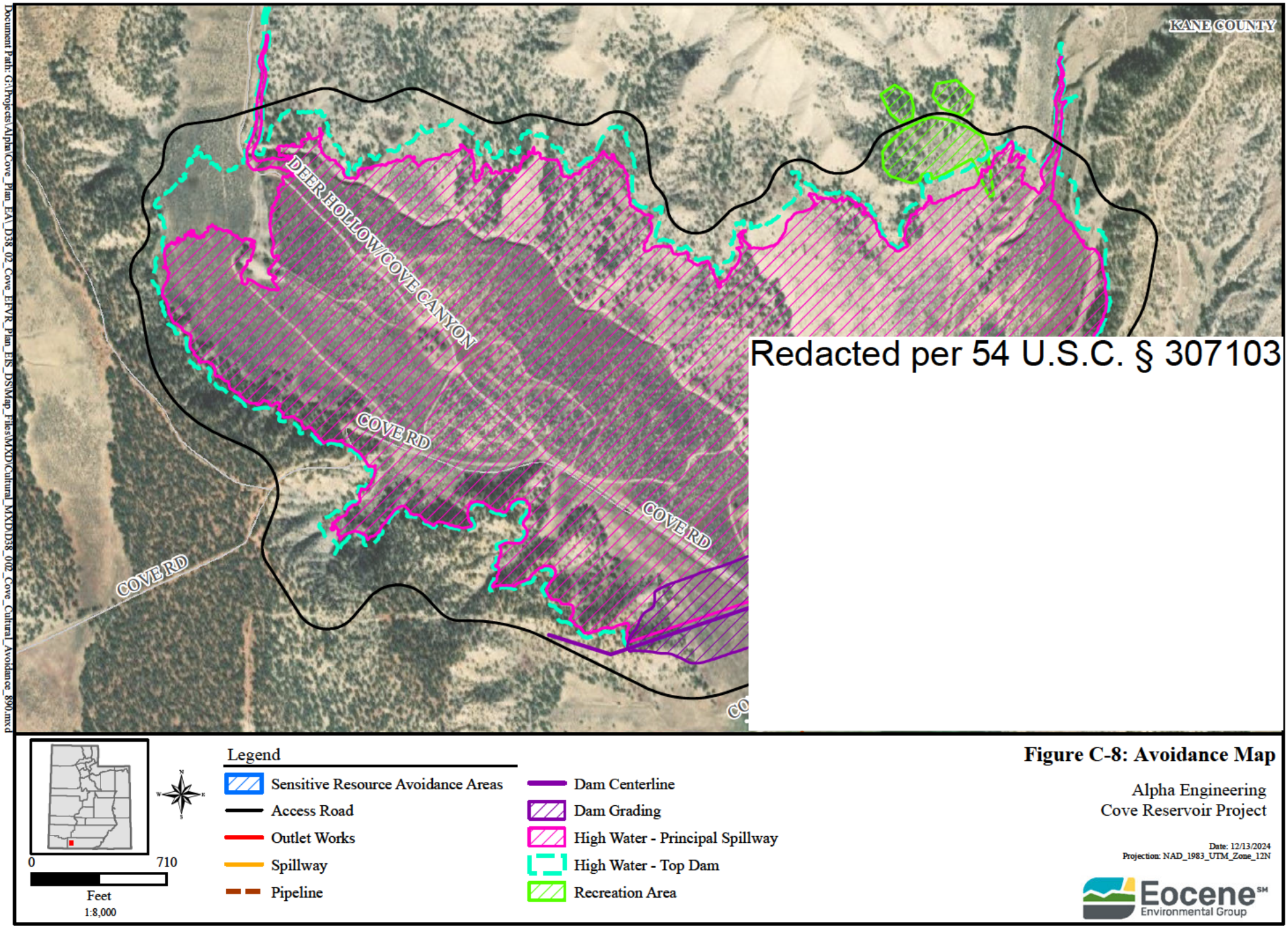

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Investigation and Analysis Report for Cove Reservoir

Appendix D

Cove Reservoir Watershed
Kane County Water Conservancy District
Kane County, Utah

The purpose of the Investigation and Analysis Report is to present information that supports the formulation, evaluation, and conclusions of the Supplemental Watershed Plan No. 8 and Environmental Impact Study (Plan-EIS). The report is required and must be included as an appendix to the Plan-EIS.

The procedures, techniques, assumptions, scope, and intensity of the investigations for each subject are described in sufficient detail so that a reader not familiar with the watersheds/dams or their deficiencies or issues can form an opinion on the adequacy of the Plan-EIS. This report supplements information contained in the Plan-EIS and is not intended to replace or duplicate information contained therein.

September 2026

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Attachment 4 Subsurface Investigation Data
Attachment 5 Conceptual Embankment Design
Attachment 6 Concept Design Drawings
Attachment 7 SITES Erosion Analysis

D.1 INTRODUCTION

The planning studies presented in this Investigation and Analysis Report (I&A Report) are based on standard methods, procedures, and computer programs used and approved for use by the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). The following information provides a summary of the investigation and analysis for the key planning studies in the preparation of the Plan-Environmental Impact Study (Plan-EIS) for the proposed Cove Reservoir Project. Additional information relevant to each of the sections provided in this report is available upon request as part of the Administrative Record for the project. Requests for additional information can be submitted to the following address:

USDA-NRCS
Wallace F. Bennett Federal Building
125 South State Street, Room 4010
Salt Lake City, Utah 84138-1100

The Cove Reservoir is located within the Cove Reservoir Watershed, situated approximately 1 mile west of the East Fork Virgin River in Kane County, Utah and approximately 1.5 miles southwest of downtown Orderville, Utah. The Cove Reservoir will be an off-stream reservoir consisting of an earthfill dam, low-level outlet works, piped principal spillway, and open channel auxiliary spillway (AS). Water will be kept within the reservoir year-round to be used as a drought and irrigation buffer.

Note on Vertical Datum: All elevations provided in this I&A Report for current conditions are in Utah Coordinate System of 1983, South Zone.

D.2 SEDIMENTATION

The site is located in the East Fork of the Virgin River Watershed at 37.273 degrees North 112.660 degrees West. The reservoir will serve as a multi-purpose structure including providing storage for irrigation, recreation, and drought.

The reservoir will have a storage capacity of 6,000 acre-feet and an average depth of 40 feet. The drainage area covers 4.7 square miles (3,034 acres). The reservoir site is in an alluvial valley that has been cut into Cretaceous and Tertiary sedimentary rocks consisting mostly of sandstone and shale. Residual soils are silt and sandy clay. The terrain adjacent to the basin valley has steep slopes. Ridges are capped with thin deposits of pebble gravel, cobbles of gray and red quartzite, gray to black chert, and gray limestone in a matrix of sand with silt. Vegetation in the drainage is sparse, consisting of brush and small trees. Using the National Engineering Handbook land cover designation, most of the drainage basin is comprised of Woods, Fair, with portions of Desert Shrub, Poor. The drainage areas can produce flash flood conditions and large sediment volumes during intense rainfall. For planning purposes, the reservoir has been conservatively assumed to contain all the sediment (100-percent trap efficiency).

An initial estimate of sediment yield has been performed using two methods included in the Bureau of Reclamation Erosion and Sedimentation Manual (BOR 2006) and the Estimated Sediment Yield Rates for the State of Utah Map (USDA 1973). These methods are described in the subsequent sections.

D.2.1 Sediment Yield as a Function of Drainage Area

Empirical sediment yield equations have been developed strictly as a function of drainage area based on reservoir sediment survey data. Strand and Pemberton (1982) developed the following equation for the semiarid climate of the southwestern U.S.:

$Q = 1.84A_d^{-0.24}$

Where Q = sediment yield, acre-feet/square miles per year
A_d = drainage area, square miles

For the reservoir drainage area of 4.7 square miles, a sediment accumulation of 6 acre-feet per year or 600 acre-feet over a 100-year period is computed.

D.2.2 Sediment Yield Classification Procedure

The Pacific Southwest Inter-Agency Committee developed a sediment yield classification procedure that estimates sediment yield as a function of nine individual drainage basin characteristics. Each characteristic is given a subjective numerical rating based on observation and experience and the sum of these ratings determines the basin classification and the annual sediment yield per unit area. Tables showing this procedure are included in the sediment supplemental documentation (Attachment 1). The sum of the basin characteristics ratings is 70, resulting in a classification number of 3, with annual sediment yield (acre-feet per square mile) ranging from 0.5 to 1.0.

For the drainage basin area of 4.7 square miles, using the upper end of the range results in an annual yield of 4.7 acre-feet and a sediment yield of 470 acre-feet over a 100-year life span.

D.2.3 Estimated Sediment Yield Rate Map

An estimated sediment yield rate map for the State of Utah was prepared by the USDA Soil Conservation Service in 1973 (USDA 1973). This map is a general area map with cautions that it is not to be used for specific sites since large variations may occur in the delineated areas. A copy of the map with the Cove Reservoir area enlarged is in the sediment supplemental documentation (Attachment 1). This area is in Yield Class 4 which indicates yield rates ranging from 0.2 to 0.5 acre-foot per square mile per year. Using the upper end of the range results in an estimate of 2.35 acre-feet per year for the 4.7-square-mile drainage area and 235 acre-feet over a 100-year life span.

D.2.4 Recommended Sediment Yield for Project Planning

These initial estimate methods are considered to provide upper-end values of the sediment volume which will accumulate over the 100-year life of the structure. Ranging from 235 (USDA Sediment Yield Rate Map) to 600 acre-feet (as shown in D.2.1), these values represent 10 percent or less of the reservoir storage volume and more refined analyses are not deemed necessary for planning purposes.

For planning purposes, an average 100-year total sediment volume of 418 acre-feet has been used. Due to the predominance of shale materials within the drainage basin, most of the sediments which are transported into the reservoir will likely be fined grained. Fine-grained sediments will remain in suspension longer, and deposition of these sediments will likely be more uniform throughout the reservoir area compared to coarser grained sediments, which are generally deposited in the upper end of reservoirs. Since most of the sediments are likely to be transported into the reservoir during periods of high stream flow, it is anticipated that some of the sediments will be deposited as aerated sediment above the PS elevation. For planning purposes, it is assumed that sediments will be equally deposited throughout the reservoir area when the reservoir is filled to elevation 5,547.5 feet (2 feet above the PS elevation). The surface area of the reservoir at elevation 5,545.5 feet (PS elevation) will be about 188 acres and the surface area of the reservoir at elevation 5,547.5 feet will be about 195 acres. Assuming 418 acre-feet of sediment is deposited uniformly over an area 195 acres in size results in a sediment depth of 2.1 feet. Based on the assumptions described above, it is estimated that 403 acre-feet of the sediment will be submerged (deposited below the PS elevation) and 15 acre-feet will be aerated (deposited above the PS elevation).

The estimated sediment yield of 418 acre-feet in 100 years is equivalent to 1.7 watershed inches. Since this sediment yield is less than 2 watershed inches in 50 years (4 watershed inches in 100 years), evaluation to reduce sedimentation yield within the watershed is not required by NRCS TR-60.

D.3 FLOODING AND RISK ANALYSIS

The project design report developed by Alpha Engineering and RB&G Engineering (Attachment 2) included a breach inundation analysis. The inundation area encompasses 0.3 square miles, extending down through agricultural land, a state highway, and sporadic residential houses and into the East Fork Virgin River. The hazard classification of the dam is “high,” and the total population at risk is estimated to be 10 to 15 people. The inundation area includes four

residential homes, appurtenant barns, and agricultural facilities. The maximum loss of life for the breach performed was determined to be 15 people.

D.4 GEOLOGY

D.4.1 Regional Geology

The Orderville area is located within the Grand Staircase section of the Colorado Plateau Physiographic Province. The Colorado Plateau Province covers areas of eastern and southern Utah, western Colorado, northwestern New Mexico, and northern Arizona. The Grand Staircase contains a series of terraces and cliffs which rise northward from the Grand Canyon to the High Plateaus. The Hurricane Fault bounds the section to the west, and the Kiabab Monocline bounds the section to the east (Stokes 1986).

The Grand Staircase section is typified by a series of alternating step-like cliffs and flat areas. The upward steps in the staircase include the Vermillion Cliffs, White Cliffs, Gray Cliffs, and Pink Cliffs. The cliffs consist of more competent material, while the lowlands between them consist of generally softer, more erodible deposits (Stokes 1986).

The age of the deposits exposed above the Grand Canyon range from the Triassic age, 245 million years ago near the Vermillion Cliffs, to the younger Tertiary deposits of the Pink Cliffs to the north. The cliffs consist of more competent material, while the lowlands between them consist of generally softer, more erodible deposits (Stokes 1986).

The age of the deposits exposed above the Grand Canyon range from the Triassic age, 245 million years ago near the Vermillion Cliffs, to the younger Tertiary deposits of the Pink Cliffs to the north, deposited 15 million years ago. A large portion of the sediments in this section were derived from continental deposits.

D.4.2 Site Geology

Surficial deposits in the study area consist of Quaternary alluvial deposits overlying bedrock. Bedrock throughout the planned reservoir basin and dam abutments consists of the Cretaceous age Tropic Shale Formation (Doelling 2008). No competent outcrops of Tropic Shale from which strike and dip could be measured were observed at the site. Based on information from drill holes and topographic and structural geology maps, bedrock in the area appears to dip 2 to 3 degrees down toward the northeast (Doelling and Davis 1989). The strike of the bedrock appears to range from North 30 degrees West to North 60 degrees West, based on geologic maps.

The following descriptions of the surficial and rock units in the study area are taken from *The Geology of Kane County, Utah, Geology, Mineral Resources and Geologic Hazards* (Doelling and Davis 1989) and interim geologic map of the Kanab 30-foot by 60-foot Quadrangle (Doelling 1999). Deposits are listed from youngest to oldest, with comments relative to the study area in italics. Additional geologic data including a geologic map is included in the 2004 feasibility study located in Attachment 3.

- *Quaternary*
    - Qa Alluvium—Sand and silty clay with lenses of sandy silt and gravel sediments consisting of unconsolidated clay, silt, sand, and gravel, which was deposited in streambeds and floodplains. During the feasibility investigation, sand and gravel deposits appeared very limited and discontinuous. Deposits may be considered for embankment material
    - Qag Alluvial gravel—Poor to well-sorted gravel and sand with some silt and clay interbeds. Exposures are predominately terrace deposits along the east side of the East Fork Virgin River, which trends southeast along the east side of the highway. Sand and gravel may be considered for granular borrow source
- *Cretaceous*
    - Ks Straight Cliffs Formation—Yellow-gray very fine to fine-grained, medium- to thick-bedded, cliff forming, calcareous sandstone with interbedded less resistant sandstone, shale, and mudstone. This unit is exposed north and northwest of the site due to faulting on the north side of Orderville. The formation is exposed as a yellow cliff-forming cap rock above the Tropic Shale. Competent material may be suitable for rip rap but appears to have many interbedded weak layers

  - Kt Tropic Shale Formation—Dark gray, drab marine shale with some gray sandstone. This unit forms the bedrock for the dam abutments and reservoir basin. At this site the formation also contains several grayish-white bentonite layers which are exposed along the south (right) side of the reservoir basin. Septarian nodules/concretions are also common locally. Some minor gypsum lenses, stringers, and fracture infilling were noted during this study
  - Kd Dakota Formation—Interbedded sandy shale, carbonaceous shale, sandstone, conglomerate, and coal
- *Jurassic*
  - Jc Carmel Formation—Sandstone, siltstone, limestone, shaly limestone, and gypsum.
  - Divided into members:
    - Jcw Winsor and Wiggler Wash Members—Reddish or yellow slope-forming silty sandstone
    - Jcp Paria River Member—Gypsum, reddish siltstone and sandstone, with some limestone at top. South of site seen as a white gypsum cliff along highway
    - Jcc Crystal Creek Member—Brown banded sandstone. To the south of site this unit exposes a small fault zone in a road cut off of highway
    - Jck Co-op Creek Member—Thin to medium bedded light gray limestone and tan limestone shale. Unit forms ledges south of sewer lagoon off of highway and was used as rip rap for lagoon. This unit is also exposed just east of the highway on the east side of the Sevier fault on the northeast end of Orderville. This may be a source of rip rap

D.5 SEISMIC ANALYSIS

Bedrock in the Orderville area shows evidence of ancient and younger Quaternary normal faulting. The Colorado Plateau Province is less tectonically active and has been less disrupted by compressional forces from the Sevier Orogeny compared to the Basin and Range Province, which is located northwest of the project site.

The project area is located near the western edge of the Intermountain Seismic Belt, which is a zone within the western U.S. between northern Arizona and northern Montana where frequent seismic activity occurs. The Sevier fault, which is the easternmost major extensional fault in southern Utah, is located about 2.7 kilometers (km) west of the site.

Probabilistic seismic analyses using the Dynamic: Conterminous U.S. 2014 (v4.1.1) online U.S. Geological Survey (USGS) Unified Hazard Tool estimate 5,000- and 10,000-year frequency Peak Ground Accelerations (PGA) at the site. This analysis resulted in estimated PGA values of 0.294 g and 0.418 g for the 5,000- and 10,000-year frequency events, respectively (USGS 2019).

An evaluation to determine ground motions that could occur at the site because of an earthquake generated by the Sevier section of the Sevier/Toroweap fault zone has been performed using the NGA West-2 Ground Motion Prediction Equations spreadsheet (v5.7) developed by the Pacific Earthquake Engineering Research Center. This section of the fault has been determined to be Quaternary age (Late Pleistocene, 10 to130,000 years ago) with no documented Holocene movement. The USGS states that the slip rate of this section is less than 0.2 millimeter per year, but no recurrence interval information is currently available. This section of the fault is about 89 km long and may be capable of generating a Maximum Credible Earthquake (MCE) with a magnitude of about 7.3. It is estimated that the MCE event of the Sevier section could generate a PGA of 1.02 g. The dam will be designed to prevent failure during this deterministically derived earthquake event.

D.5.1 Geologic Seismic Hazard Classification

Since failure of the Cove Reservoir Dam with the reservoir filled to the normal pool elevation may cause loss of life and serious damage to homes, important public utilities, and Highway 89, the seismic hazard classification of the dam will be High Hazard (NRCS 2005).

D.6 SUBSURFACE EXPLORATIONS

The characteristics of the subsurface material at the site were evaluated by drilling 5 borings during the 2004 feasibility study to depths ranging from 39 to 101 feet and excavating 2 test pits to depths of about 12 feet. Figure 4 from the 2004 feasibility study, which illustrates the locations of the test holes, is included in Attachment 4 for reference along with the logs for the borings and test pits. All five drill holes were completed within or very near the footprint of the proposed dam.

Both the drill holes and the test pits were used in evaluating the characteristics of the overburden material at the site. Bedrock core was recovered from four of the borings to assess the competency and condition of the foundation bedrock.

Three holes were drilled within the footprint of the dam, and one hole was drilled on each of the abutments at the locations shown in Attachment 4. The test holes are also shown on the profile included in Attachment 4, which was Figure 5 in the 2004 feasibility report.

DH 04-1, 04-2, and 04-4 were drilled vertically and DH 04-3 and DH 04-5 were drilled at an angle of 60 degrees from horizontal. While the drill logs indicate the angles and direction the hole was drilled, the core is not classified as being “oriented;” hence, the actual direction of bedding and fractures seen in the core cannot always be determined. Terms on the drill logs such as vertical fractures and angles of bedding referring to how these features appear relative to the cored sample and not to actual vertical and horizontal planes.

D.6.1 Soil Profile

The depth of soil overburden varied from 20 to 47 feet at the locations of the borings drilled within the valley floor. Deeper deposits which were not encountered at the boring locations may be present. TP 04-5, excavated on the small knoll at the planned upstream toe of the dam near the maximum section, encountered heavily weathered shale bedrock at a depth of only 4 feet.

The soil overburden sampled from the drill holes and test pits consists predominantly of lean clay with interbedded layers and lenses of fat clay, sandy silt, and silty sand with pockets of gravel. The overburden is a combination of weathered material from the underlying Tropic Shale formation and alluvial material washed down from the surrounding slopes. The silt and clay deposits were heterogeneously layered, with some sections of the test pits showing distinct layers several inches in thickness and other sections of the test pits showing thin, closely spaced lenses less than an inch in thickness. When combined, these layers generally exhibit the characteristics of lean clay with medium plasticity and good workability. A close examination of the sidewall of the test pits showed that the interbedded layers of silty sand were generally fine grained and from 1 to 6 inches in thickness. Gravel particles tended to be sandstone or shale in origin with sub-angular to sub-rounded edges. Generally, the pockets of gravel were fine grained with a size range of 0.25 to 1 inch. The gravel layers which made up these scattered deposits were observed to be from 1 to 3 feet in thickness. A few cobbles and boulders up to 12 inches in size were encountered within the test pits. A pin-hole structure was readily evident in the silt- and clay-type deposits within the upper 10 feet of the soil profile at this site, and the moisture content of the samples collected varied from dry to very dry.

Standard Penetration Test values ranged from 6 to 55, indicating that the material is in a firm to hard condition. Thirteen disturbed samples and seven undisturbed samples were recovered from the bore holes. Some of the undisturbed samples recovered were not extracted intact due the very dry condition of the soil.

The overburden on the abutments was removed during construction of the access roads for DH 04-3 and DH 04-5. Drilling began directly in the weathered bedrock. It is estimated from the access road cut that the depth of overburden prior to its removal was between 1 and 3 feet.

D.6.2 Bedrock Profile

The quality of the bedrock is characterized by the percent of core recovered, along with the Rock Quality Designation (RQD). The RQD is the percent of material within a cored interval that is recovered in pieces at least twice the core diameter (~4 inches) in length. The recovered core generally consisted of gray mudstone (Tropic Shale Formation) with occasional bentonite layers.

It will be noted from the boring logs that the percent recovery and RQD ranged from 63 to 100 in DH 04-1 and DH 04-2, which is located on the valley floor.

In DH 04-3 on the right abutment, the bedrock in the upper 25 feet was highly weathered and fractured, with the percent recovery ranging from 78 to 100 and the RQD varying from 18 to 65. Below 25 feet, the percent recovery ranged from 69 to 100 and the RQD varied from 42 to 100 except for the layer between 32 and 38 feet, which had 0 percent RQD. Minor gypsum coating was observed on some joints in the upper 70 feet. Bentonite layers, approximately 1.5 feet thick, were encountered at 25, 75, and 95 feet.

In DH 04-5 on the left abutment, the bedrock in the upper 40 feet was highly fractured, with the percent recovery ranging from 0 to 96 and an RQD of 0. Below 40 feet, the bedrock was relatively competent, with the percent recovery ranging from 80 to 100 and the RQD varying from 60 to 100. A few random gypsum stringers were observed in the core between 28 and 46 feet. Bentonite layers ranging in thickness from 0.5 to 2 feet were encountered at 71, 77, and 89 feet.

D.6.3 Groundwater

The depth where groundwater was measured in the borings is shown on the boring logs and profile included in Attachment 4. It can be observed from the profile that the gradient is toward the center of the basin.

D.7 GEOTECHNICAL ANALYSIS

An earthfill dam will be the most efficient structure for the reservoir at this site due to 1) the characteristics of the foundation material, 2) an adequate source of embankment material within the basin, and 3) the lack of a good source of gravel and rock in close proximity to the site for construction of a roller-compacted concrete or rockfill-type structure. Therefore, geotechnical analyses have been limited to an earthfill-type embankment.

D.7.1 Embankment Cross Section

A conceptual embankment design cross section is included in Attachment 5. The plan and cross section were included as Figures 4 and 6 in the 2004 feasibility study. Per the cross section, a homogeneous embankment with an internal chimney filter/drain is proposed. Zone I will consist of relatively impervious material from the foundation excavation and the reservoir basin. The material will be predominately lean clay. Material within the dam footprint and reservoir basin is several percent below the optimum moisture, so moisture conditioning of the borrow materials will be required. Some mixing to blend silt and sand layers with the clay will also be required to produce a uniform embankment soil having at least 50 percent passing a No. 200 sieve. An 8-foot-wide chimney filter/drain will be located downstream of centerline and will be designed to protect the lean clay from piping and to intercept water, preventing saturation of the downstream embankment. Slope protection will be required, with rock riprap and bedding planned for the upstream slope and native shallow root seeding planned for the downstream slope.

A 6-inch surface course of untreated road base will be placed to cap the crest of the dam to provide a finished surface. The crest will be sloped at 2 percent downward toward the reservoir to prevent ponding.

A crest width of 25 feet has been assumed, with an upstream slope of 3H:1V (Horizontal:Vertical) and downstream slope 2H:1V. The crest of the dam will be 6.5 and 3.0 feet above the crests of the PS and AS, respectively.

D.7.2 Stability Analysis

Preliminary steady-state reservoir full and instantaneous draw down slope stability analyses were performed during the 2004 feasibility study (Attachment 3). Calculated factors of safety were 1.51 and 2.18 for the downstream and upstream slopes, respectively, for reservoir full steady-state conditions. A factor of safety of 1.2 was calculated for the upstream slope instantaneous draw down condition. These calculated factors of safety are adequate to meet NRCS and Utah State Dam Safety requirements.

D.7.3 Settlement Analysis

A settlement analysis was performed for the maximum section of the embankment during the 2004 feasibility study. The analysis resulted in a calculated consolidation settlement of 48 inches beneath the center of the dam and 1 inch beneath the upstream and downstream toes if the proposed embankment were constructed on the native overburden soils without any treatment. The foundation treatment will include excavation and replacement of overburden deposits beneath the embankment footprint to reduce the expected consolidation and differential settlement, which could result in embankment cracking. The excavation depth will extend into bedrock in the cutoff trench at the dam centerline, transitioning to a depth of 10 feet at the embankment toes to reduce the estimated consolidation settlement to less than 6 inches.

D.7.4 Foundation Treatment

Due to the potential for collapse of the native overburden deposits, it is recommended that a portion of the overburden soil be excavated to limit settlement. The excavated material can be used as embankment fill. A cutoff trench will be required to extend through the weathered mudstone and into competent rock.

The field investigations revealed significant fracturing of the bedrock at select locations, principally on the abutments. The results of the permeability tests show that significant seepage loss can be expected through the bedrock abutments. Due to the nature of the foundation bedrock, it is believed that a majority of the seepage will be a result of secondary permeability through fractures and joints rather than by seepage through unbroken deposits (primary permeability). To mitigate the potential harmful effects of large seepage losses, the design will include the features described in the following subsections.

D.7.4.1 Impervious Clay Cut-Off Trench

The design will include an impervious clay cut-off trench extended through the overburden soil, weathered bedrock, and at least 5 feet of competent bedrock. Fractures and joints beneath the impervious cut-off and sand filter will be treated to prevent internal erosion. Final foundation treatment will need to be completed shortly after final excavation to prevent air slacking and cracking of the mudstone rock.

D.7.4.2 Grout Curtain

Based on the permeability test results and the condition of the recovered bedrock core, the design will include a foundation grouting program for the abutments. The conceptual design includes a triple-row grout curtain installed beneath the center of the embankment abutments.

D.7.4.3 Downstream Filter and Drain

Two separate but interrelated structures, a downstream filter and drainage blanket, have been included in the conceptual design to mitigate the potential for piping of embankment material and facilitate drainage of seepage which may bypass the cut-off.

A collector toe drain has also been included in the conceptual design. Manholes will be installed along the pipeline to facilitate seepage monitoring and allow drain access.

D.8 WATER QUALITY

There is no permanent pool or perennial stream associated with the Cove Reservoir. The lower elevations of the drainage course appear to be intermittent while the higher reaches appear ephemeral. There is no culinary use or habitat use to be associated with the water discharged through the dam. There is a scarcity of information regarding current water quality at the project site. The reservoir will serve as a storage facility for diverted river flows. As discussed in Section D.2, the reservoir site is situated in an alluvial valley which will likely produce large sediment volumes during intense rainfalls. Water storage within the reservoir will allow sediment to settle out of the water before leaving the reservoir, thus improving downstream water quality conditions.

D.9 HYDROLOGIC ANALYSIS

The preliminary design report developed by Alpha Engineering and RB&G Engineering (Attachment 2) included the identification of three design floods per NRCS requirements in

development of the PS and AS. The design floods include the FBH—also referred to as the IDF for the State of Utah—the SDH, and the PSH. The FBH was defined from the 24-hour Extreme Event Hydrograph. The results are included in Table 1.

Table 2: Design Flood Information

Design Flood	Crest Elev.	Peak Water Elev.	Geometry	Peak Storage	Peak Res'v Inflow	Peak Res'v Outflow	Peak Depth over AS
FBH (General)	5549.2 feet (AS)	5551.8 feet	30 feet (AS width)	7,221 acre-feet	3,524 cfs	404 cfs	2.8 feet
ASH (General)	5549.2 feet (AS)	5549.6 feet	30 feet (AS width)	6,855 acre-feet	1,766 cfs	71 cfs	0.4 feet
PSH	5545.5 feet (PS)	5548.2 feet	30 inches (PS diameter)	6,535 acre-feet	850 cfs	39 cfs	0.0 feet

Additional results from the analysis indicate peak reservoir inflows for the following events:

- 2-/5-/10-/25-/50-/100-/500-year, 24-hour (AMC II) 89/175/261/396/506/632/ and 1,064 cfs
- 100-year, 6-/24-hour (AMC III) 2,280/1,031 cfs
- Local SEP Hydrograph 6,395 cfs
- General SEP Hydrograph 1,587 cfs

The total required freeboard based on Administrative Rules for Dam Safety and TR-60 was calculated and included the determination of the maximum wave runup during 50-mile-per-hour (mph) and 100-mph winds. According to Dam Safety and TR-60 requirements, the total freeboard requirement is 6.3 feet above the PS crest elevation, or 5,551.8 feet. The top of dam for the Cove Reservoir has been set at 5,552.0 feet to accommodate hydrologic and freeboard constraints.

D.10 AUXILIARY SPILLWAY SUITABILITY AND INTEGRITY ANALYSIS

Flood routing analyses performed for the conceptual design indicate that the SDH (AS Hydrograph) can be routed through the proposed Cove Reservoir and PS without use of the AS; therefore, no erosion within the AS would occur as a result of the stability design storm, and the NRCS stability design requirements would be satisfied. An integrity design erosion analysis for the AS while passing the Freeboard Design Hydrograph was performed using the NRCS SITES computer program (version 2015.1.8). The estimated peak flow through the AS while routing the FBH through the reservoir is 378 cfs. NRCS requires that the spillway be designed to not breach during passage of the freeboard storm.

The boring completed on the left abutment nearest the proposed AS during the 2004 feasibility study (DH04-5) encountered weathered shale at the ground surface. Based upon a review of erosion parameters for weathered shale included in the SITES program Help menu, a head cut index of 0.2 and representative diameter of 1 inch was used to model the weathered shale materials. The results of the SITES analysis are illustrated in Attachment 7, and it will be noted that the estimated erosion as a result of the freeboard storm does not result in a spillway breach. The results of the analysis indicate that NRCS AS integrity requirements are satisfied.

D.11 DESIGN CRITERIA

NRCS TR-60, Earth Dams and Reservoirs (NRCS 2005), and Utah State Rule R655-11, Requirements for the Design, Construction, and Abandonment of Dams, will be the governing design criteria for the proposed Cove Reservoir Dam. In cases where the requirements of the two design criteria are different, the more conservative will be used for design of the Cove Dam and Reservoir.

D.12 AGENCY COORDINATION

During the preliminary scoping period for the project, scoping questions, comments, and concerns were requested from government agencies, both orally at public meetings and via written submittal of comments.

A scoping notice was mailed to interested parties, published in the local newspaper, and posted to the NRCS project website. The scoping comment period was open for 30 days and no comments were received.

A public notice of availability of the Draft Plan-EIS will be mailed to interested parties, published in the local newspaper, and posted to the NRCS project website. The Draft Plan-EIS will be released for public review and comment, and a public meeting will be held.

Agency coordination and consultation is summarized and documented in Section 1.5, Section 5, and Appendix E of the Plan-EIS.

D.13 ALTERNATIVES EVALUATION

The formulation process of alternatives for the construction of Cove Reservoir followed procedures outlined in the NRCS National Watershed Program Manual (NWPM) (NRCS 2014a) Parts 501 through 506, NRCS National Watershed Program Handbook (NRCS 2010) Parts 600 through 606, Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G) (USWRC 1983), and other NRCS watershed planning policy. Alternatives were developed by the project team based on the ability to address the purpose and need of the project and were formulated in consideration of four criteria outlined in the P&G (USWRC 1983): completeness, effectiveness, efficiency, and acceptability. No comments were received during the scoping period regarding the formulation process for the initial alternatives, and no suggested alternatives, including alternative sites for the proposed reservoir, were received.

According to the NWPM, the following relevant alternatives and expected consequences must be evaluated:

- No Action Alternative—Most likely future condition if none of the federally assisted action alternatives are selected
- National Economic Development (NED) Alternative—One of the alternatives, or a combination of them. This is the federally assisted alternative with the greatest economic benefits

D.13.1 Alternatives Eliminated from Detailed Study

As described in detail in Section 3.3 of the Plan-EIS, alternatives were developed early in the process following the procedures identified above but were eliminated from detailed study due to environmental impacts, cost, effectiveness, and logistics. A description of the alternatives eliminated from detailed study is included below.

D.13.1.1 Alternative Reservoir Sites

Four potential dam sites were identified in the general vicinity of the project area. One site was located about 0.5 miles north of Orderville. However, it was determined that the site was located on a complex fault structure with one major and two minor faults converging at the potential dam axis. Additionally, the depth to bedrock was determined to be excessive (UDWRe 1988). See Section 3.3 of the Plan-EIS for a detailed discussion of this potential site.

Three other potential dam sites are located too far away to effectively meet the needs of the local water users. Additionally, development of these sites would be less efficient, more expensive, and more environmentally damaging primarily due to the need for much longer water transmission pipelines. Therefore, none of these sites were carried forward for analysis in the Plan-EIS.

D.13.1.2 Non-Structural Alternatives

Non-structural alternatives, such as water conservation, water recycling, and utilizing other sources of water, were considered. These alternatives were determined to be infeasible because they would not meet the purpose and need of the project, which is to provide sufficient critical water storage capacity, more efficient and reliable water flow (particularly during dry summer months), and increased recreation opportunities. The Kane County Water Conservancy District (KCWCD) already implements water conservation measures for projects in their jurisdiction. No other water sources sufficient to meet the purpose and need of the Proposed Action are located

near the project area. Therefore, none of these non-structural alternatives were carried forward for analysis in the Plan-EIS.

D.13.2 Alternatives Studied in Detail

This section discusses the evaluation of the alternatives for the proposed Cove Reservoir Project that were studied in detail. Two alternatives were evaluated in detail: 1) the No Action and 2) the development of Cove Reservoir and associated facilities. Concept design drawings for the Cove Reservoir alternative are included in Attachment 6.

Preliminary cost estimates developed for the alternatives taken forward used the following procedures:

- Cost estimates were based on 2026 U.S. dollars
- Estimated quantities of construction materials and labor
- Costs associated with mitigation of potential environmental and cultural/historical impacts were not included

D.13.2.1 No Action Alternative

With implementation of the No Action Alternative, the proposed reservoir, associated recreation facilities, transmission line, access road, and new pipelines would not be authorized. Existing environmental conditions would remain the same. No direct costs would accompany the implementation of this alternative; however, financial opportunities would be foregone. The existing Glendale hydroelectric power plant and pipeline would remain in place. Irrigation demand during summer months would continue to exceed water availability on approximately 1,109.06 acres of cropland. Recreation and related socioeconomic opportunities associated with the Proposed Action would not be realized. The up to 1,752 acre-feet of additional water for downstream endangered fish and flycatcher habitat would not be realized. An exact determination of revenue that would be lost as a result of implementing the No Action Alternative has not been determined.

D.13.2.2 Cove Reservoir Alternative

Implementation of this alternative would authorize the construction of the proposed reservoir, spillways, and associated recreation facilities, including an overnight camping area and boat ramp, pipelines, and access road. The estimated cost of the reservoir, access road, and pipeline is approximately $38,979,000. Development of the recreation area is projected to cost approximately $751,000. In total, costs for the project would be approximately $39,730,000 (see Section 6 of the Plan-EIS for details). Estimated project costs are shown in Table D-3 below. Construction activities would take approximately 15 months to complete (see Appendix E, Draft Plan of Development, in Plan-EIS).

D.13.2.2.1 Reservoir and Dam

The proposed dam would be designed to meet current NRCS (NRCS 2019) and Utah Dam Safety regulations (Utah Office of Administrative Rules 2019) and engineering standards. The structure would be constructed using earth and rock fill with a central clay core. The length of the dam would be approximately 1,900 feet, with a maximum dam height of 90 feet. A 200-foot site located immediately below the dam would be used for instrumentation and additional staging. The reservoir would have a maximum capacity of approximately 6,032 acre-feet and would provide additional irrigation water to around 1,110 acres of cropland. Approximately 15 months would be required to complete dam and reservoir construction (see Appendix E, Draft Plan of Development, in Plan-EIS). When fully operational, the reservoir would provide up to 1,752 acre-feet annually downstream to Washington County during the summer months to augment endangered fish and flycatcher habitat.

D.13.2.2.2 Conservation Pool/Fish Stock

A conservation pool of approximately 300 acre-feet of water (with a maximum water depth of 50 to 100 feet) would be maintained in the proposed reservoir. The conservation pool would have a surface area of approximately 75 acres and would support a cold-water trout fishery.

D.13.2.2.3 Principal Spillway and Auxiliary Spillway

A 30-inch pipeline, approximately 1,020 feet in length, would be used as the PS. The spillway would include an intake screen and structure at the intake as well as an energy dissipating structure at the outfall. The pipeline would be located near the left abutment and would convey excess flow away from the dam structure. The AS would be approximately 1,100 feet in length and consist of a trapezoidal earthen channel, including a concrete weir structure near the base of the reservoir. The spillway would run from the left abutment of the dam and transition into an existing downstream drainage channel.

D.13.2.2.4 Recreation Area and Boat Ramp

Project implementation would include an approximately 10-acre outdoor recreation area. Approximately 3.5 acres would be used to construct a boat ramp, picnic facilities, pavilion, restrooms, and 20 overnight camping facilities. The timeline for the construction and installation of these amenities has not yet been determined. The proposed reservoir would provide water-based recreation activities such as swimming, small-engine/non-motorized boat use, and fishing.

D.13.2.2.5 Access Road

Approximately 3.3 miles of new and existing roads would be constructed or improved to provide and maintain access to properties surrounding the reservoir. Approximately 1.2 miles of existing roadway will be widened to a graveled width of 28 feet. Approximately 2.1 miles of new roadway will be constructed and graveled to a width of 28 feet. The road would be constructed to permit two-way traffic. A borrow ditch and culverts would be installed in drainages, as needed. The access road would be graded and graveled using a gravel road base material. The access road would be constructed early in the construction process to provide access for upstream property owners. This would also facilitate construction of the dam.

D.13.2.2.6 Borrow Areas

Three existing borrow pit sites outside of the reservoir basin have been identified to provide gravel and riprap material: the Tait (29 acres), Lamb (17 acres), and Esplin (13.8 acres) pits. The project would use two of these three sites—the Esplin for riprap and either the Tait or Lamb pit for gravel. Because the final selection between the Tait and Lamb pits has not yet been determined, all three pits are analyzed as part of the project.
Use of the borrow pits would result in a maximum of 5.7 acres of disturbance, consisting of approximately 5 acres at the Esplin pit and either 0.5 acres at the Lamb pit or 0.7 acres at the Tait pit. Although only a portion of the pits would be disturbed, the entire area of each pit was included in the project area as the exact location of disturbance is unknown.

D.13.2.2.7 Pipelines

The installation of two water transmission pipelines would be completed as part of the Proposed Action. The purpose of the pipelines would be to 1) convey water to the proposed reservoir and 2) upsize the existing undersized irrigation line in the Glendale area. The Cove Reservoir pipeline would be approximately 1,000 feet (0.19 miles) of new 24-inch pipeline. This line would extend from the existing mainline, that is installed from the Orderville irrigation diversion dam to the Cove Reservoir. The new line would access the proposed reservoir at the dam site. This new extension would provide water from the East Fork Virgin River to fill the reservoir in the spring during high runoff. It would also be used to provide water from the reservoir to local irrigation users as needed during the summer months.

The Glendale pipeline is upsizing a portion of the existing Glendale irrigation system. The pipeline would consist of approximately 9,200 feet (1.74 miles) of new 10-inch pipeline. This pipeline would run from the current Glendale hydroelectric power plant location to the Orderville Diversion Dam. Excess water from the proposed pipeline would be combined with water diverted from the Orderville Diversion Dam to fill the proposed reservoir.

D.14 ECONOMIC EVALUATION

This National Economic Efficiency (NEE) analysis evaluates the costs and benefits of an Alternative that includes five components: 1) A 6,000-acre-foot off-stream reservoir; 2) A extension of the existing Orderville Irrigation pipeline to the Cove Reservoir that diverts water from the East Fork of the Virgin River (EFVR) to fill the reservoir when excess water is available; 3) A pipeline to provide pressurized irrigation water to the Mt. Carmel Irrigation

District; 4) Recreation Facilities at the reservoir, all in Kane County; and 5) Water for irrigation and Municipal and Industrial (M&I) purposes in Washington County. All economic benefits and costs are provided in 2026 dollars and have been expressed in average annual values using the fiscal year 2026 Federal Water Resource Rate of 3.25 percent.

Evaluation of Agricultural Water Management (AWM) relied on crop budgets for alfalfa and alfalfa establishment. The original budgets were produced by Utah State University Cooperative Extension Service for Kane County, UT. Data in the budgets were brought to current value based on a multiplier derived from Producer Prices Paid Index. The without project (WO Proj) scenario (less than full water supply) estimated a 3 ton per acre production; the with project (W Proj) scenario (full water supply) estimated a 5 ton per acre output. A net return per acre was calculated based on the difference between the W Proj and WO Proj budgets and applied to the acres in Kane County. The same analytical procedure was used for AWM in Washington County.

The project would assure a full water supply for 1109.06 acres in the Glendale, Orderville, and Mt. Carmel Irrigation Districts in Kane County; provide flat water recreation opportunities; provide irrigation water for 67 acres and 300 acre-feet of M&I water in Washington County.

In sum, the Preferred Alternative has an estimated $1,359,000 in annual average costs and would provide an estimated $1,397,000 in annual average benefits; this would result in annualized net benefits of approximately $38,000. Costs were allocated to each purpose using the Separable Cost-Remaining Benefits (SCRB) methodology of cost allocation.

This NEE Analysis evaluates the costs and benefits of the 6,000-acre-foot alternative over the No Action Alternative for the Cove EFVR Watershed Project. The analysis uses Natural Resources Conservation Service (NRCS) guidelines for evaluating NEE benefits as outlined in the NRCS Natural Resources Economics Handbook and the U.S. Department of Agriculture's (USDA) Guidance for Conducting Analyses Under the Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies and Federal Water Resource Investments (DM 9500-013).

All economic benefits and costs are provided in FY 2026 dollars and, in accordance with the NRCS Natural Resources Economics Handbook, are presented in average annual values using the fiscal year 2026 Federal Water Resource Discount Rate of 3.25 percent.

D.14.1 Analysis Considerations

This section describes the economic analysis funding sources, evaluation units, project implementation timeline, period of analysis, and project purpose. All values in this analysis are presented in 2026 dollars.

D.14.2 Funding

Overall, PL 83-566 funds would cover $24,889,000 (62.6 percent) of project costs, which includes $20,320,000 construction costs, $4,200,000 technical assistance (engineering), $233,000 project administration, and $135,000 land rights costs. The sponsors and other non-federal funds would contribute $14,841,000, or 37.4 percent of the total project cost. Operation, maintenance, and replacement (OM&R) is estimated at $13,000 annually. Cost sharing for each of the purposes, as described in the NWPM are as follows: AWM – 75% Federal, 25% Local; Recreation – 50% Federal, 50% Local, M&I Water – 50% Federal, 50% Local.

D.14.3 Evaluation Unit

The proposed project includes a 6,000-acre-foot off-stream reservoir and dam, principal and auxiliary spillways, recreation facilities at the reservoir, pipelines, booster pump station, and access road improvements. Details on the proposed project components are included in Chapter 4.2.2.1 of the Watershed Plan Environmental Impact Statement (Plan-EIS).

D.14.4 Project Implementation Timeline

If PL 83-566 funds are made available, construction would likely be completed over approximately 3 years. The project would be completed in three phases based on the amount of

construction that could be completed during the non-irrigation season. For each phase, the analysis assumes that full benefits would be realized the year after construction is completed.

D.14.5 Analysis Period

The analysis period is 103 years since the project would take 3 years to construct and 100 years is the expected project life of the reservoir, pipelines, and recreation facilities. Construction would start in Year -3, and the life of the project is 100 years after installation for a total analysis period of 103 years.

D.14.6 Project Purpose

The purposes of the proposed project are to enhance the efficiency and reliability of the current agricultural water management in Long Valley, part of the EFVR sub-watershed, while complying with the Zion National Park Water Rights Settlement of 1996. Effective irrigation systems and water management strategies would support farm profitability amid constraints posed by scarce and costly water resources. Water is also provided to Washington County to address summer irrigation water shortages; provide for public recreation at the reservoir through developed camping sites and boat access to the reservoir. The project provides an enhanced Municipal and Industrial water supply in Washington County as more municipal water providers join and receive water from the WCWCD system.

D.14.7 Alternatives Considered During Formulation

This section presents the alternatives considered during project formulation. Additional information is found in Chapter 4.0 of the Plan-EIS.

According to the Principles, Requirements and Guidelines (PR&G) for Water and Land Related Resources and the NRCS National Watershed Program Manual (NWPM), Agricultural Water Management (AWM), Recreation, and M&I Water are the purposes analyzed for the Cove EFVR Watershed Plan-EIS. Economic Table 6, Comparison of NEE Benefits and Costs, contains a summary of the average annual project costs and benefits. Incremental analysis considering project measures was conducted.

As described in the Plan-EIS, the main purpose of the Watershed Plan is to provide a reliable water supply for 922acres in Kane County and 67 acres in Washington County. In addition, recreation facilities will be installed at the Cove EFVR reservoir site, and 300 acre-feet of water will be supplied to users in Washington County.

A full range of alternatives and options were considered for detailed study during project formulation and scoping, including alternative reservoir sites, alternative reservoir size, and non-structural measures. After careful examination, several alternatives were eliminated from detailed study as they were considered infeasible, did not adequately meet the purpose and need for the project, were environmentally more impactful, presented safety concerns, or were cost prohibitive. These alternatives are described in detail in Chapter 4.3 of the Plan-EIS.

An agreement between the State of Utah, WCWCD, Kane County Water Conservancy District, and the National Park Service identifies allowable water use and depletion in the EFVR Basin east of Zion National Park (Zion National Park Water Rights Settlement Agreement 1996). The Agreement establishes that new diversions or depletions of surface and ground water sources in the EFVR would not exceed a total depletion of 5,000 acre-feet per year. It was also stipulated that 1 or more reservoirs constructed in the Basin could not exceed 6,750 acre-feet. For the purposes of this analysis and in addition to the Cove Reservoir site, seven other potential dam sites were identified in the general vicinity of the project area and dismissed from detailed study as described in chapter 4.3.1 of the Plan-EIS.

Three alternatives were evaluated.
A No Action Alternative (Alternative 1) - The No Action Alternative considers the actions that would take place if no federal action or federal funding were provided for the project. Current irrigation facilities and existing environmental conditions in the project area would remain the same. Irrigation demand during summer months would continue to exceed water availability. Deficiencies in crop production would continue for the foreseeable future. Recreation and socioeconomic opportunities associated with the Preferred Alternative would not be realized.

A 6,000 acft reservoir (Alternative 2) - Alternative 2 consists of construction of a 6,000-acre-foot reservoir and dam, principal and auxiliary spillways, recreation area, pipelines, and booster pump station (Appendix B-7 through B-12)., and three borrow pit sites were identified to supply material for dam construction (Appendix B-1).

The individual project components are discussed in detail in chapter 4 of the Plan-EIS (beginning at 4.2). The structure, located near Orderville, Utah, would consist of a homogeneous earth-fill dam with an internal filter/drain. The length of the dam would be approximately 1,900 feet with a maximum dam height of 90 feet and a crest elevation of 5,552 feet above mean sea level (amsl). The reservoir would have a maximum capacity of approximately 6,055 acre-feet. The dam would be situated 0.6 miles from US-89 southwest of downtown Ordervillle.

The Alternative 2 would include the development of an approximately 4.1-acre outdoor recreation area. The recreation area would include a boat ramp, 2 pit toilets, a pavilion, and 20 recreational vehicle site facilities (including a barbecue grill, table, and fire pit). No utilities would be extended to the recreation facilities.

Alternative 2 would provide 300 acft of water to meet the growing need for M&I water in Washington County. Access road improvements would be included as part of Alternative 2. Approximately 3.2 miles of new and existing access roads would be constructed and/or improved to provide access around the reservoir and to maintain access to properties surrounding the reservoir. Approximately 1.2 miles of existing roadway would be widened to 28 feet (currently 12–16 feet wide). Approximately 2.0 miles of new 2-lane roadway would be constructed at 28 feet width.

Benefits to AWM were assessed by comparing the FWOFI alternative and the FWFI alternative. Crop budgets for alfalfa and alfalfa establishment produced by the Utah State University Cooperative Extension Service were used to assess benefits to increased and reliable water supplies for 1,109 acres in Kane County and 67 acres in Washington County.

The 2016 crop budget operating costs for Kane and Washington Counties were brought to current value using the Producer Prices Paid Index for FY 2026 (152) divided by the Index for 2006 (148), giving a multiplier of 1.03 Fixed costs were not considered in the analysis since each operator has a full complement of machinery and sprinkler systems.

Kane County alfalfa production in the FWOFI alternative is 3 tons per acre while the FWFI alternative is 5 tons per acre. Washington County, alfalfa production is 4 tons and 6 tons per acre, respective to the FWOFI and FWFI alternatives. Residue grazing values were also assessed in both Kane and Washington Counties.

Per acre benefits were calculated by subtracting the FWOFI alternative net return from the FWFI alternative net return. This was done for both Kane and Washington Counties. The 1,109 acres in Kane County are comprised of three Irrigation companies: Orderville, 286.05 acres; Glendale, 427.26 acres; and, Mt Carmel, 395.75 acres. There are 198 acres in Mt. Carmel sprinkler irrigated and 198 acres flood irrigated. A per-acre, sprinkler system purchase-cost was calculated and included in the 198 flood irrigated acres in the Mt. Carmel district. The FWFI alternative and a benefit was calculated as above. The same analysis was employed for oat hay/alfalfa establishment.

AWM benefits were calculated assuming a 10-year crop rotation: 8 years in alfalfa and 2 years in oat hay/alfalfa establishment. A weighted average (80 percent alfalfa, 20 percent oat hay/alfalfa establishment) per-acre net return was calculated for the 713.31 acres in Glendale and Orderville. A weighted average (80 percent alfalfa, 20 percent oat hay/alfalfa establishment and 50 percent sprinkler irrigated and 50 percent flood to sprinkler irrigated) per-acre net return was calculated for the Mt. Carmel area. Total AWM benefits are shown in Table 2. Evaluation files for AWM are found in the EXCEL workbook titled Irrigation Benefit Analysis (Appendix B). Each sheet in the workbook details the AWM analysis.

A Benefits to recreation were assessed based on the Army Corps of Engineers Unit Day Values for recreation activities. Point values for General Recreation and Specialized Recreation for each category (Recreation Experience, Availability of Opportunity, Carrying Capacity, Accessibility, Environmental Quality) were assigned based on the Tables 1 and 2 in the above EGM. Point

values were converted to dollar values based on the table of Conversion of Points to Dollar Values (page 2 of the EGM).
Recreation benefits were calculated based on recreation use at Jackson Flat Reservoir (14,090 annual visits). Total points were determined for General Recreation (64) and Specialized Recreation (53). A dollar value was calculated for both General Recreation and Specialized Recreation for each of the categories listed above and a weighted average (assuming 50 percent General and 50 percent Specialized) computed for the Project equal to $28.53 per annual visit for a benefit of $414,000. The USCOE EGM point values and their conversion are in the following tables.

Table 2: USCOE EGM point values

-	Unit Day Value Point Values (General Recreation)	Unit Day Value Point Values (Specialized Recreation)
Recreation experience	23	13
Availability of Opportunity	4	3
Carrying Capacity	11	11
Accessibility	11	11
Environmental quality	15	15
TOTAL PTS	64	53
Value	$12.23	$44.82

Table 3: Dollar Values and Corresponding Point Values

Point Values	General Recreation Values (1)	General Fishing and Hunting Values (1)	Specialized Fishing and Hunting Values (2)	Specialized Recreation Values other than Fishing and Hunting (2)
0	$5.17	$7.44	$36.22	$21.02
10	$6.14	$8.41	$37.19	$22.31
20	$6.79	$9.05	$37.84	$23.93
30	$7.76	$10.02	$38.81	$25.87
40	$9.70	$11.00	$39.78	$27.49
50	$11.00	$11.97	$43.66	$31.05
60	$11.97	$13.26	$47.54	$34.28
70	$12.61	$13.91	$50.45	$41.39
80	$13.91	$14.88	$54.33	$48.18
90	$14.88	$15.20	$58.21	$54.98
100	$15.52	$15.52	$61.44	$61.44

Table 4: Calculations based on Dollar and Point Values

General Recreation $ value at 60 pts	$11.97
General Recreation $ value at 70 pts	$12.61

General Recreation $ value at 64 pts equals (12.61-11.97) times .4 plus 11.97 equals	$12.23
Specialized Recreation $ value at 50 pts	$43.66
Specialized Recreation $ value at 60 pts	$47.54
Specialized Recreation $ value at 53 pts equals ($47.54-$43.66) times .3 plus $43.66 equals	$44.82
Combined Value equals .5 times 12.23+.5 times 47.54	$28.53

Benefits to M&I in Washington County were assessed based on cost information in the following study prepared for the WCWCD: Washington County Small Surface Water Storage Project Feasibility Study. The average annual cost of the Ash Creek Project per acre-foot was computed from information in Table 5-1: Cost Comparison of Water Supply Alternatives of the Feasibility Study. The 2022 cost per acre-foot was updated to the current value based on a multiplier computed from the Engineering News Record Construction Cost indices for FY 2022 and FY 2025. The average annual cost per acre-foot was then multiplied by the 300-acre-foot unit provided by the Cove EFVR Reservoir. This value is then a cost savings attributed to WCWCD and is the computed M&I benefit. The following table shows the calculations.

Table 5: Municipal and Industrial Water Benefits Calculations

-	Construction Cost	Amortized Const Cost	Acre-Foot	Ave Ann Const Cost per Acre-Foot	Benefit per 300 Acre-Foot
	$101,622,816	$3,443,338	1,739	$1,980	$594,020

3,000 acft reservoir (Alternative 3) - Alternative 3 consists of a 3,000-acre-foot reservoir and dam, principal and auxiliary spillways, recreation area, pipelines, and booster pump station (Appendix B-13). Access road improvements would be included under Alternative 3, and three borrow pit sites were identified to supply necessary materials for the dam construction (Appendix B-1). The individual project components are discussed in detail in the chapter 4 of the Plan-EIS (beginning at 4.2).

The structure would consist of a homogeneous earth fill dam with an internal filter/drain. The length of the dam would be approximately 1,700 feet with a maximum dam height of 70 feet and a and a crest elevation of 5,530 feet amsl.

Alternative 3 would include the development of an approximately 2-acre outdoor recreation area. The recreation area would include a boat ramp, 1 pit toilet, a pavilion, and 12 recreational vehicle site facilities (including a barbecue grill, table, and fire pit). No utilities would be extended to the recreation facilities.

Alternative 3 would provide 200 acft of water to meet the growing need for M&I water in Washington County. Access road improvements would be the same as discussed under Alternative 2.

D.14.8 Costs of the Preferred Alternative

This section evaluates the costs of the Preferred Alternative: the 6,000-Acre-Foot Reservoir, Recreation Facilities; providing a full irrigation water supply for 1,109 acres in Kane County, and; M&I water to meet a growing demand in Washington County.

D14.9 Proposed Project Costs

Economic Table 6-1 and Economic Table 6-2 in the Plan-EIS (Chapter 6.12) summarize installation costs, distribution of costs, and total annual average costs for the 6,000-Acre-Foot

Alternative. Average annual costs include those associated with installation and other direct costs. Economic Table 4 in the Plan-EIS (Chapter 6.12) summarizes the average annual costs of the 6,000-Acre-Foot Alternative over the No Action Alternative.
These NEE average annual costs are estimated at $1,368,000 and include $1,354,000 in installation costs and $13,000 in other annual direct costs, including OM&R costs.

D.14.10 Project Installation Costs

The costs of each component of the NEE alternative are provided in **Table 2**.

Table 6: Estimated Installation Costs of the Preferred Alternative

Works of Improvement	Units	Number of Federal Land	Number of Non-Federal Land	Number Total	PL 83-566 Funds Federal Land (Dollars)	PL 83-566 Funds Non-Federal Land (Dollars)	PL 83-566 Funds Total (Dollars)	Other Funds Federal Land (Dollars)	Other Funds Non-Federal Land (Dollars)	Other Funds Total (Dollars)	Grand Total (Dollars)
Reservoir and Dam	Cubic Yards	-	1	1	-	$20,889,300	$20,889,300	-	$13,206,200	$13,206,200	$34,096,000
Glendale Irrigation Pipeline	Linear Feet	-	1	1	-	$597,538	$597,538	-	$174,475	$174,475	$772,000
Mt. Carmel Irrigation Pipeline	Linear Feet	-	1	1	-	$2,170,775	$2,170,775	-	$633,844	$633,844	$2,805,000
Recreational Facilities	Cubic Yards	-	1	1	-	$416,206	$416,206	-	$335,069	$335,069	$751,000
Access Roads	Linear Feet	-	1	1	-	$815,108	$815,108	-	$490,991	$490,991	$1,306,000
Total Project	-	-	5	5	-	**$24,889,000**	**$24,889,000**	-	**$14,841,000**	**$14,841,000**	**$39,730,000**

D.14.11 Additional Replacement Costs

The 6,000-Acre-Foot Alternative would result in no additional replacement costs above the No Action Alternative since the structures life would be equal to the project life (100 years).

D.14.12 Benefits of the 6,000-Acre-Foot Reservoir Alternative

Economic Table 6-5 in the Plan-EIS (Chapter 6.12) compares the project benefits to the annual average project costs identified in Economic Table 6-2 in the Plan-EIS (see also **Table 3**, below). This section details the anticipated project benefits for AWM, Recreation, and M&I Water.

Benefits Considered and Included in Analysis:

AWM: $389,000
Recreation: $414,000
M&I: $594,000

D.14.12.1 Increase Water Delivery Reliability

The NEE alternative would assure a reliable water supply for 922 acres in Kane County and 67 acres in Washington County during the low water months of July, August, and September.

D.14.12.2Improve Water Conservation

The NEE alternative would improve water conservation in the Mt. Carmel Irrigation District with the conversion of 202 acres of sprinkle-irrigated land.

D.14.13 Incremental Analysis

The NEE Alternative is evaluated using an incremental analysis, which identifies how total costs and benefits change as project phases are added (**Table 3**). In the incremental analysis, the project is divided into three phases of construction – 1. Reservoir Construction, Glendale Pipeline Construction, Mt. Carmel Pipeline Construction, and Reservoir proportion of Access Road; 2. Recreation Facilities Construction and Recreation proportion of Access Road; and 3. M&I Water, and M&I proportion of Road.

Table 7:Incremental Analysis of Annual National Economic Efficiency Costs and Benefits Under the 6,000-Acre-Foot Alternative[1]

Alternatives	Total Costs	Incremental Costs	Total Benefits	Incremental Benefits	Net Benefits
No Action	0	0	0	0	0
3,000 acft reservoir	$1,095,962	$1,095,962	$980,995	$980,995	-$114,967
6,000 acft reservoir	$1,346,192	$250,230	$1,396,983	$415,988	$165,758

[1]Average Annual Values at a Price Base: 2026 dollars amortized over 100 years at a discount rate of 3.25 percent

D.14.14 Costs of the National Economic Efficiency Alternative

This section evaluates the costs of the NEE Alternative over the No Action Alternative. Under the No Action Alternative, landowners and operators in Kane and Washington counties would experience low water supplies during July, August, and September, leading to reduced crop yields. Recreation opportunities would be foregone and the need for M&I water supply in Washington County would be unfulfilled.

D.14.15 Proposed Project Costs

Economic Table 6-1 and Economic Table 6-2 in the Plan-EIS (Chapter 6.12) summarize installation costs, distribution of costs, and total annual average costs for the NEE Alternative. Project installation costs are also included in **Table 1** of this report.

D.14.16 Benefits of the National Economic Efficiency Alternative

Benefits of the NEE Alternative are shown in **Table 3**, above.

D.14.17 The Preferred Alternative

The NEE Alternative and the Federally Recommended Alternative is the 6,000-acre-foot Reservoir Alternative (Alternative 2 in the Plan-EIS). The NEE alternative is defined as the federally assisted alternative with the greatest public benefits with appropriate consideration of costs. Public benefits (i.e., positive ecosystem services) encompass environmental, economic, and social goals; include monetary and non-monetary effects; and allow for the consideration of both quantified and unquantified measures.

Alternative 2 is the Preferred Alternative and was selected by the sponsor based on the beneficial outcomes and proposed costs. This NEE Alternative has an overall benefit cost ratio that is greater than 1.00, as shown in **Table 4**.

Table 8:Comparison of Benefits and Costs[2]

-	Average Annual Costs	Average Annual Benefits	Benefit-Cost Ratio	Net Benefits
Agriculture Water Management	$503,402	$389,000	0.77	-$114,402

-	Average Annual Costs	Average Annual Benefits	Benefit-Cost Ratio	Net Benefits
Recreation	$424,749	$414,000	0.97	-$10,749
M&I Water	$431,257	$594,000	1.38	$162,743

[2]Discount rate of 3.25% with a 100-year period of analysis. Price base 2026

The Preferred Alternative will allow the sponsors to provide reliable irrigation water to agricultural and urban property and offer recreational opportunities, and it would also meet a part of the potable supply deficit in the Washington County Water Conservancy District. Average annual monetary benefits are estimated to be $1,397,000. Average annual cost is estimated at $1,359,000, resulting in net benefits of $38,000. Environmentally, adverse impacts will be minimized during construction. Long-term there would be adverse, although negligible, impacts.

Benefit to Cost Ratio: 1.03 to 1.0
Net Beneficial Effects: $38,000
Funding Schedule: The most likely scenario is for the project to be implemented over 3 years, including the design and construction.
Period of Analysis: 100 years (plus 3 years for design and construction)
Project Life: 100 years

D.14.18 Project Benefits Summary

The planning policy used for this PR&G Report states that Federal investments in water resources as a whole should strive to maximize public benefits with appropriate consideration of costs. Public benefits (i.e., positive ecosystem services) encompass environmental, economic, and social goals; include monetary and non-monetary effects; and allow for the consideration of both quantified and unquantified measures. The Preferred Alternative will allow the sponsors to provide a reliable water supply for irrigation, provide recreation opportunities, and provide an unmet need for M&I Water. The Preferred Alternative maximizes public benefits as reflected in **Table 4**.

Provisioning service, agricultural land—Water from Alternative 2 would provide agricultural water the Hurricane Bench Lake area for maintaining agricultural production. Water could also be used to provide urban agricultural benefits to water users in St. George for personal food production through gardening or other enterprises that produce local food.
Provisioning services, agricultural water—Alternative 2 would increase the available amount of irrigation and M&I water for Kane County and Washington County by approximately 2,148 acre-feet.
Provisioning services, livestock water—Alternative 2 would increase the available amount of livestock water for Kane and Washington County by approximately 2,148 acre-feet.
Regulating services, water quality and quantity—Alternative 2 would increase water quality in the EFVR by containing sediment within the reservoir during flash flooding events.
Supporting services, wildlife habitat—Alternative 2 would continue to provide habitat for plants and wildlife within the EFVR with the addition of new habitat within the Cove Reservoir.

Cultural services, recreation—Alternative 2 would have no impact on the recreational value of the EFVR while also providing new recreational opportunities at the Cove Reservoir site.
Provisioning Services, fishing—Alternative 2 would have no impact in aquatic habitat or species within the EFVR, and therefore, would have no impact on fishing opportunities within the EFVR. The reservoir would provide an additional but minor sport fishing opportunity.
Regulating services, Riparian zones—The creation of riparian vegetation under Alternative 2 would positively impact the ecosystem services, as riparian vegetation provides benefits like water filtration, nutrient cycling, and wildlife habitat.
Cultural services, species conservation—Alternative 2 would have no impact on species conservation. Minor, temporary impacts may occur during construction but would not result in the loss of species existence or abundance of suitable habitat.
Cultural Services, non-material benefits—Alternative 2 would benefit non-material ecosystem services such as mental health, aesthetic experiences, and recreation. The increase in available water would support the mental health of agricultural farmers in the Long Valley area who rely on agriculture for income. The reservoir and recreation area would provide a scenic landscape and recreation opportunities (fishing, boating, swimming) for visitors and residents to enjoy.

D14.19 Watershed Project Costs

Project costs for the project were estimated by the engineers for Fiscal Year 2026. The costs of the project were allocated to Agricultural Water Management (AWM), Recreation, and M&I purposes according to the procedure in the Resource Economics Handbook, Part 611 Water Resources Handbook for Economics, Chapter 6 Costs and Cost Allocation (NRCS 2014b). Work Plan-EIS tables were constructed based on the calculated cost allocated to AWM, Recreation, and M&I Water Supply. Within these purposes, the costs were shared between NRCS and the local and state entities as specified in the NWPM. In this case, cost share for irrigation water management is 75 percent federal and 25 percent local. Within these guidelines, engineering is 100 percent federal and OM&R is 100 percent local. See Table 6-2a in the Plan-EIS for the results of the cost allocation/cost sharing process.

All costs were amortized at the Fiscal Year 2026 Federal Water Resource Discount Rate of 3.25 percent for 103 years. Average Annual Costs are computed as the sum of the amortized construction cost and the annual operation and maintenance cost. Engineers estimate that each of the structures would last 100 years, the life of the project.

All project implementation costs were estimated by the project engineers, including installation and annual operation and maintenance. All costs were converted to present values by discounting each cost to the beginning of the period of analysis using the applicable project discount rate. Installation costs incurred before the project is installed will be carried forward to the end of the installation period by applying compound interest at the project's discount rate from the date costs were incurred. Finally, the project discount rate was used to convert the present values to average annual equivalent terms.

Replacement costs are necessary if the installed structure's life is less than the project life. Average Annual Replacement Costs are calculated by amortizing the present value of the worn-out structure's construction cost with the current FY discount rate over the project structure's life. If the physical life of the alternative is the same as the project, replacement costs are not

included, and we assume the Replacement Costs are the same as the Average Annual Costs. In this project, the structure's life was equal to the project life and replacement costs were not necessary and not calculated.

Table 9:Watershed Project Annual Cost Summary[2]

Evaluation Unit	Amortization of Installation Cost	Operation, Maintenance, and Replacement	Total
Agricultural Water Management	$503,285	$117	$503,402
Recreation	$411,765	$12,984	$424,749
M&I Water	$431,125	$132	$431,257
Total Project	$1,346,175	$13,233	$1,359,408

[2]Discount rate 3.25 with a 100-year period of analysis. Price base 2026

D14.20 Watershed Project Benefits and Costs

For the Preferred Alternative, the average annual monetary benefits are estimated to be $1,397,000. Average annual cost is estimated at $1,359,408 and includes $13,233 of annual OM&R costs, resulting in net benefits of $162,743. The Preferred Alternative produces a benefit-cost ratio of 1.03 to 1.00. Environmentally adverse impacts will be minimized during construction. Long-term, there would be adverse, although negligible, environmental impacts. See Chapter 5.0 of the Plan-EIS for a detailed analysis of environmental effects from the project.

Table 10:Watershed Project Benefit-Cost Summary[2]

	Average Annual Costs [3/]	Average Annual Benefits [2/]	Benefit-Cost Ratio	Net Benefits
Agricultural Water Management	$503,402	$389,000	0.77	-$114,402
Recreation	$424,749	$414,000	0.97	-$10,749
M&I Water	$431,257	$594,000	1.38	$162,743
Grand Total	$1,359,000	$1,397,000	1.03	$38,000

[2]Discount rate 3.25 percent with a 100-year period of analysis. Price base 2026

D.15 ENVIRONMENTAL EVALUATION

The Environmental Impact Statement is a NRCS planning process described in the NRCS National Planning Procedures Handbook (NRCS 2013). The Environmental Impact Statement identifies and analyzes the economic, environmental, and social concerns for a project. This planning process is then described in the Plan-EIS, Appendix D and Appendix E.. This Environmental Impact Statement planning process started with the identification of problems and opportunities and continues through the application and evaluation of the project.

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Attachment 1 Sediment Supplemental Documentation

Sediment

The site is located in the East Fork of the Virgin River Watershed at 37.273° N 112.660° W. The reservoir will serve as a multi-purpose structure including providing storage for irrigation, recreation, and drought.

The reservoir will have a storage capacity of 6,032 acre-feet and an average depth 40 feet. The drainage area covers 4.7 square miles (3034 acres). The reservoir site is in an alluvial valley that has been cut into Cretaceous and Tertiary sedimentary rocks consisting mostly of sandstone and shale. Residual soils are silt and sandy clay. The terrain adjacent to the basin valley has steep slopes. Ridges are capped with thin deposits of pebble gravel and cobbles of grey and red quartzite, grey to black chert, and grey limestone in a matrix of sand with silt. Vegetation in the drainage is sparse, consisting of brush and small trees. Using the National Engineering Handbook (NEH) land cover designation, the majority of the drainage basin is comprised of Woods, Fair; with portions of Desert Shrub, Poor. The drainage areas are capable of producing flash flood conditions and large sediment volumes during intense rainfalls. The reservoir is expected to contain all of the sediment and therefore, the trap efficiency is assumed to be 100 percent for the reservoir.

An initial estimate of sediment yield has been performed using two methods included in the Bureau of Reclamation Erosion and Sedimentation Manual (November 2006) and the Estimated Sediment Yield Rates for the State of Utah Map (U.S.D.A SCS, 1973). These methods are described below.

Sediment Yield as a Function of Drainage Area

Empirical sediment yield equations have been developed strictly as a function of drainage area based on reservoir sediment survey data. Strand and Pemberton (1982) developed the following equation for the semiarid climate of the Southwestern United States:

$$Q = 1.84A_d^{-0.24}$$

Where Q = sediment yield in ac-ft/mi^2/yr
A_d = drainage area in mi^2

For the reservoir drainage area of 4.7 mi^2, a sediment accumulation 6 acre-feet per year or 600 acre-feet over a 100- year period is computed.

Sediment Yield Classification Procedure

The Pacific Southwest Inter-Agency Committee developed a sediment yield classification procedure that estimates sediment yield as a function of nine individual drainage basin characteristics. Each characteristic is given a subjective numerical rating based on

observation and experience and the sum of these ratings determines the basin classification and the annual sediment yield per unit area. Tables showing this procedure are included on the following page. The sum of the basin characteristics ratings is 70, resulting in a classification number of 3, with annual sediment yield (ac-ft/mi^2) ranging from 0.5 to 1.0. For the drainage basin area of 4.7 mi^2, using the upper end of the range results in an annual yield of 4.7 ac-ft and a sediment yield of 470 acre-feet over a 100-year life span.

Estimated Sediment Yield Rate Map

An estimated sediment yield rate map for the State of Utah was prepared by the U.S.D.A. Soil Conservation Service in 1973. This map is a general area map with cautions that it is not to be used for specific sites since large variations may occur in the delineated areas. A copy of the map with the Cove Reservoir area enlarged is attached. This area in in a Yield Class 4 which indicates yield rates ranging from 0.2 to 0.5 ac-ft./sq mi^2/year. Using the upper end of the range, results in an estimate of 2.35 ac-ft per year for the 4.7 sq mi^2 drainage area and 235 acre-feet over a 100-year life span.

These initial estimate methods are considered to provide upper end values of the sediment volume which will accumulate over the 100-year life of the structure. Ranging from 235 to 600 acre-feet, these values represent 10% or less of the reservoir storage volume and more refined analyses are not deemed necessary for planning purposes.

Table 2.9. List of drainage basin characteristics and possible range of numerical ratings (modified from Pacific Southwest Interagency Committee, Water Management Subcommittee, 1968)

Drainage basin characteristics	Sediment yield levels		
	High rating	Moderate rating	Low rating
Surface geology	10: marine shales and related mudstones and siltstones	5: rocks of medium hardness moderately weathered and fractured	0: massive hard formations
Soils	10: fine textured and easily dispersed or single grain salts and fine sands	5: medium textured, occasional rock fragments, or caliche crusted layers	0: frequent rock fragments, aggregated clays, or high organic content
Climate	10: frequent intense convective storms	5: infrequent convective storms, moderate intensity	0: humid climate with low intensity rainfall, arid climate with low intensity rainfall, or arid climate with rare convective storms
Runoff	10: high flows or volume per unit area	5: moderate flows or runoff volume per unit area	0: low flows or volume per unit area or rare runoff events
Topography	20: steep slopes (in excess of 30%), high relief, little or no flood plain development	10: moderate slopes (about 20%), moderate flood plain development	0: gentle slopes (less than 5%), extensive flood plain development
Ground cover	10: ground cover less than 20%, no rock or organic litter in surface soil	0: ground cover less than 40%, noticeable organic litter in surface soil	-10: area completely covered by vegetation, rock fragments, organic litter with little opportunity for rainfall to erode soil
Land use	10: more than 50% cultivated, sparse vegetation, and no rock in surface soil	0: less than 25% cultivated, less than 50% intensively grazed	-10: no cultivation, no recent logging, and only low intensity grazing, if any
Upland erosion	25: rill, gully, or landslide erosion over more than 50% of the area	10: rill, gully, or landslide erosion over about 25% of area	0: no apparent signs of erosion
Channel erosion	25: continuous or frequent bank erosion, or active headcuts and degradation in tributary channels	10: occasional channel erosion of bed or banks	0: wide shallow channels with mild gradients, channels in massive rock, large boulders, or dense vegetation or artificially protected channels

TOTAL = 70

Table 2.10. Drainage basin sediment yield classification (Randle, 1996)

Drainage basin classification number	Total rating	Annual sediment yield (ac-ft/mi^2)
1	> 100	> 3
2	75 to 100	1.0 to 3.0
3	50 to 75	0.5 to 1.0
4	25 to 50	0.2 to 0.5
5	0 to 25	<0.2

- EXPLANATION -

Yield Class	Yield Rate 1/ (Ac.Ft/Sq.Mi/Yr.)	Total Area (Sq.Mi.)
1	> 3.0	____
2	1.0-3.0	____
3	0.5-1.0	____
4	0.2-0.5	____
5	0.1-0.2	____
6	< 0.1	____

▼ 0.45 AVERAGE ANNUAL SUSPENDED SEDIMENT YIELDS DETERMINED FROM SEDIMENT TRANSPORT RECORDS. RATES ARE IN AC.FT/SQ.MI/YR.

80 - 20 ECT. (PERCENT OF SHEET AND RILL EROSION - PERCENT OF CHANNEL AND GULLY EROSION.

Subregion Number	Subregions
4	SNAKE
1A	BEAR LAKE
1B	GREAT SALT LAKE
2A	SEVIER LAKE
2B	GREEN RIVER
2C	SAN JUAN - COLORADO
3	UPPER MAIN STEM
	LOWER MAIN STEM

1/ DO NOT USE THESE RATES TO DETERMINE SEDIMENT YIELDS AT SPECIFIC SITES. LARGE VARIATIONS IN SEDIMENT RATES MAY OCCUR WITHIN THE DELINEATED AREAS.

Cove Reservoir

SOURCES OF INFORMATION

1. GREAT BASIN, UPPER COLORADO AND LOWER COLORADO REGIONS, COMPREHENSIVE FRAMEWORK STUDY, APPENDICES VIII, WATERSHED MANAGEMENT, JUNE 1971, PACIFIC SOUTHWEST INTER-AGENCY COMMITTEE/WATER RESOURCES COUNCIL.
2. UTAH STATE SOILS MAP AND SOILS DESCRIPTIONS.
3. RESERVOIR SURVEYS BY SCS & USBR
4. SUSPENDED LOAD MEASUREMENTS BY USGS, USBR & SCS.
5. WATERSHED STUDIES BY SCS.
6. GENERAL KNOWLEDGE OF THE STATE FROM REGULAR SCS PROGRAM WORK.

ESTIMATED SEDIMENT YIELD RATES FOR THE STATE OF UTAH

EROSION & SEDIMENTATION -70
WESTERN U.S. WATER PLAN
AUGUST 1973
(SUBJECT TO REVISION)
prepared by
U.S.D.A., Soil Conservation Service
Geologist, Bob L. Bridges

10 5 0 5 10 15
scale in miles

Attachment 2 Preliminary Design Report

Preliminary Design Report

Cove Reservoir

Kane County

Water Conservancy District

PRELIMINARY

August 2020

ALPHA ENGINEERING

RB&G ENGINEERING, INC.

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Part I. Introduction

The Kane County Water Conservancy District (KCWCD) is proposing to install a new reservoir known as Cove Reservoir with associated facilities to be located near Orderville, Utah. The reservoir is a joint venture between KCWCD and the Washington County Water Conservancy District (WCWCD). The system will store water rights from local irrigation companies for use throughout the year.

The engineering design is being performed by Alpha Engineering Company (Alpha) out of St. George, Utah, and RB&G Engineering, Inc., (RB&G) out of Provo, Utah. Alpha is responsible for providing hydraulic analyses and spillway and water conveyance facility design, and RB&G is responsible for providing geologic investigations and dam structure design.

The project includes the construction of an off-stream reservoir less than one mile off the main drainage course, East Fork Virgin River (see **Figure 1** below). The reservoir is designed to hold approximately 6,055 acre-feet of water. The dam will be an earthen structure with principal and emergency spillways adjacent to the left abutment. To convey flows to and from the reservoir, new piping will be installed to tie into existing water transmission facilities. Due to immediately downstream homes, this dam is classified as High Hazard.

This report is being prepared as a comprehensive analysis of the design elements associated with the construction and operation of Cove Reservoir. The project location is shown below and overall exhibits of the project components—which include the dam structure, principal and auxiliary spillways, outlet works, an access road around the reservoir and a water conveyance system that ties the reservoir into the existing water system—are shown in **Appendix A, Exhibits 1 and 2**.



Figure 1 Cove Reservoir Location

This study references the following sources in the analysis of the hydrologic conditions at the Cove Reservoir:

- Technical Release 210-60 (TR-60), USDA 2019
- Technical Release 55 (TR-55), USDA 1986
- Technical Release 56 (TR-56), USDA 2014
- Utah Administrative Code Rule R655-11 (UAC), utah.gov 2020
- Hydrometeorological Report 49 (HMR-49), USACE 1984
- PMP Studies by Donald T. Jensen (Jensen), USU 1995 and 2003
- National Engineering Handbook, Section 4 (NEH-4), Mockus 1965 and 1972
- NOAA Atlas 14 (NWS), NWS 2018
- National Land Cover Database (NLCD), MRLC 2011
- Web Soil Survey (WSS), NRCS 2018
- National Engineering Handbook Part 630 (NEH), USDA 2019
- Flood Hydrology Manual (USBR), USBR 1989

The following software programs were used in modeling the hydrologic/hydraulic conditions and breach analysis:

- HEC-1 version 4.1 (HEC-1), USACE 1998
- USDA Water Resource Site Analysis version 2005.1.8 (SITES), USDA 2005
- HEC-RAS version 5.0.5 (HEC-RAS), USACE 2016
- Bentley FlowMaster version V8i (FlowMaster), Bentley 2009

Part II. Hydrology Analysis

A. Site Location and Existing Conditions

The Cove Reservoir dam is located 0.6 miles west of Highway 89 along Cove Road due southwest of the town of Orderville, Utah, or 37.269° North Latitude and 112.661° West Longitude. The reservoir surface area generated with the construction of the dam is approximately 188 acres and is comprised of undisturbed shrub ground cover, natural drainage channels, dirt roads and a section of ranch land used for grazing.

An aerial drone survey was performed across the anticipated footprint of the reservoir and was used to generate a 3D model of the existing surface with an approximate one-foot vertical accuracy and six inch horizontal accuracy. This surface model was used in designing the different components of the project and are shown at 10-foot contour intervals on **Appendix A, Exhibit 2**.

Using available USGS DEM data, the area upstream of the proposed reservoir was delineated to determine the drainage area tributary to the reservoir. The drainage basin tributary to the Cove Reservoir site is 3,034 acres, or 4.7 square miles, and is generally comprised of undeveloped shrub and evergreen forest ground cover. The centroidal location of the tributary drainage basin is 37.305° North Latitude and 112.662° West Longitude. The mean basin elevation is 6271'. The average annual temperature for the area is 51.2°F (NWS, Climate Monitoring) with an average annual precipitation of 15.6 inches (USGS, StreamStats). The Climatic Index calculates to 0.6 (NEH 630, Equation 21-1). An exhibit of the Cove Reservoir and its tributary drainage basin is shown in **Appendix A, Exhibit 3**. This exhibit also shows delineated subbasins of the overall tributary drainage basin as will be discussed later in this report.

B. Design Criteria

The hydrographs analyzed in this study, as required by NRCS and Utah Dam Safety, are summarized in **Table 1**. The NRCS requires hydrograph analyses for the Principal Spillway, Auxiliary Spillway and Freeboard (TR-60, Part 2). The Utah State Engineers Office requires hydrograph analyses for probable maximum flood events (general and local storms) and for 100-year events with saturated soil conditions (UAC, Section 11-4A). As directed by the NRCS, additional hydrographs with varying return frequencies are being analyzed for informational purposes.

Hydrograph	Frequency	Duration	Precipitation
NRCS Required Hydrographs			
Principal Spillway Hydrograph	100-year	10-day	TR-60, Fig 2-1 (NWS)
Auxiliary Spillway Hydrographs	Maximum	6- & 24-hour	TR-60, Fig 2-2
Freeboard Hydrographs	Maximum	6- & 24-hour	TR-60, Fig 2-2
Varying Frequency Hydrographs	2-, 5-, 10-, 25-, 50-, 100- & 500-year	24-hour	NWS
Utah State Required Hydrographs			
SEP Hydrographs	Maximum	6- & 72-hour	Jensen
100-year (AMC III) Hydrographs	100-year	6- & 72-hour	NWS

Table 1 Summary of Design Hydrographs

Each of the above hydrographs is included in this analysis as separate Storm Events. For purposes of this analysis, **Table 2** assigns numbers to each Storm Event.

	Storm Event	Duration	Frequency	AMC
01	2-year 24-hour	24-hour	2-year	II
02	5-year 24-hour	24-hour	5-year	II
03	10-year 24-hour	24-hour	10-year	II
04	25-year 24-hour	24-hour	25-year	II
05	50-year 24-hour	24-hour	50-year	II
06	100-year 24-hour	24-hour	100-year	II
07	500-year, 24-hour	24-hour	500-year	II
08	100-year 6-hour AMC III	6-hour	100-year	III
09	100-year 24-hour AMC III	24-hour	100-year	III
10	Local SEP Hydrograph (SEP-L)	6-hour	Maximum	II
11	General SEP Hydrograph (SEP-G)	72-hour	Maximum	II
12	Principal Spillway Hydrograph (PSH)	10-day	100-year	-[1]
13	Local Auxiliary Spillway Hydrograph (ASH-L)	6-hour	Maximum	II
14	General Auxiliary Spillway Hydrograph (ASH-G)	24-hour	Maximum	II
15	Local Freeboard Hydrograph (FBH-L)	6-hour	Maximum	II
16	General Freeboard Hydrograph (FBH-G)	24-hour	Maximum	II

Table 2 Summary of Storm Events

The Principal Spillway Hydrograph (Storm Event 12) will be used in designing the Principal spillway. The most critical of the Auxiliary Spillway, Freeboard and SEP Hydrographs (Storm Events 10, 11, 13, 14, 15 and 16) will be used in designing the auxiliary spillway and establishing the top-of-dam elevation. The Local Auxiliary Spillway Hydrograph (Storm Event 13) is used to check the stability of auxiliary spillway.

[1] As directed in NEH 630.2102(a)(1), Curve Numbers reflected in NEH 630.2102, Table 21-2, are used for the PSH because the precipitation value exceeds 6 inches.

C. Precipitation Values

The precipitation values for the 2- to 500-year, 24-hour and the 100-year, 10-day storm events (Storm Events 01 through 09 and 12) are taken from NWS. For the PSH (Storm Event 12), see also TR-60, Figure 2-1. Fourteen evenly spaced points throughout the drainage basin were taken and averaged out to calculate a single overall precipitation value for each storm frequency. An exhibit reflecting these points is included in **Appendix A, Exhibit 4**, and calculations are included in **Appendix B**.

The precipitation values for the SEP storms (Storm Events 10 and 11) are taken from HMR-49 and Jensen. It is noted that HMR-49 outlines the method used in calculating the Probable Maximum Precipitation (PMP) values for this drainage basin. Jensen has been accepted by the Utah State Engineer's Office and further updates the PMP values. PMP values that have been updated by Jensen are referred to as Spillway Evaluation Precipitation (SEP) values and are used in lieu of the PMP values. Calculations for the SEP values are included in **Appendix B**.

The precipitation value for the ASH and FBH storm events (Storm Events 13 through 16) are taken from TR-60, Figure 2-2. The precipitation values are calculated using the NWS 100-year and Jensen SEP precipitation values. Calculations for the ASH and FBH values are included in **Appendix B**.

The precipitation values for each storm event are summarized in **Table 3**.

	Storm Event	Precipitation Value
01	2-year 24-hour	1.61 in
02	5-year 24-hour	2.01 in
03	10-year 24-hour	2.34 in
04	25-year 24-hour	2.79 in
05	50-year 24-hour	3.14 in
06	100-year 24-hour	3.51 in
07	500-year, 24-hour	4.69 in
08	100-year 6-hour AMC III	2.75 in
09	100-year 24-hour AMC III	3.51 in
10	Local SEP Hydrograph (SEP-L)[2]	7.67 in
11	General SEP Hydrograph (SEP-G)	12.50 in
12	Principal Spillway Hydrograph (PSH)	6.83 in
13	Local Auxiliary Spillway Hydrograph (ASH-L)	4.03 in
14	General Auxiliary Spillway Hydrograph (ASH-G)	5.85 in
15	Local Freeboard Hydrograph (FBH-L)	7.67 in
16	General Freeboard Hydrograph (FBH-G)	10.20 in

Table 3 Storm Event and Precipitation Values

[2] As allowed by UAC, SEP values are used in this analysis and are updated values (Jensen) to PMP values calculated in HMR-49. For comparison purposes, the Local PMP Precipitation Value is 9.46 inches and the General PMP Precipitation Value is 12.50 inches.

D. Drainage Basin Parameters

The 4.7-square mile tributary drainage basin for the Cove Reservoir was divided into 12 smaller subbasins, ranging in size from 0.13 square miles to 1.01 square miles, to facilitate calculations of the overall basin and account for the varying land cover conditions across each subbasin. The subbasin characteristics are summarized in **Table 4** and discussed in following sections.

Sub-basin	Area (sq mi)	CN, AMC II/III	Flow Length (ft)	Ave Slope (%)	Lag Time, AMC II/III (hr)	Time of Conc, AMC II/III (hr)	Initial Abst, AMC II/III (in)
1	0.503	72.8/86.0	7,814	44.5	0.30/0.20	0.51/0.34	0.75/0.32
2	0.436	72.5/85.8	7,709	42.1	0.31/0.21	0.52/0.34	0.76/0.33
3	0.279	71.0/84.9	5,069	42.6	0.23/0.15	0.39/0.25	0.82/0.36
4	0.453	73.3/86.3	7,181	42.1	0.29/0.19	0.48/0.32	0.73/0.32
5	0.805	74.1/86.8	10,349	42.7	0.38/0.25	0.63/0.42	0.70/0.30
6	0.150	84.3/92.5	3,221	36.9	0.12/0.08	0.19/0.14	0.37/0.16
7	0.327	75.7/87.8	7,022	39.6	0.27/0.18	0.46/0.31	0.64/0.28
8	1.012	84.0/92.4	11,194	23.1	0.40/0.29	0.67/0.48	0.38/0.17
9	0.242	85.5/93.1	4,699	34.4	0.16/0.11	0.26/0.19	0.34/0.15
10	0.129	86.7/93.7	3,010	33.3	0.11/0.08	0.18/0.14	0.31/0.13
11	0.279	84.8/92.8	6,019	24.0	0.23/0.17	0.39/0.28	0.36/0.16
12	0.127	81.2/90.9	3,485	12.0	0.24/0.17	0.40/0.28	0.46/0.20
Total[3]	**4.742**	**77.8/88.9**	**33,591**	**35.4**	**0.95/0.65**	**1.58/1.09**	**0.57/0.25**

Table 4 Drainage Subbasin Parameters

i. Land Use

Land use and soil data were obtained from NLCD and WSS. The majority of the basin is comprised of *42-Evergreen Forest*, with portions of *52-Shrub/Scrub* and smaller portions of *41-Deciduous Forest*, *21/22-Developed Open Space/Low Intensity* and *31-Barren Land*. An exhibit of the land use is included in **Appendix A, Exhibit 5**. The soil data for the site classifies the basin to have a relatively even mixture of all four hydrologic soil groups. An exhibit of the hydrologic soil groups is included in **Appendix A, Exhibit 6**.

Each subbasin is assigned a Soil Conservation Service Curve Number (CN) that associates the land use with the soil data. As different types of soil cover exist throughout a subbasin, CNs have been prorated on an area-weighted basis. CNs for each subbasin are taken from NEH, Tables 9-2 and 9-5. Because NLCD land use designations do not directly correspond to NEH land cover descriptions, **Table 5** demonstrates how each correspond for this analysis.

NLCD Land Use Designation	NEH Land Cover Designation
21/22-Developed Open Space/Low Intensity	Open Space, Poor (Table 9-5)
31-Barren Land	Desert Shrub, Fair (Table 9-2)

[3] While the Area for the Overall basin is a sum of each of the subbasins, the flow length is derived from portions of Subbasins B1, B2, B4, B6 and B8, which comprise the longest path through the Overall basin and is used to calculate the lag time and time of concentration. The average slope, curve number and initial abstraction were calculated based on the Overall basin.

41-Deciduous Forest	Pinyon-Juniper, Fair (Table 9-2)
42-Evergreen Forest	Pinyon-Juniper, Poor (Table 9-2)
52-Shrub/Scrub	Desert Shrub, Good (Table 9-2)

Table 5 NLCD Land Use to NEH Land Cover Designations

CNs for the individual subbasins are summarized in **Table 4** and range between 71.0 and 86.7 for AMC II and between 84.9 and 93.7 for AMC III. CNs used for the PSH (Storm Event 12) are modified per NEH 630.2102, Table 21-2, and range between 53.0 and 75.4. The overall basin CN is 77.8 for AMC II and 88.9 for AMC III. NLCD Land Use descriptions and curve number calculations are included in **Appendix B**.

ii. Lag Times

Lag times and times of concentration for the subbasins were calculated using methodology outlined in NEH Chapter 15, which estimates the lag time, TLAG, and time of concentration, T_c, for large drainage basins as:

$$TLAG = \frac{l^{0.8}\left(\left(\frac{1000}{CN} - 10\right) + 1\right)^{0.7}}{1{,}900Y^{0.5}}$$

$$T_c = \frac{TLAG}{0.6}$$

Paths for the basin lengths (l) are shown in **Appendix A, Exhibit 3**. Criteria and calculated lag times and times of concentration for the individual subbasins are summarized in **Table 4**. The overall time of concentration for the entire tributary basin—having a basin length of 33,591 feet, an average CN of 77.8/88.9 (AMC II/III), and an average watershed land slope of 35.4%–are 1.58 hours for AMC II and 1.09 hours for AMC III. For the PSH (Storm Event 12), which uses a CN based on NEH 630.2102, Table 21-2, the average CN is 71.8 and the overall time of concentration is 1.88 hours.

iii. Initial Abstraction

Initial abstraction depths for the subbasins were calculated using methodology outlined in TR-55, which estimates the initial abstraction depth, I_a, as:

$$I_a = 0.2 \times \left(\frac{1000}{CN} - 10\right)$$

Initial abstraction depth for the individual subbasins are summarized in **Table 4**. The overall basin initial abstraction depth equates to 0.57 inches for AMC II and 0.25 inches for AMC III. For the PSH (Storm Event 12), which uses a CN based on NEH 630.2102, Table 21-2, the initial abstraction for the overall basin is 0.79 inches.

iv. Reach Parameters

In developing the hydrologic models of the drainage basin, accumulating flows were routed along reach paths as shown in **Appendix A, Exhibit 3**. The geometry and characteristics of these reaches were based on field observations and engineering judgment. A trapezoidal channel was assumed along the reaches in conformance with field measurements having an increasing flow width, ranging from 20 to 40 feet wide, and a roughness coefficient of 0.30.

E. Storm Hydrographs

For the PSH, ASH and FBH (Storm Events 12-16), the hydrographs were developed using NEH 630.2102 and 2103. For all other storm events (Storm Events 01-11), a dimensionless design storm distribution (NEH 630.2103, Figure 21-9) was applied and modeled using HEC-1 software. The dimensionless storm distribution and calculated storm hydrographs are shown in tabular form with calculations in **Appendix B**.

F. Results

As mentioned, Storm Events 01 through 10 were modeled using HEC-1 software to determine the hydrographs. Each of the storm events were setup as separate models, and model output for the models is included in **Appendix C**. Storm Events 12-16 were developed using NEH 630.2103 and 2103 but were also modeled using HEC-1 software for comparison purposes, the calculations for which can also be found in **Appendix C**. The most conservative value between the NEH 630 results and HEC-1 model was used for these storm events. The peak inflows into the reservoir and total inflow volumes for each storm event are summarized in **Table 6**.

	Storm Event	Peak Inflow	Volume
01	2-year 24-hour	89 cfs	77 af
02	5-year 24-hour	175 cfs	130 af
03	10-year 24-hour	261 cfs	178 af
04	25-year 24-hour	396 cfs	254 af
05	50-year 24-hour	506 cfs	317 af
06	100-year 24-hour	632 cfs	387 af
07	500-year, 24-hour	1,064 cfs	624 af
08	100-year 6-hour AMC III	2,280 cfs	425 af
09	100-year 24-hour AMC III	1,031 cfs	601 af
10	Local SEP Hydrograph (SEP-L)	6,395 cfs	1,286 af
11	General SEP Hydrograph (SEP-G)	1,587 cfs	2,439 af
12	Principal Spillway Hydrograph (PSH)	850 cfs	749 af
13	Local Auxiliary Spillway Hydrograph (ASH-L)	2,180 cfs	498 af
14	General Auxiliary Spillway Hydrograph (ASH-G)	1,766 cfs	868 af
15	Local Freeboard Hydrograph (FBH-L)	6,395 cfs	1,286 af
16	General Freeboard Hydrograph (FBH-G)	3,524 cfs	1,880 af

Table 6 Peak Flows by Storm Event

Part III. Hydraulic Analysis

A. Spillway Analysis

The principal spillway (PS)—which will be an inlet and pipe carrying the flows away from the dam structure—is sized based on TR-60, Section 2-1 and Part 6. The auxiliary spillway (AS)—which will be a broad-crested weir discharging into a trapezoidal open channel—is sized based on TR-60, Section 2-2 and Part 7. The hydrographs analyzed in designing the spillway configuration are the Principal Spillway Hydrograph (PSH), Auxiliary Spillway Hydrographs (ASH) and the Freeboard Hydrographs (FBH) (Storm Events 12-16). The remaining storm events are being analyzed for comparison purposes and to ensure they are routed adequately through the principal and auxiliary spillways configuration.

SITES was used to model the PSH, ASH and FBH (Storm Events 12-16). Iteratively designed principal and auxiliary spillways were used in the model to accurately reflect conditions. A conservative auxiliary spillway crest elevation was used and each of the storm events were attenuated accordingly through the reservoir using HEC-1 modeling. A summary of the maximum water surface elevations produced in the HEC-1 models is shown in **Table 7**.

	Storm Event	Maximum Water Elevation
01	2-year 24-hour	5546.0’
02	5-year 24-hour	5546.4’
03	10-year 24-hour	5546.7’
04	25-year 24-hour	5547.3’
05	50-year 24-hour	5547.7’
06	100-year 24-hour	5548.1’
07	500-year, 24-hour	5548.9’
08	100-year 6-hour AMC III	5548.3
09	100-year 24-hour AMC III	5548.8’
10	Local SEP Hydrograph (SEP-L)	5551.0’
11	General SEP Hydrograph (SEP-G)	5551.6’
12	Principal Spillway Hydrograph (PSH)	5548.2’
13	Local Auxiliary Spillway Hydrograph (ASH-L)	5548.6’
14	General Auxiliary Spillway Hydrograph (ASH-G)	5549.6’
15	Local Freeboard Hydrograph (FBH-L)	5551.0’
16	General Freeboard Hydrograph (FBH-G)	5551.8’

Table 7 Maximum Water Surface Elevation by Storm Event

The worst-case scenario storm event is the General Freeboard Hydrograph (Storm Event 16). This storm event is also referred to as the Inflow Design Flood (IDF).

A comparative analysis was performed to see the changes in hydrologic flows during the higher frequency storm events with construction of the proposed reservoir, a summary of which is included in **Table 8**.

	Storm Event	Peak Flow *before* Proposed Reservoir	Peak Flow *after* Proposed Reservoir
01	2-year 24-hour	89 cfs	16 cfs
02	5-year 24-hour	175 cfs	22 cfs
03	10-year 24-hour	261 cfs	26 cfs
04	25-year 24-hour	396 cfs	31 cfs
05	50-year 24-hour	506 cfs	35 cfs
06	100-year 24-hour	632 cfs	38 cfs
07	500-year, 24-hour	1,064 cfs	43 cfs

Table 8 Peak Flows Before and After the Proposed Reservoir

B. Spillway Parameters

Models were setup in SITES based on the governing storm events for the PSH, ASH and FBH (Storm Events 12-16). The inflow hydrographs produced in the Hydrology Analysis section was input into the model. Output for the model is included in **Appendix C**. The results from the SITES model, which incorporate the principal and auxiliary spillway parameters at an AS width of 30 feet, include the following:

- Peak Inflow (ASH-L): 2,180 cfs
- Peak Inflow (FBH-G): 6,395 cfs
- Principal Spillway Crest Elevation: 5545.5’
- Auxiliary Spillway Crest Elevation: 5548.5’
- Maximum Water Surface (ASH-L): 5548.7’
- Maximum Water Surface (FBH-G): 5552.3’
- Peak reservoir outflow (FBH-G): 648 cfs (PS: 127 cfs, AS: 521 cfs)
- Maximum depth above AS crest: 3.8 feet

Additional constraints are considered in the design of the principal and auxiliary spillways. A riser is proposed to be installed at the inlet to the principal spillway. The riser shall have a larger cross-sectional area to reduce excessive surging, noise, vibration and vortex action. Per TR-60, Section 6-2, this cross-sectional area shall be a minimum of 2.5’ x 7.5’ (L x W). A trash rack shall be incorporated into the riser structure to avoid clogging, and an anti-vortex device (i.e. anti-vortex baffle plate) shall also be incorporated to prevent a vortex condition as water spills into the riser. An air vent is also added to the inlet to remove air and improve hydraulic performance.

It is noted that the SITES model maximum water surface elevation of 5552.3’. A more conservative auxiliary spillway crest elevation was chosen at elevation 5549.2’. All storm event hydrographs

were modeled in HEC-1 using this elevation. Based on the HEC-1 model results and the site and code constraints, the following spillway parameters were selected:

- Principal Spillway (Pipe)
  - Crest Elevation: 5545.5'
  - Pipe Material: Ductile Iron Encased in Concrete
  - Pipe Diameter: 30 inches
- Auxiliary Spillway (Trapezoidal Channel)
  - Crest Elevation: 5549. 2'
  - Material: Earthen
  - Base Width: 30 feet
  - Bank Slopes: 2:1 (H:V)

The HEC-1 results are summarized as follows:

- Peak Inflow: 3,524 cfs
- Peak Outflow: 404 cfs
- Maximum Water Surface: 5551.8'
- Maximum depth above AS crest: 2.6 feet
- Time to Maximum Water Surface: 19.2 hours (0.8 days)
- Time to first flow in auxiliary spillway: 10.2 hours (0.4 days)
- Time to zero flow in auxiliary spillway: 105.8 hours (5.4 days)

C. *Emergency Drain and Outlet Works*

The emergency drain pipeline is required in order to drain the water supply storage in case of emergency. According to Utah State Code R655-11-7A, the pipeline is required to drain 90% of the storage volume within 30 days neglecting reservoir inflows.

Due to geographical constraints, the proposed drain is approximately 675 feet in length. The water discharges approximately 300 feet from the base of the dam into an existing ephemeral drainage channel. The maximum water surface elevation is 5545.5 feet (principal spillway crest elevation providing for 6,055 acre-feet of storage), and the outlet works discharge elevation is 5497.5 feet, which provides for 600 acre-feet of storage. A minimum 24-inch pipeline is required to drain the Cove Reservoir within the required amount of time.

A 24-inch ductile iron (DI) pipeline encased in concrete has been selected to be installed through the dam section in order to withstand bearing pressures and minimize thermal expansion. A riser is proposed to be installed at the inlet to the emergency drain pipeline with a control valve to allow use as needed. The riser shall have a larger cross-sectional area to reduce excessive surging, noise, vibration and vortex action. A trash rack shall be incorporated into the riser structure to avoid clogging, and an anti-vortex device (i.e. anti-vortex baffle plate) shall also be incorporated

to prevent a vortex condition as water spills into the riser. An air vent is also added to the inlet to remove air and improve hydraulic performance. Once the emergency drain pipeline exits through the dam section, a pipeline will be upsized to 30 inches to allow the reservoir to drain in the appropriate amount of time. An energy dissipation structure and trash rack will be installed at the outlet of the pipe as it discharges into the existing channel.

Different configurations of the riser, valve and pipe inlet were evaluated, including:

1. A sloping structure constructed on the upstream face of the dam that extends to the dam crest with a stem-operated gate.

2. A shorter vertical structure with one slide gate. This structure would be partially submerged under normal reservoir operation and would not extend to the dam crest.

Of the two configurations considered, it was decided that the first configuration consisting of a sloping structure and stem operated gate would best meet the needs of the project. The second configuration was not used due to cost considerations and functionality of the valve. A stem for the gate will extend up along the face of the dam and will be supported on concrete blocks spaced every 10 feet. The blocks will have adjustable stem guides to allow for re-alignment, as required.

Reservoir discharge data has been determined by combining the amount of head in the reservoir combined with losses from the entrance, pipe friction, and other minor losses. Calculations are included in **Appendix A**. **Table 9** summarizes the discharge data:

Water Surface Elevation (ft)	Water Storage (ac-ft)	Discharge Time (days)
5545.5	6055	0.0
5530	3542	10.1
5514	1737	18.1
5797	587	23.9

Table 9 Emergency Drain Discharge Rating

The emergency drain pipeline will be also used as the feed into the reservoir. The pipeline will tie into the existing irrigation system. A new pump station will be installed on the existing irrigation system that will pump flows from the East Fork Virgin River into the reservoir. Valving will be installed to allow pressurized flows to fill the reservoir while stopping flows from discharging into the existing channel. During emergencies, pumping will stop and the valving will be opened to allow flows to discharge into the existing channel and drain the reservoir.

Part IV. Freeboard Analysis

A. Storm and Wind Events

The Administrative Rules for Dam Safety and TR-60, Part 5, state that the freeboard above the principal spillway crest elevation must exceed the values produced by the scenarios given below. In analyzing a permeable and an impermeable dam, a range of freeboard is given for the first and second condition. The dam is considered to be semi-permeable, and therefore, the actual freeboard requirement is adjusted within this range.

1. 100-year, 24-hour storm (AMC III) in conjunction with a 50-mph wind.
2. 100-mph wind without any significant rainstorm.
3. IDF (or FBH-G) without any significant windstorm.
4. ASH with Wave Action (TR-60)

B. Maximum Wave Runup

Historic data for the design wind for the Cove Reservoir area is not available. As required, wind speeds of 50 mph and 100 mph were analyzed. For these two wind speeds, the wind setup, wave height, and total wave runup was calculated as summarized in **Table 10**. Calculations are included in **Appendix B**.

Wind Velocity	Wave Runup	Wind Setup	Wave Freeboard
50 mph	2.8 ft	0.1 ft	2.9 ft
100 mph	5.8 ft	0.1 ft	5.9 ft

Table 10 Wave Runup by Wind Speed

Wave Action was further calculated using procedures outlined in TR-56. The maximum overwater wind velocity calculated to 87 mph and produced a significant wave height 1.8 ft. Calculations are included in **Appendix B**.

C. Results

The total required freeboard for each storm and wind event is summarized in **Table 11**. The Storm Freeboard is taken from the difference between the principal spillway crest elevation and the maximum water surface elevation produced by the respective storm events. The Total Freeboard is the sum of the Storm Freeboard plus the Wave Freeboard.

Scenario	Wave Freeboard	Storm Freeboard	Total Freeboard
1	2.9 ft	3.3 ft	6.2 ft
2	5.9 ft	0.0 ft	5.9 ft
3	0.0 ft	6.3 ft	6.3 ft
4	1.8 ft	4.1 ft	5.9 ft

Table 11 Total Freeboard Requirements

The governing total freeboard requirement is 6.3 feet as taken from Scenario 3. With a principal spillway crest elevation of 5545.5', the minimum top of dam elevation allowing for adequate freeboard is 5551.8'. The proposed top of dam elevation is 5552.0'.

Part V. Breach Analysis

A. Criteria

Breach simulations were completed for "Sunny Day" and "Rainy Day" scenarios. Both scenarios assume the water level is at the auxiliary spillway crest elevation (5549.2') at the start of the model. The "Sunny Day" scenario breaches immediately with no storm event attenuating through the reservoir. The "Rainy Day" scenario attenuates the worst-case storm event and breaches as the water surface elevation approaches the top of the dam.

A sensitivity analysis was performed to determine the most extreme breach within NRCS parameters. Per TR-60, the minimum peak discharge of the breach hydrograph is:

$$Q_{max} = 1{,}100\left(\frac{V_s H_w}{A}\right)^{1.35} = 1{,}100\left(\frac{(7{,}245)(85.5)}{20{,}400}\right)^{1.35} = 110{,}305\ cfs$$

But not less than:

$$Q_{max} = 3.2H_w^{2.5} = 3.2(85.5^{2.5}) = 216{,}304\ cfs$$

Nor more than:

$$Q_{max} = 65H_w^{1.85} = 65(85.5^{1.85}) = 243{,}810\ cfs$$

As a result of the analysis, the most extreme breach occurred under the following breach parameter

- Storm Event: Local Freeboard Hydrograph (Storm Event 15)
- Depth of water at breach: 85.5'
- Water surface elevation: 5551.5'
- Bottom width: 427.5' (water depth multiplied by 5)
- Side slope: 1:1 (H:V)
- Time to develop: 0.95 hours
- Storm event for "Rainy Day" scenario
    - Peak inflow: 6,395 cfs
    - Inflow volume: 1,286 af
- Manning's 'n': 0.05
- Width of the downstream valley: approx. 1,100'
- Breach location at maximum section of dam
- Cross-sectional area of dam embankment at breach location: approx. 20,400 sf
- Reservoir storage at breach: 7,245 af

B. Methodology

Separate HEC-RAS models were setup for the “Sunny Day” and “Rainy Day” scenarios. Constraints were input based on the Hydrology, Hydraulic and Freeboard Analyses of this report. The terrain downstream of the dam structure was imported into the HEC-RAS geometry editor using USGS DEM files to simulate a 2D breach for each scenario.

C. Results

Inundation maps have been prepared based on the results of the HEC-RAS models, as shown in **Appendix A, Exhibits 7 and 8**. Model output from the HEC-RAS models are included in **Appendix D**. The results of the models are summarized below.

- Sunny Day
    - Maximum outflow: 205,567 cfs
- Rainy Day
    - Maximum outflow: 243,575 cfs

Appendix A. Exhibits

Exhibit 1. Overall Project Components

Exhibit 2. Reservoir Project Components

Exhibit 3. Reservoir Drainage Basin

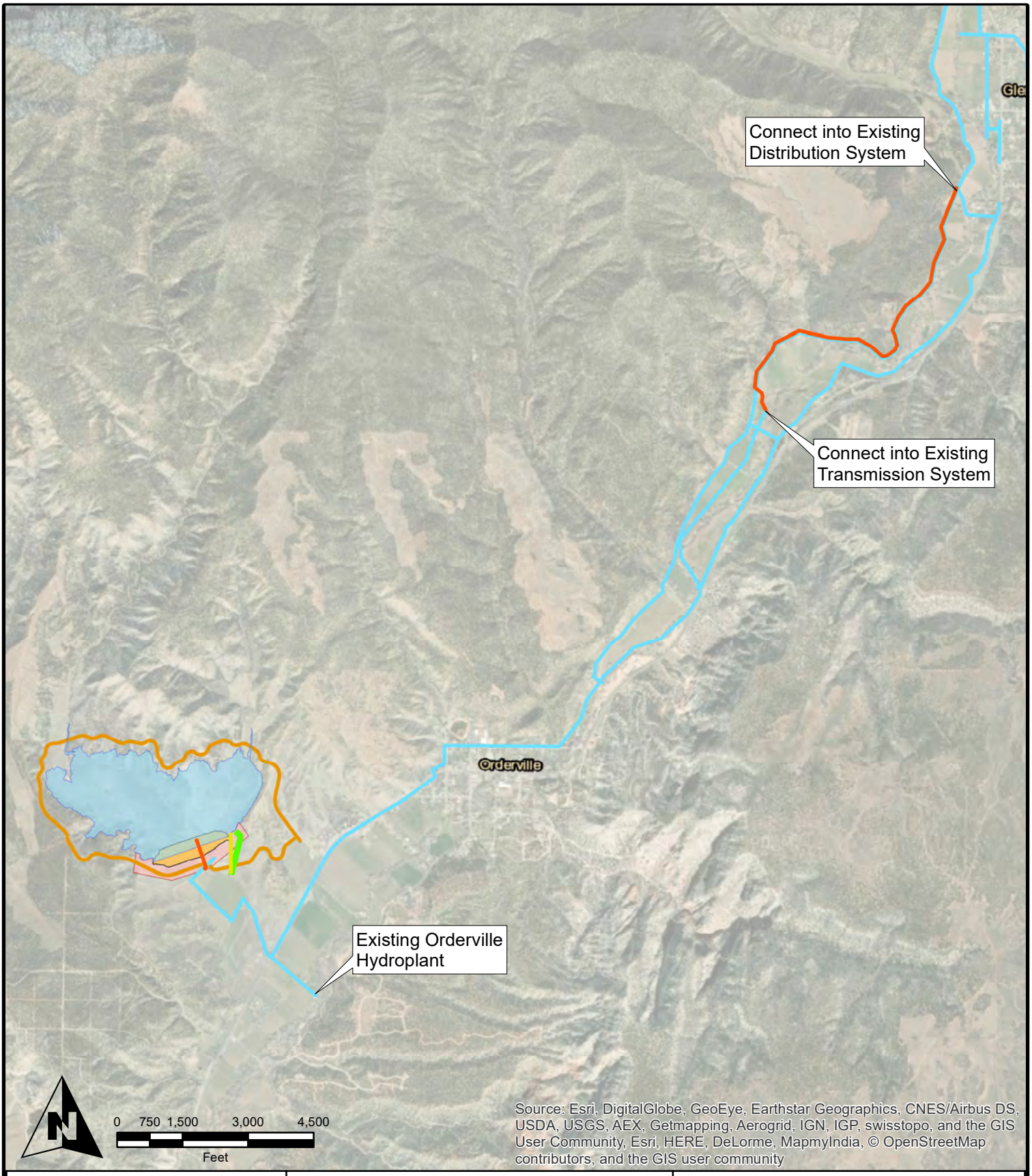
Exhibit 4. NWS Precipitation Points

Exhibit 5. NLCD Soil Data

Exhibit 6. Hydrologic Soil Groups

Exhibit 7. Sunny Day Breach Inundation Map

Exhibit 8. Rainy Day Breach Inundation Map



ALPHA ENGINEERING

RB&G ENGINEERING, INC.

- Cove Reservoir
- Cove Dam Structure
- Construction/Instrumentation Buffer Area
- Existing Transmission Pipeline
- New Transmission Pipeline

Overall Project Components

Exhibit 1 - Cove Reservoir

Spatial Reference:	UT83-SF
Drawn By:	JTM
Scale:	1 inch = 3,000 feet
Date:	September 17, 2019

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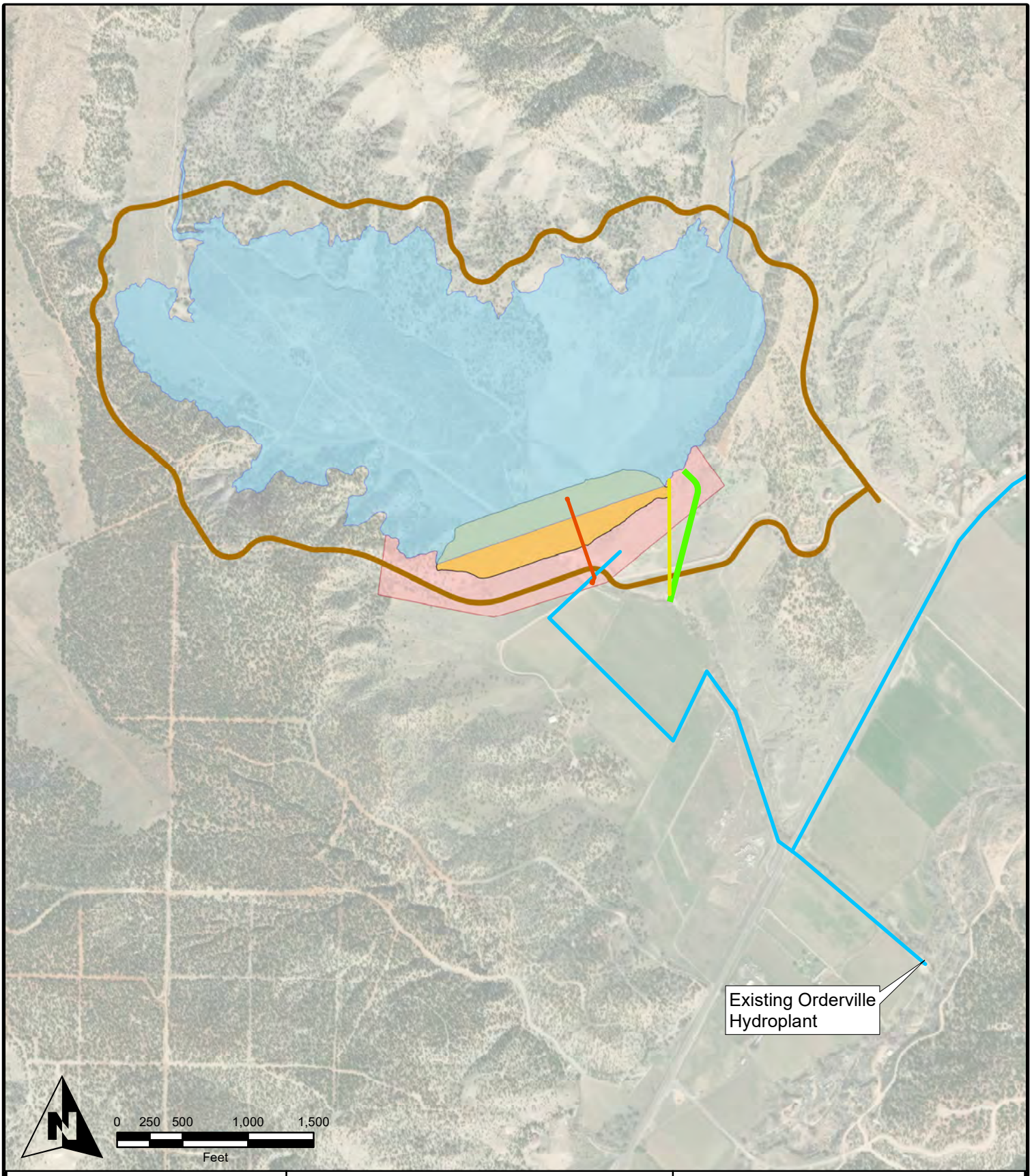

ALPHA ENGINEERING

RB&G ENGINEERING, INC.

- Cove Reservoir
- Cove Dam Structure
- Construction/Instrumentation Buffer Area
- Existing Transmission Pipeline
- OutletWorks
- Principal Spillway
- Auxiliary Spillway
- Access Road

Reservoir Project Components

Exhibit 2 - Cove Reservoir

Spatial Reference:	UT83-SF
Drawn By:	JTM
Scale:	1 inch = 1,000 feet
Date:	September 17, 2019

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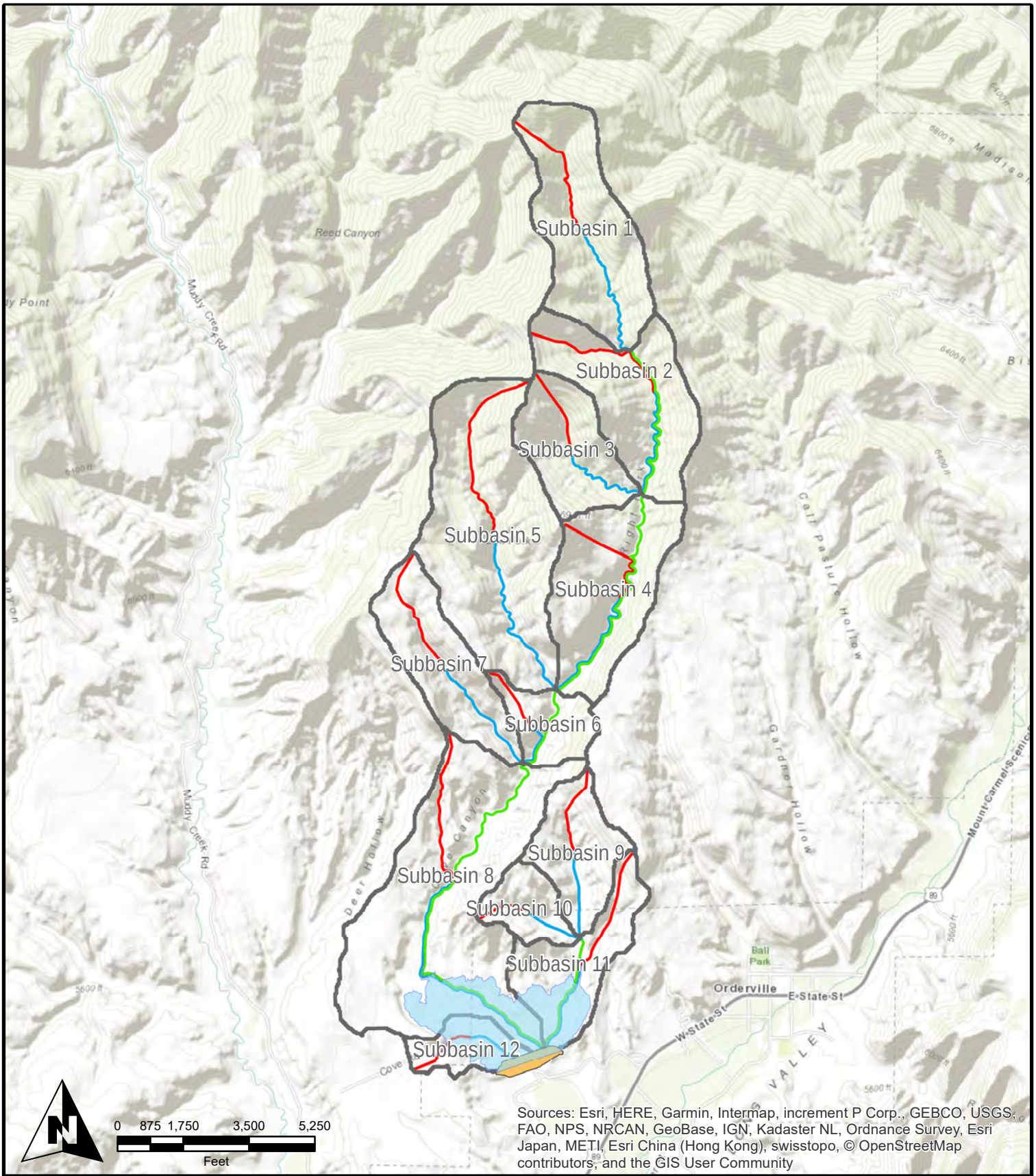

ALPHA ENGINEERING

RB&G ENGINEERING, INC.

- Cove Reservoir
- Drainage Subbasins
- Centroidal Water Course
- Maximum Water Course
- Routed Flow (Modeling)

Reservoir Drainage Basin

Exhibit 3 - Cove Reservoir

Spatial Reference:	UT83-SF
Drawn By:	JTM
Scale:	1 inch = 3,500 feet
Date:	September 17, 2019

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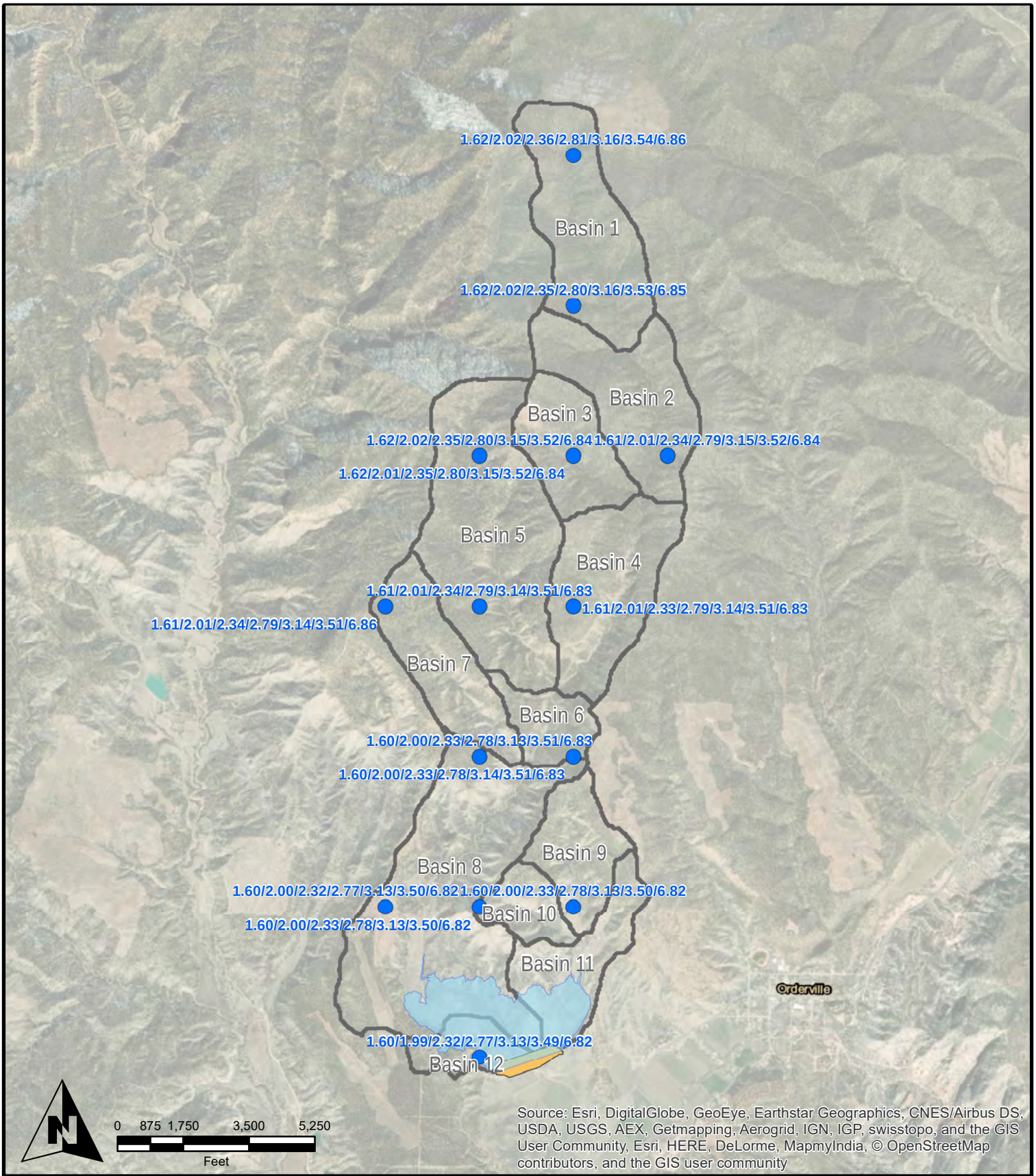

ALPHA ENGINEERING

RB&G ENGINEERING, INC.

Cove Reservoir

Drainage Subbasins

NOAA Precipitation Values
2-yr / 5-yr / 10-yr / 25-yr / 50-yr / 100-yr / 100-yr (10-day)

NOAA Precipitation Points

Exhibit 4 - Cove Reservoir

Spatial Reference:	UT83-SF
Drawn By:	JTM
Scale:	1 inch = 3,500 feet
Date:	September 17, 2019

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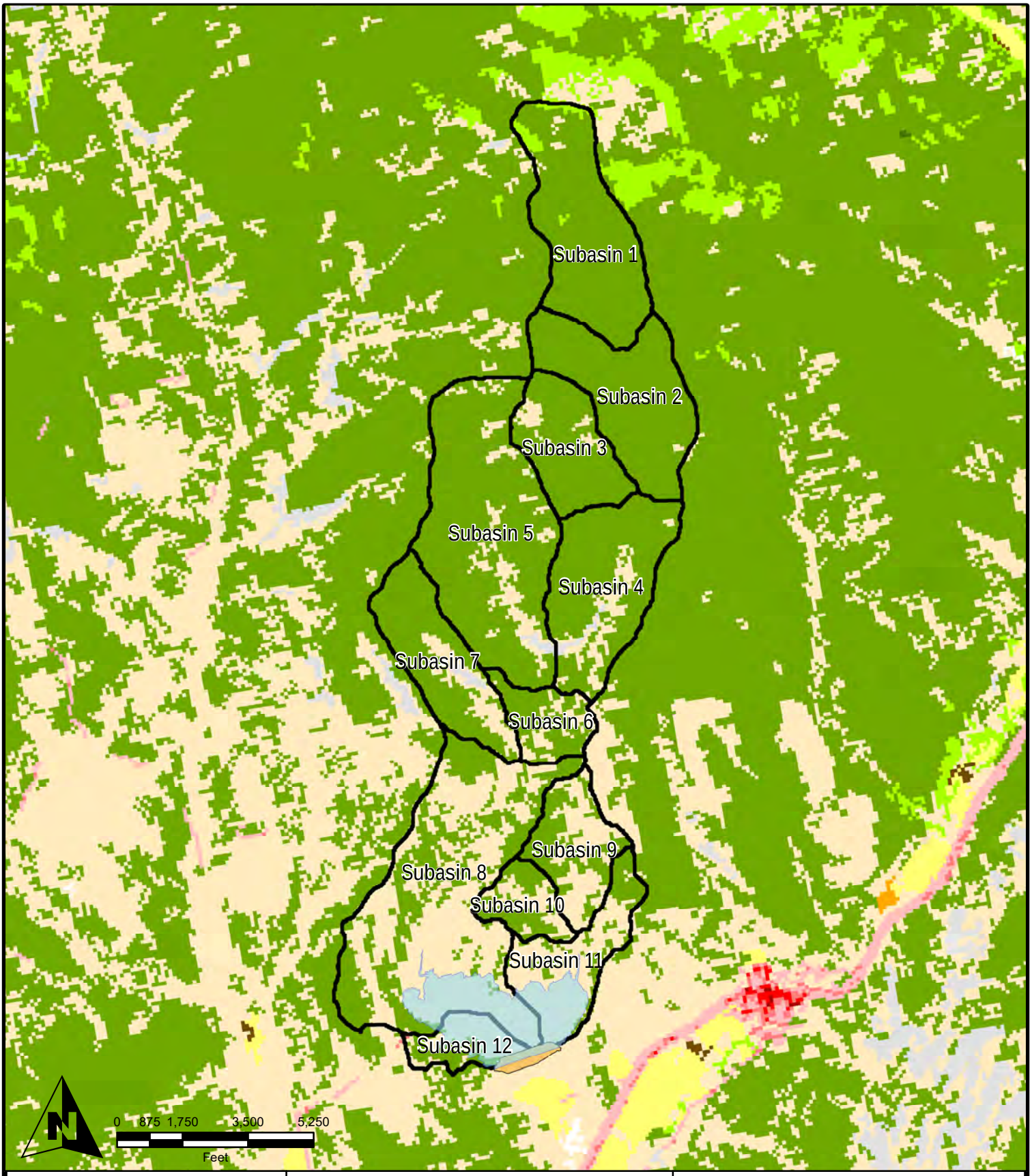


ALPHA ENGINEERING

RB&G ENGINEERING, INC.

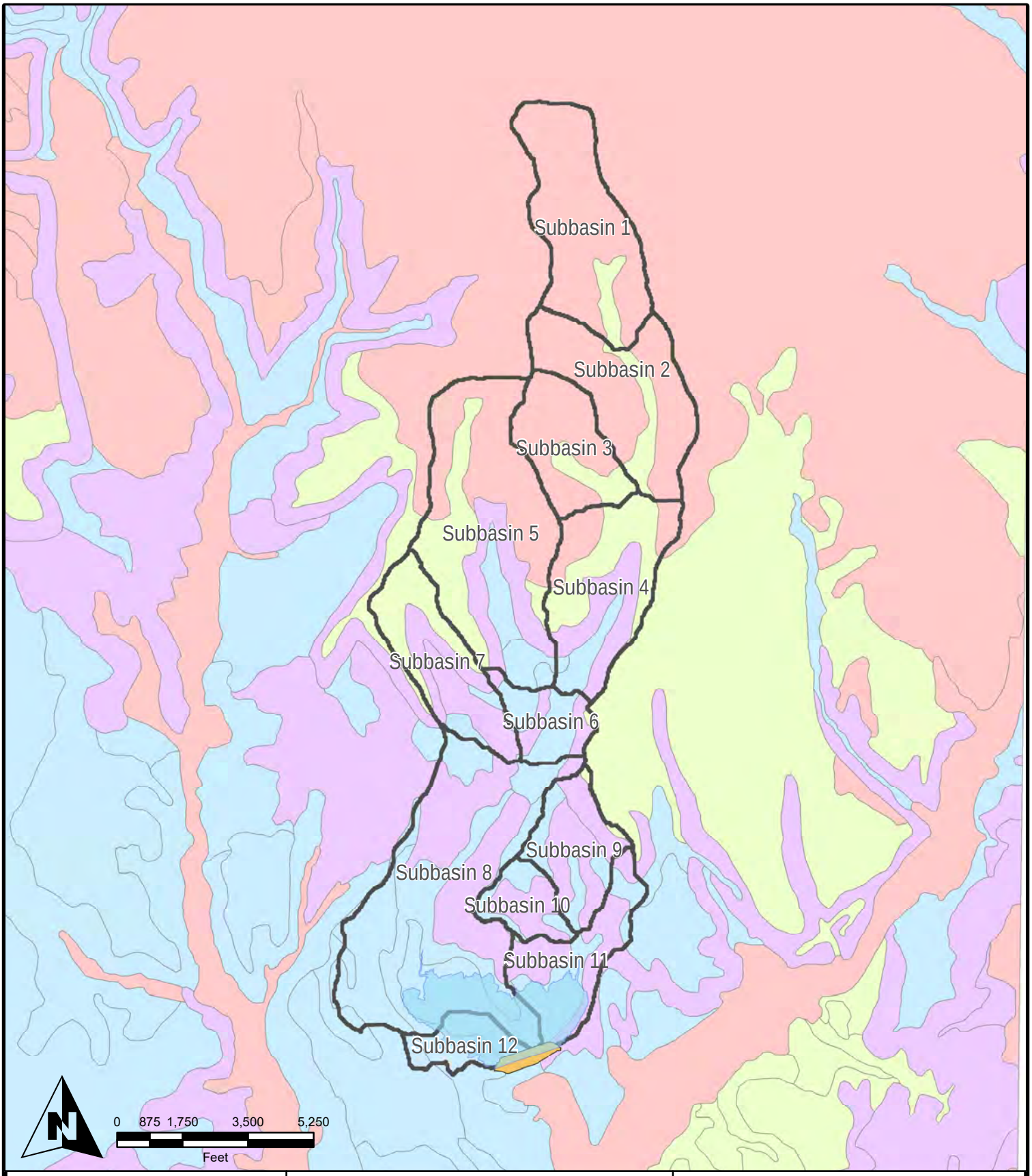
Cove Reservoir
Drainage Subbasins
NLCD Land Cover
21 - Developed, Open Space
22 - Developed, Low Intensity
23 - Developed, Medium Intensity
24 - Developed, High Intensity
31 - Barren Land (Rock/Sand/Clay)
41 - Deciduous Forest
42 - Evergreen Forest
43 - Mixed Forest
52 - Shrub/Scrub
81 - Pasture/Hay
82 - Cultivated Crops
90 - Woodly Wetlands

NLCD Soil Data

Exhibit 5 - Cove Reservoir

Spatial Reference:	UT83-SF
Drawn By:	JTM
Scale:	1 inch = 3,500 feet
Date:	September 17, 2019

P:\357-21 KCWCD Cove Reservoir Environmental and Design\Drawings\GIS\357-21 Design Report Exhibit 5 NLCD Soil Data.mxd, 9/17/2019 11:44:54 AM jmadsen



ALPHA ENGINEERING

RB&G ENGINEERING, INC.

Cove Reservoir
Drainage Subbasins
Hydrologic Soil Group
A
B
C
D

Hydrologic Soil Groups

Exhibit 6 - Cove Reservoir

Spatial Reference:	UT83-SF
Drawn By:	JTM
Scale:	1 inch = 3,500 feet
Date:	September 17, 2019

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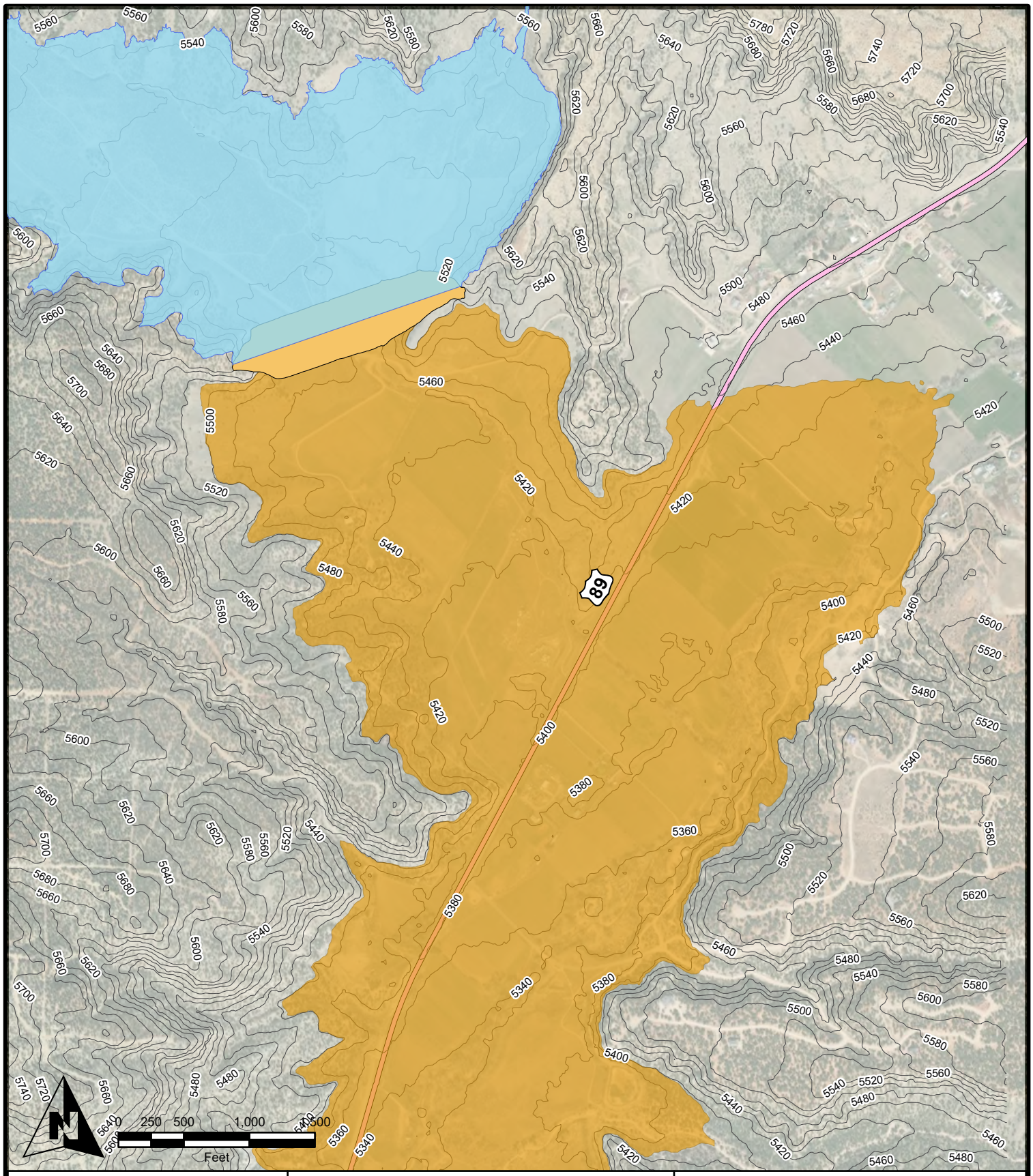


ALPHA ENGINEERING

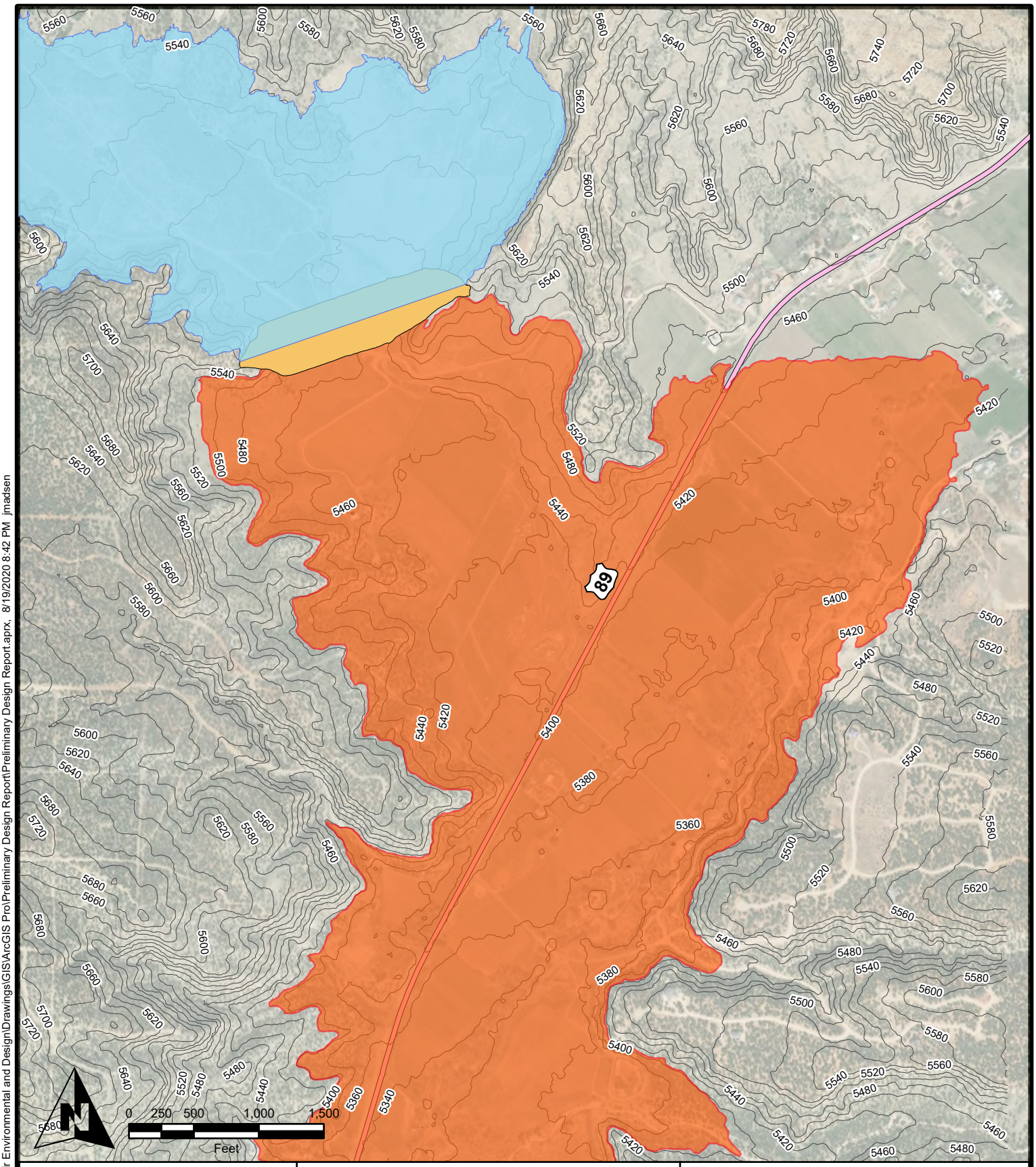
RB&G ENGINEERING, INC.

- Reservoir
- Cove Dam Structure
- Inundation Boundary (Sunny Day)
- Contours (20' Interval)

Sunny Day Breach Inundation Map

Exhibit 7 - Cove Reservoir

Spatial Reference:	UT83-SF
Drawn By:	JTM
Scale:	1:12,000
Date:	August 19, 2020



ALPHA ENGINEERING

RB&G ENGINEERING, INC.

- Reservoir
- Cove Dam Structure
- Inundation Boundary (Rainy Day)
- Contours (20' Interval)

Rainy Day Breach Inundation Map

Exhibit 8 - Cove Reservoir

Spatial Reference:	UT83-SF
Drawn By:	JTM
Scale:	1:12,000
Date:	August 19, 2020

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Appendix B. Calculations

Section 1. Soil Data and Curve Numbers

Section 2. Storm Distributions

Section 3. Precipitation Values

Section 4. Wave Runup

Section 5. Emergency Drain

Section 1. Soil Data and Curve Numbers

```
**********************************************************************
* Program written in ANSI-C by J. Heward                             *
* June 21 2018                                                       *
* Alpha Engineering                                                  *
* 43 S. 100 E.                                                       *
* St. George, Utah 84770                                             *
* 435-628-6500                                                       *
*                                                                    *
* Calculates curve number within basin                               *
* based on NLCD Data & Soil Data                                     *
*                                                                    *
* The following curve numbers are assumed for each                   *
* NLCD Landcover Class and Hydrologic Soil Group:                    *
*  NLCD  Group_A   Group_B   Group_C  Group_D                        *
*    11     98.0     98.0     98.0     98.0                         *
*    12     98.0     98.0     98.0     98.0                         *
*    21     68.0     79.0     86.0     89.0                         *
*    22     68.0     79.0     86.0     89.0                         *
*    23     61.0     75.0     83.0     87.0                         *
*    24     89.0     92.0     94.0     95.0                         *
*    31     55.0     72.0     81.0     86.0                         *
*    41     36.0     58.0     73.0     80.0                         *
*    42     58.0     75.0     85.0     89.0                         *
*    43     36.0     60.0     73.0     79.0                         *
*    51     35.0     56.0     70.0     77.0                         *
*    52     49.0     68.0     79.0     89.0                         *
*    71     39.0     61.0     74.0     80.0                         *
*    72     39.0     61.0     74.0     80.0                         *
*    73     39.0     61.0     74.0     80.0                         *
*    74     39.0     61.0     74.0     80.0                         *
*    81     49.0     69.0     79.0     84.0                         *
*    82     61.0     70.0     77.0     80.0                         *
*    90     30.0     55.0     70.0     77.0                         *
*    95     30.0     55.0     70.0     77.0                         *
**********************************************************************

<<Basin 1>>
       NLCD,  Soil_Group,  %_Watershed,    CN,  Weighted_CN
         41,           B,          4.5,  58.0,          2.6
         42,           A,          8.0,  58.0,          4.7
         42,           B,         85.9,  75.0,         64.4
         52,           B,          1.6,  68.0,          1.1
                                   Composite CN = **72.8**

<<Basin 2>>
       NLCD,  Soil_Group,  %_Watershed,    CN,  Weighted_CN
         42,           A,         14.5,  58.0,          8.4
         42,           B,         85.1,  75.0,         63.8
         52,           B,          0.4,  68.0,          0.3
                                   Composite CN = **72.5**

<<Basin 3>>
       NLCD,  Soil_Group,  %_Watershed,    CN,  Weighted_CN
         42,           A,         19.6,  58.0,         11.4
         42,           B,         71.4,  75.0,         53.6
         52,           B,          9.0,  68.0,          6.1
                                   Composite CN = **71.0**

<<Basin 4>>
```

NLCD,	Soil_Group,	%_Watershed,	CN,	Weighted_CN
31,	C,	0.0,	81.0,	0.0
31,	D,	1.8,	86.0,	1.6
42,	A,	38.7,	58.0,	22.5
42,	B,	19.0,	75.0,	14.2
42,	C,	7.9,	85.0,	6.7
42,	D,	18.2,	89.0,	16.2
52,	A,	0.3,	49.0,	0.2
52,	B,	0.4,	68.0,	0.3
52,	C,	4.5,	79.0,	3.6
52,	D,	9.2,	89.0,	8.2

Composite CN = **73.3**

<<Basin 5>>

NLCD,	Soil_Group,	%_Watershed,	CN,	Weighted_CN
31,	C,	0.0,	81.0,	0.0
31,	D,	0.9,	86.0,	0.8
42,	A,	25.5,	58.0,	14.8
42,	B,	38.5,	75.0,	28.8
42,	C,	10.3,	85.0,	8.8
42,	D,	12.9,	89.0,	11.5
52,	A,	0.0,	49.0,	0.0
52,	B,	4.1,	68.0,	2.8
52,	C,	3.1,	79.0,	2.4
52,	D,	4.7,	89.0,	4.2

Composite CN = **74.1**

<<Basin 6>>

NLCD,	Soil_Group,	%_Watershed,	CN,	Weighted_CN
42,	A,	0.5,	58.0,	0.3
42,	C,	49.2,	85.0,	41.8
42,	D,	23.0,	89.0,	20.4
52,	A,	3.0,	49.0,	1.5
52,	C,	13.9,	79.0,	11.0
52,	D,	10.3,	89.0,	9.2

Composite CN = **84.3**

<<Basin 7>>

NLCD,	Soil_Group,	%_Watershed,	CN,	Weighted_CN
31,	C,	0.0,	81.0,	0.0
31,	D,	2.6,	86.0,	2.3
42,	A,	41.1,	58.0,	23.8
42,	C,	7.4,	85.0,	6.3
42,	D,	29.4,	89.0,	26.2
52,	A,	0.0,	49.0,	0.0
52,	C,	1.7,	79.0,	1.4
52,	D,	17.7,	89.0,	15.7

Composite CN = **75.7**

<<Basin 8>>

NLCD,	Soil_Group,	%_Watershed,	CN,	Weighted_CN
21,	C,	0.0,	86.0,	0.0
42,	A,	0.0,	58.0,	0.0
42,	C,	26.9,	85.0,	22.9
42,	D,	10.5,	89.0,	9.3
52,	A,	0.0,	49.0,	0.0
52,	C,	39.4,	79.0,	31.1
52,	D,	23.2,	89.0,	20.6

Composite CN = **84.0**

<<Basin 9>>

NLCD,	Soil_Group,	%_Watershed,	CN,	Weighted_CN
42,	A,	0.6,	58.0,	0.3
42,	C,	20.7,	85.0,	17.6
42,	D,	27.7,	89.0,	24.7
52,	A,	3.7,	49.0,	1.8
52,	C,	10.4,	79.0,	8.2
52,	D,	36.9,	89.0,	32.8

Composite CN = **85.5**

<<Basin 10>>

NLCD,	Soil_Group,	%_Watershed,	CN,	Weighted_CN
42,	C,	27.5,	85.0,	23.4
42,	D,	32.1,	89.0,	28.5
52,	C,	12.4,	79.0,	9.8
52,	D,	28.1,	89.0,	25.0

Composite CN = **86.7**

<<Basin 11>>

NLCD,	Soil_Group,	%_Watershed,	CN,	Weighted_CN
42,	A,	0.2,	58.0,	0.1
42,	C,	9.1,	85.0,	7.7
42,	D,	18.0,	89.0,	16.0
52,	A,	0.0,	49.0,	0.0
52,	C,	37.4,	79.0,	29.5
52,	D,	35.3,	89.0,	31.4

Composite CN = **84.8**

<<Basin 12>>

NLCD,	Soil_Group,	%_Watershed,	CN,	Weighted_CN
21,	C,	0.1,	86.0,	0.0
22,	C,	0.4,	86.0,	0.4
42,	C,	35.0,	85.0,	29.7
52,	C,	64.0,	79.0,	50.6
52,	D,	0.5,	89.0,	0.5

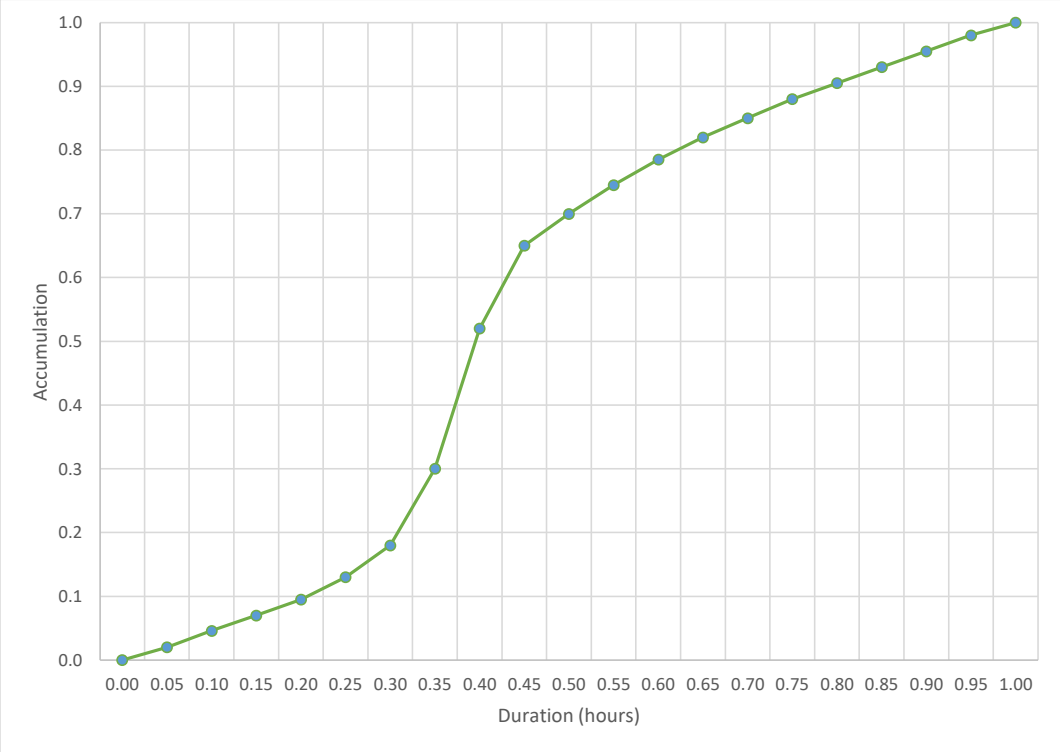
Composite CN = **81.2**

Section 2. Storm Distributions

Dimensionless Hydrograph

Hours	Accumulation
0.00	0.000
0.05	0.020
0.10	0.046
0.15	0.070
0.20	0.095
0.25	0.130
0.30	0.180
0.35	0.300
0.40	0.520
0.45	0.650
0.50	0.700
0.55	0.745
0.60	0.785
0.65	0.820
0.70	0.850
0.75	0.880
0.80	0.905
0.85	0.930
0.90	0.955
0.95	0.980
1.00	1.000

(NEH 630, Chapter 21, Figure 21-9)



PSH Hydrograph

Characteristics

Drainage Area	4.742	sq mi
Time of Concentration	1.88	hr
Ave. Annual Precipitation	15.6	in
Ave. Annual Temperature	51.2	°F
Curve Number	71.8	
100-yr, 24-hr Precipitation	3.51	in
100-yr, 10-day Precipitation	6.83	in
Structure Hazard Classification	High	
Climatic Index	0.6	

Principal Spillway Mass Curve

Adjusted Areal Rainfall

Not Applicable (<10 sq mi)

Adjusted 10-day Curve Numbers (Table 21-2)

$CN_{1\text{-day}}$	77.8	
$CN_{10\text{-day}}$	71.8	

Direct Runoff (NEH, Appendix 10A)

$Q_{1\text{-day}}$	1.49	in
$Q_{10\text{-day}}$	3.66	in

Net Runoff (Table 21-4)

Channel Loss Reduction Factor	0.84	
$Q_{1\text{-day net}}$	1.25	in
$Q_{10\text{-day net}}$	3.08	in

Mass Curve (Equation 21-2)

a	0.3903
Qd (1-hour)	0.3625

Time (days)	Qd (inches)	Inc. Volumes (inches)	Rank	Inc. Volume Ranked	Inc. Arrangement	Time (hrs)	Inc. Volumes Rearrange	PSMC	Dimensionless PSMC
0.0000	0.0000	-	-	-	-	0	-	0.0000	0.0000
0.0417	0.3624	0.3624	1	0.3624	239	1	0.0050	0.0050	0.0016
0.0833	0.4749	0.1126	2	0.1126	237	2	0.0051	0.0101	0.0033
0.1250	0.5564	0.0814	3	0.0814	235	3	0.0051	0.0152	0.0049
0.1667	0.6225	0.0661	4	0.0661	233	4	0.0051	0.0203	0.0066
0.2083	0.6792	0.0567	5	0.0567	231	5	0.0051	0.0254	0.0082
0.2500	0.7293	0.0501	6	0.0501	229	6	0.0052	0.0305	0.0099
0.2917	0.7745	0.0452	7	0.0452	227	7	0.0052	0.0357	0.0116
0.3333	0.8159	0.0414	8	0.0414	225	8	0.0052	0.0409	0.0133
0.3750	0.8543	0.0384	9	0.0384	223	9	0.0052	0.0462	0.0150
0.4167	0.8902	0.0359	10	0.0359	221	10	0.0053	0.0515	0.0167
0.4583	0.9239	0.0337	11	0.0337	219	11	0.0053	0.0568	0.0184
0.5000	0.9558	0.0319	12	0.0319	217	12	0.0053	0.0621	0.0202
0.5417	0.9862	0.0303	13	0.0303	215	13	0.0054	0.0674	0.0219
0.5833	1.0151	0.0289	14	0.0289	213	14	0.0054	0.0728	0.0237
0.6250	1.0428	0.0277	15	0.0277	211	15	0.0054	0.0783	0.0254

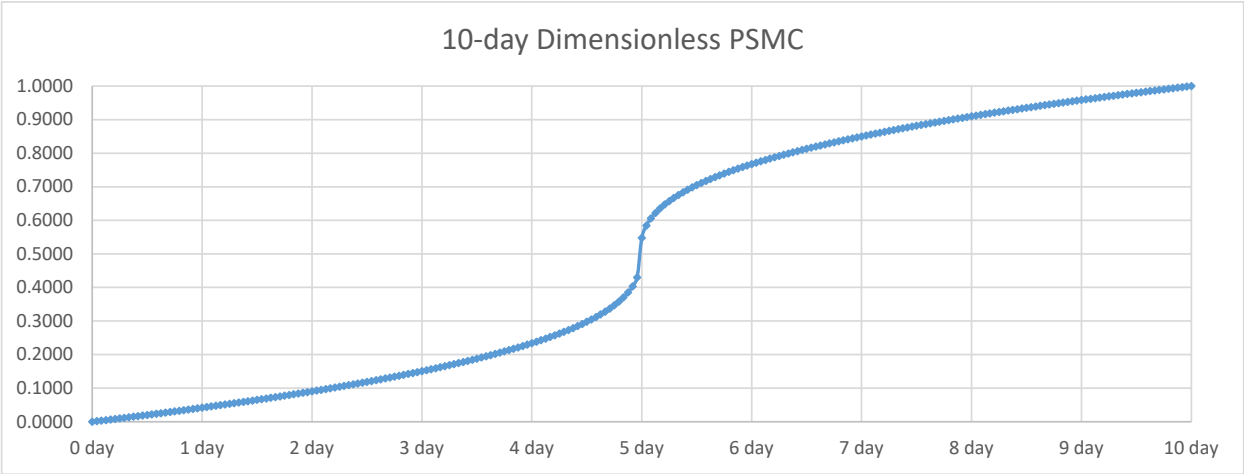
0.6667	1.0694	0.0266	16	0.0266	209	16	0.0055	0.0837	0.0272
0.7083	1.0950	0.0256	17	0.0256	207	17	0.0055	0.0892	0.0290
0.7500	1.1197	0.0247	18	0.0247	205	18	0.0055	0.0947	0.0308
0.7917	1.1436	0.0239	19	0.0239	203	19	0.0056	0.1003	0.0326
0.8333	1.1667	0.0231	20	0.0231	201	20	0.0056	0.1059	0.0344
0.8750	1.1892	0.0224	21	0.0224	199	21	0.0056	0.1115	0.0362
0.9167	1.2110	0.0218	22	0.0218	197	22	0.0057	0.1171	0.0381
0.9583	1.2322	0.0212	23	0.0212	195	23	0.0057	0.1228	0.0399
1.0000	1.2528	0.0206	24	0.0206	193	24	0.0057	0.1285	0.0418
1.0417	1.2729	0.0201	25	0.0201	191	25	0.0058	0.1343	0.0436
1.0833	1.2926	0.0196	26	0.0196	189	26	0.0058	0.1401	0.0455
1.1250	1.3117	0.0192	27	0.0192	187	27	0.0058	0.1459	0.0474
1.1667	1.3305	0.0188	28	0.0188	185	28	0.0059	0.1518	0.0493
1.2083	1.3488	0.0183	29	0.0183	183	29	0.0059	0.1577	0.0513
1.2500	1.3668	0.0180	30	0.0180	181	30	0.0060	0.1637	0.0532
1.2917	1.3844	0.0176	31	0.0176	179	31	0.0060	0.1697	0.0551
1.3333	1.4017	0.0173	32	0.0173	177	32	0.0060	0.1757	0.0571
1.3750	1.4186	0.0169	33	0.0169	175	33	0.0061	0.1818	0.0591
1.4167	1.4352	0.0166	34	0.0166	173	34	0.0061	0.1879	0.0611
1.4583	1.4516	0.0163	35	0.0163	171	35	0.0062	0.1941	0.0631
1.5000	1.4676	0.0160	36	0.0160	169	36	0.0062	0.2003	0.0651
1.5417	1.4834	0.0158	37	0.0158	167	37	0.0063	0.2065	0.0671
1.5833	1.4989	0.0155	38	0.0155	165	38	0.0063	0.2129	0.0692
1.6250	1.5142	0.0153	39	0.0153	163	39	0.0063	0.2192	0.0712
1.6667	1.5292	0.0150	40	0.0150	161	40	0.0064	0.2256	0.0733
1.7083	1.5441	0.0148	41	0.0148	159	41	0.0064	0.2320	0.0754
1.7500	1.5586	0.0146	42	0.0146	157	42	0.0065	0.2385	0.0775
1.7917	1.5730	0.0144	43	0.0144	155	43	0.0065	0.2451	0.0796
1.8333	1.5872	0.0142	44	0.0142	153	44	0.0066	0.2517	0.0818
1.8750	1.6012	0.0140	45	0.0140	151	45	0.0067	0.2583	0.0839
1.9167	1.6150	0.0138	46	0.0138	149	46	0.0067	0.2650	0.0861
1.9583	1.6286	0.0136	47	0.0136	147	47	0.0068	0.2718	0.0883
2.0000	1.6420	0.0134	48	0.0134	145	48	0.0068	0.2786	0.0905
2.0417	1.6553	0.0133	49	0.0133	143	49	0.0069	0.2855	0.0928
2.0833	1.6684	0.0131	50	0.0131	141	50	0.0069	0.2924	0.0950
2.1250	1.6814	0.0129	51	0.0129	139	51	0.0070	0.2994	0.0973
2.1667	1.6942	0.0128	52	0.0128	137	52	0.0071	0.3065	0.0996
2.2083	1.7068	0.0126	53	0.0126	135	53	0.0071	0.3136	0.1019
2.2500	1.7193	0.0125	54	0.0125	133	54	0.0072	0.3208	0.1042
2.2917	1.7317	0.0124	55	0.0124	131	55	0.0073	0.3281	0.1066
2.3333	1.7439	0.0122	56	0.0122	129	56	0.0073	0.3354	0.1090
2.3750	1.7560	0.0121	57	0.0121	127	57	0.0074	0.3428	0.1114
2.4167	1.7679	0.0120	58	0.0120	125	58	0.0075	0.3503	0.1138
2.4583	1.7798	0.0118	59	0.0118	123	59	0.0075	0.3578	0.1163
2.5000	1.7915	0.0117	60	0.0117	121	60	0.0076	0.3654	0.1187
2.5417	1.8031	0.0116	61	0.0116	119	61	0.0077	0.3731	0.1212
2.5833	1.8145	0.0115	62	0.0115	117	62	0.0078	0.3809	0.1238
2.6250	1.8259	0.0114	63	0.0114	115	63	0.0079	0.3888	0.1263
2.6667	1.8372	0.0113	64	0.0113	113	64	0.0079	0.3967	0.1289
2.7083	1.8483	0.0112	65	0.0112	111	65	0.0080	0.4047	0.1315
2.7500	1.8594	0.0110	66	0.0110	109	66	0.0081	0.4129	0.1341
2.7917	1.8703	0.0109	67	0.0109	107	67	0.0082	0.4211	0.1368
2.8333	1.8812	0.0108	68	0.0108	105	68	0.0083	0.4294	0.1395
2.8750	1.8919	0.0108	69	0.0108	103	69	0.0084	0.4378	0.1422
2.9167	1.9026	0.0107	70	0.0107	101	70	0.0085	0.4463	0.1450

2.9583	1.9131	0.0106	71	0.0106	99	71	0.0086	0.4549	0.1478
3.0000	1.9236	0.0105	72	0.0105	97	72	0.0087	0.4636	0.1506
3.0417	1.9340	0.0104	73	0.0104	95	73	0.0088	0.4725	0.1535
3.0833	1.9443	0.0103	74	0.0103	93	74	0.0090	0.4814	0.1564
3.1250	1.9545	0.0102	75	0.0102	91	75	0.0091	0.4905	0.1594
3.1667	1.9646	0.0101	76	0.0101	89	76	0.0092	0.4997	0.1624
3.2083	1.9747	0.0101	77	0.0101	87	77	0.0093	0.5090	0.1654
3.2500	1.9847	0.0100	78	0.0100	85	78	0.0095	0.5185	0.1685
3.2917	1.9946	0.0099	79	0.0099	83	79	0.0096	0.5281	0.1716
3.3333	2.0044	0.0098	80	0.0098	81	80	0.0097	0.5378	0.1747
3.3750	2.0141	0.0097	81	0.0097	79	81	0.0099	0.5477	0.1780
3.4167	2.0238	0.0097	82	0.0097	77	82	0.0101	0.5578	0.1812
3.4583	2.0334	0.0096	83	0.0096	75	83	0.0102	0.5680	0.1845
3.5000	2.0429	0.0095	84	0.0095	73	84	0.0104	0.5784	0.1879
3.5417	2.0524	0.0095	85	0.0095	71	85	0.0106	0.5889	0.1914
3.5833	2.0618	0.0094	86	0.0094	69	86	0.0108	0.5997	0.1948
3.6250	2.0711	0.0093	87	0.0093	67	87	0.0109	0.6106	0.1984
3.6667	2.0803	0.0093	88	0.0093	65	88	0.0112	0.6218	0.2020
3.7083	2.0895	0.0092	89	0.0092	63	89	0.0114	0.6331	0.2057
3.7500	2.0987	0.0091	90	0.0091	61	90	0.0116	0.6447	0.2095
3.7917	2.1077	0.0091	91	0.0091	59	91	0.0118	0.6566	0.2133
3.8333	2.1168	0.0090	92	0.0090	57	92	0.0121	0.6687	0.2173
3.8750	2.1257	0.0090	93	0.0090	55	93	0.0124	0.6810	0.2213
3.9167	2.1346	0.0089	94	0.0089	53	94	0.0126	0.6937	0.2254
3.9583	2.1434	0.0088	95	0.0088	51	95	0.0129	0.7066	0.2296
4.0000	2.1522	0.0088	96	0.0088	49	96	0.0133	0.7199	0.2339
4.0417	2.1609	0.0087	97	0.0087	47	97	0.0136	0.7335	0.2383
4.0833	2.1696	0.0087	98	0.0087	45	98	0.0140	0.7475	0.2429
4.1250	2.1782	0.0086	99	0.0086	43	99	0.0144	0.7618	0.2475
4.1667	2.1868	0.0086	100	0.0086	41	100	0.0148	0.7767	0.2524
4.2083	2.1953	0.0085	101	0.0085	39	101	0.0153	0.7919	0.2573
4.2500	2.2037	0.0085	102	0.0085	37	102	0.0158	0.8077	0.2624
4.2917	2.2122	0.0084	103	0.0084	35	103	0.0163	0.8240	0.2678
4.3333	2.2205	0.0084	104	0.0084	33	104	0.0169	0.8410	0.2733
4.3750	2.2288	0.0083	105	0.0083	31	105	0.0176	0.8586	0.2790
4.4167	2.2371	0.0083	106	0.0083	29	106	0.0183	0.8769	0.2849
4.4583	2.2453	0.0082	107	0.0082	27	107	0.0192	0.8961	0.2912
4.5000	2.2535	0.0082	108	0.0082	25	108	0.0201	0.9162	0.2977
4.5417	2.2616	0.0081	109	0.0081	23	109	0.0212	0.9374	0.3046
4.5833	2.2697	0.0081	110	0.0081	21	110	0.0224	0.9599	0.3119
4.6250	2.2777	0.0080	111	0.0080	19	111	0.0239	0.9838	0.3196
4.6667	2.2857	0.0080	112	0.0080	17	112	0.0256	1.0094	0.3280
4.7083	2.2936	0.0079	113	0.0079	15	113	0.0277	1.0371	0.3370
4.7500	2.3015	0.0079	114	0.0079	13	114	0.0303	1.0674	0.3468
4.7917	2.3094	0.0079	115	0.0079	11	115	0.0337	1.1011	0.3578
4.8333	2.3172	0.0078	116	0.0078	9	116	0.0384	1.1395	0.3703
4.8750	2.3250	0.0078	117	0.0078	7	117	0.0452	1.1848	0.3850
4.9167	2.3327	0.0077	118	0.0077	5	118	0.0567	1.2414	0.4034
4.9583	2.3404	0.0077	119	0.0077	3	119	0.0814	1.3229	0.4298
5.0000	2.3481	0.0077	120	0.0077	1	120	**0.3624**	1.6852	0.5476
5.0417	2.3557	0.0076	121	0.0076	2	121	0.1126	1.7978	0.5842
5.0833	2.3633	0.0076	122	0.0076	4	122	0.0661	1.8639	0.6056
5.1250	2.3708	0.0075	123	0.0075	6	123	0.0501	1.9140	0.6219
5.1667	2.3783	0.0075	124	0.0075	8	124	0.0414	1.9555	0.6354
5.2083	2.3858	0.0075	125	0.0075	10	125	0.0359	1.9913	0.6470

5.2500	2.3932	0.0074	126	0.0074	12	126	0.0319	2.0232	0.6574
5.2917	2.4006	0.0074	127	0.0074	14	127	0.0289	2.0522	0.6668
5.3333	2.4080	0.0074	128	0.0074	16	128	0.0266	2.0788	0.6755
5.3750	2.4153	0.0073	129	0.0073	18	129	0.0247	2.1035	0.6835
5.4167	2.4226	0.0073	130	0.0073	20	130	0.0231	2.1266	0.6910
5.4583	2.4298	0.0073	131	0.0073	22	131	0.0218	2.1484	0.6981
5.5000	2.4371	0.0072	132	0.0072	24	132	0.0206	2.1690	0.7048
5.5417	2.4443	0.0072	133	0.0072	26	133	0.0196	2.1887	0.7112
5.5833	2.4514	0.0072	134	0.0072	28	134	0.0188	2.2074	0.7173
5.6250	2.4585	0.0071	135	0.0071	30	135	0.0180	2.2254	0.7231
5.6667	2.4656	0.0071	136	0.0071	32	136	0.0173	2.2427	0.7287
5.7083	2.4727	0.0071	137	0.0071	34	137	0.0166	2.2593	0.7341
5.7500	2.4797	0.0070	138	0.0070	36	138	0.0160	2.2753	0.7393
5.7917	2.4867	0.0070	139	0.0070	38	139	0.0155	2.2909	0.7444
5.8333	2.4937	0.0070	140	0.0070	40	140	0.0150	2.3059	0.7493
5.8750	2.5006	0.0069	141	0.0069	42	141	0.0146	2.3205	0.7540
5.9167	2.5075	0.0069	142	0.0069	44	142	0.0142	2.3347	0.7586
5.9583	2.5144	0.0069	143	0.0069	46	143	0.0138	2.3485	0.7631
6.0000	2.5213	0.0068	144	0.0068	48	144	0.0134	2.3619	0.7675
6.0417	2.5281	0.0068	145	0.0068	50	145	0.0131	2.3750	0.7717
6.0833	2.5349	0.0068	146	0.0068	52	146	0.0128	2.3878	0.7759
6.1250	2.5416	0.0068	147	0.0068	54	147	0.0125	2.4003	0.7799
6.1667	2.5484	0.0067	148	0.0067	56	148	0.0122	2.4125	0.7839
6.2083	2.5551	0.0067	149	0.0067	58	149	0.0120	2.4245	0.7878
6.2500	2.5618	0.0067	150	0.0067	60	150	0.0117	2.4362	0.7916
6.2917	2.5684	0.0067	151	0.0067	62	151	0.0115	2.4477	0.7953
6.3333	2.5750	0.0066	152	0.0066	64	152	0.0113	2.4589	0.7990
6.3750	2.5816	0.0066	153	0.0066	66	153	0.0110	2.4700	0.8026
6.4167	2.5882	0.0066	154	0.0066	68	154	0.0108	2.4808	0.8061
6.4583	2.5948	0.0065	155	0.0065	70	155	0.0107	2.4915	0.8096
6.5000	2.6013	0.0065	156	0.0065	72	156	0.0105	2.5020	0.8130
6.5417	2.6078	0.0065	157	0.0065	74	157	0.0103	2.5123	0.8163
6.5833	2.6142	0.0065	158	0.0065	76	158	0.0101	2.5224	0.8196
6.6250	2.6207	0.0064	159	0.0064	78	159	0.0100	2.5324	0.8228
6.6667	2.6271	0.0064	160	0.0064	80	160	0.0098	2.5422	0.8260
6.7083	2.6335	0.0064	161	0.0064	82	161	0.0097	2.5519	0.8292
6.7500	2.6399	0.0064	162	0.0064	84	162	0.0095	2.5614	0.8323
6.7917	2.6462	0.0063	163	0.0063	86	163	0.0094	2.5708	0.8353
6.8333	2.6526	0.0063	164	0.0063	88	164	0.0093	2.5800	0.8383
6.8750	2.6589	0.0063	165	0.0063	90	165	0.0091	2.5892	0.8413
6.9167	2.6651	0.0063	166	0.0063	92	166	0.0090	2.5982	0.8442
6.9583	2.6714	0.0063	167	0.0063	94	167	0.0089	2.6071	0.8471
7.0000	2.6776	0.0062	168	0.0062	96	168	0.0088	2.6158	0.8500
7.0417	2.6838	0.0062	169	0.0062	98	169	0.0087	2.6245	0.8528
7.0833	2.6900	0.0062	170	0.0062	100	170	0.0086	2.6331	0.8556
7.1250	2.6962	0.0062	171	0.0062	102	171	0.0085	2.6415	0.8583
7.1667	2.7023	0.0061	172	0.0061	104	172	0.0084	2.6499	0.8610
7.2083	2.7085	0.0061	173	0.0061	106	173	0.0083	2.6582	0.8637
7.2500	2.7146	0.0061	174	0.0061	108	174	0.0082	2.6663	0.8664
7.2917	2.7206	0.0061	175	0.0061	110	175	0.0081	2.6744	0.8690
7.3333	2.7267	0.0061	176	0.0061	112	176	0.0080	2.6824	0.8716
7.3750	2.7327	0.0060	177	0.0060	114	177	0.0079	2.6903	0.8741
7.4167	2.7387	0.0060	178	0.0060	116	178	0.0078	2.6981	0.8767
7.4583	2.7447	0.0060	179	0.0060	118	179	0.0077	2.7058	0.8792
7.5000	2.7507	0.0060	180	0.0060	120	180	0.0077	2.7135	0.8817

7.5417	2.7567	0.0060	181	0.0060	122	181	0.0076	2.7211	0.8842
7.5833	2.7626	0.0059	182	0.0059	124	182	0.0075	2.7286	0.8866
7.6250	2.7685	0.0059	183	0.0059	126	183	0.0074	2.7360	0.8890
7.6667	2.7744	0.0059	184	0.0059	128	184	0.0074	2.7434	0.8914
7.7083	2.7803	0.0059	185	0.0059	130	185	0.0073	2.7507	0.8938
7.7500	2.7861	0.0059	186	0.0059	132	186	0.0072	2.7579	0.8961
7.7917	2.7920	0.0058	187	0.0058	134	187	0.0072	2.7650	0.8984
7.8333	2.7978	0.0058	188	0.0058	136	188	0.0071	2.7721	0.9007
7.8750	2.8036	0.0058	189	0.0058	138	189	0.0070	2.7792	0.9030
7.9167	2.8094	0.0058	190	0.0058	140	190	0.0070	2.7861	0.9053
7.9583	2.8151	0.0058	191	0.0058	142	191	0.0069	2.7930	0.9075
8.0000	2.8209	0.0057	192	0.0057	144	192	0.0068	2.7999	0.9098
8.0417	2.8266	0.0057	193	0.0057	146	193	0.0068	2.8067	0.9120
8.0833	2.8323	0.0057	194	0.0057	148	194	0.0067	2.8134	0.9142
8.1250	2.8380	0.0057	195	0.0057	150	195	0.0067	2.8201	0.9163
8.1667	2.8437	0.0057	196	0.0057	152	196	0.0066	2.8267	0.9185
8.2083	2.8493	0.0057	197	0.0057	154	197	0.0066	2.8333	0.9206
8.2500	2.8550	0.0056	198	0.0056	156	198	0.0065	2.8398	0.9227
8.2917	2.8606	0.0056	199	0.0056	158	199	0.0065	2.8463	0.9248
8.3333	2.8662	0.0056	200	0.0056	160	200	0.0064	2.8527	0.9269
8.3750	2.8718	0.0056	201	0.0056	162	201	0.0064	2.8591	0.9290
8.4167	2.8774	0.0056	202	0.0056	164	202	0.0063	2.8654	0.9311
8.4583	2.8829	0.0056	203	0.0056	166	203	0.0063	2.8717	0.9331
8.5000	2.8884	0.0055	204	0.0055	168	204	0.0062	2.8779	0.9351
8.5417	2.8940	0.0055	205	0.0055	170	205	0.0062	2.8841	0.9371
8.5833	2.8995	0.0055	206	0.0055	172	206	0.0061	2.8903	0.9391
8.6250	2.9049	0.0055	207	0.0055	174	207	0.0061	2.8964	0.9411
8.6667	2.9104	0.0055	208	0.0055	176	208	0.0061	2.9024	0.9431
8.7083	2.9159	0.0055	209	0.0055	178	209	0.0060	2.9084	0.9450
8.7500	2.9213	0.0054	210	0.0054	180	210	0.0060	2.9144	0.9470
8.7917	2.9267	0.0054	211	0.0054	182	211	0.0059	2.9203	0.9489
8.8333	2.9321	0.0054	212	0.0054	184	212	0.0059	2.9262	0.9508
8.8750	2.9375	0.0054	213	0.0054	186	213	0.0059	2.9321	0.9527
8.9167	2.9429	0.0054	214	0.0054	188	214	0.0058	2.9379	0.9546
8.9583	2.9483	0.0054	215	0.0054	190	215	0.0058	2.9437	0.9565
9.0000	2.9536	0.0053	216	0.0053	192	216	0.0057	2.9494	0.9584
9.0417	2.9589	0.0053	217	0.0053	194	217	0.0057	2.9551	0.9602
9.0833	2.9642	0.0053	218	0.0053	196	218	0.0057	2.9608	0.9620
9.1250	2.9695	0.0053	219	0.0053	198	219	0.0056	2.9664	0.9639
9.1667	2.9748	0.0053	220	0.0053	200	220	0.0056	2.9720	0.9657
9.2083	2.9801	0.0053	221	0.0053	202	221	0.0056	2.9776	0.9675
9.2500	2.9854	0.0053	222	0.0053	204	222	0.0055	2.9832	0.9693
9.2917	2.9906	0.0052	223	0.0052	206	223	0.0055	2.9887	0.9711
9.3333	2.9958	0.0052	224	0.0052	208	224	0.0055	2.9941	0.9729
9.3750	3.0010	0.0052	225	0.0052	210	225	0.0054	2.9996	0.9746
9.4167	3.0062	0.0052	226	0.0052	212	226	0.0054	3.0050	0.9764
9.4583	3.0114	0.0052	227	0.0052	214	227	0.0054	3.0103	0.9781
9.5000	3.0166	0.0052	228	0.0052	216	228	0.0053	3.0157	0.9799
9.5417	3.0218	0.0052	229	0.0052	218	229	0.0053	3.0210	0.9816
9.5833	3.0269	0.0051	230	0.0051	220	230	0.0053	3.0263	0.9833
9.6250	3.0320	0.0051	231	0.0051	222	231	0.0053	3.0315	0.9850
9.6667	3.0371	0.0051	232	0.0051	224	232	0.0052	3.0368	0.9867
9.7083	3.0423	0.0051	233	0.0051	226	233	0.0052	3.0420	0.9884
9.7500	3.0473	0.0051	234	0.0051	228	234	0.0052	3.0471	0.9901
9.7917	3.0524	0.0051	235	0.0051	230	235	0.0051	3.0523	0.9918

9.8333	3.0575	0.0051	236	0.0051	232	236	0.0051	3.0574	0.9934
9.8750	3.0625	0.0051	237	0.0051	234	237	0.0051	3.0625	0.9951
9.9167	3.0676	0.0050	238	0.0050	236	238	0.0051	3.0676	0.9967
9.9583	3.0726	0.0050	239	0.0050	238	239	0.0050	3.0726	0.9984
10.0000	3.0776	0.0050	240	0.0050	240	240	0.0050	3.0776	1.0000



Unit Hydrograph

Unit Storm Duration

ΔD 0.25 hr << 0.2-hr time increments are used

Time to Peak

Tp 1.25 hr << rounded to 1.0 hr

Unit Hydrograph Peak Discharge

qp 2295 cfs

Time Ratio	Discharge Ratio	Time (hr)	q (cfs)
0.0	0.000	0.000	0
0.1	0.030	0.100	69
0.2	0.100	0.200	230
0.3	0.190	0.300	436
0.4	0.310	0.400	711
0.5	0.470	0.500	1079
0.6	0.660	0.600	1515
0.7	0.820	0.700	1882
0.8	0.930	0.800	2134
0.9	0.990	0.900	2272
1.0	1.000	1.000	2295
1.1	0.990	1.100	2272
1.2	0.930	1.200	2134
1.3	0.860	1.300	1974
1.4	0.780	1.400	1790
1.5	0.680	1.500	1561
1.6	0.560	1.600	1285
1.7	0.460	1.700	1056
1.8	0.390	1.800	895

Time (hr)	q (cfs)
0	**0**
0.30	230
0.60	711
0.90	1515
1.20	2134
1.50	**2295**
1.80	2134
2.10	1790
2.40	1285
2.70	895
3.00	**643**
3.30	475
3.60	337
3.90	246
4.20	177
4.50	**126**
4.80	92
5.10	67
5.40	48

1.9	0.330	1.900	757
2.0	0.280	2.000	643
2.2	0.207	2.200	475
2.4	0.147	2.400	337
2.6	0.107	2.600	246
2.8	0.077	2.800	177
3.0	0.055	3.000	126
3.2	0.040	3.200	92
3.4	0.029	3.400	67
3.6	0.021	3.600	48
3.8	0.015	3.800	34
4.0	0.011	4.000	25
4.5	0.005	4.500	11
5.0	0.000	5.000	0

5.70	34
6.00	**25**
6.30	19
6.60	14
6.90	9
7.20	5
7.50	**0**
7.80	0
8.10	0
8.40	0
8.70	0
9.00	**0**
9.30	0
9.60	0

Sum	4592 cfs-h

Check

Unit Hydrograph (per 1 in. Unit Runoff) 3060.2 cfs-h

Variance -50.05%

Principal Spillway Hydrograph

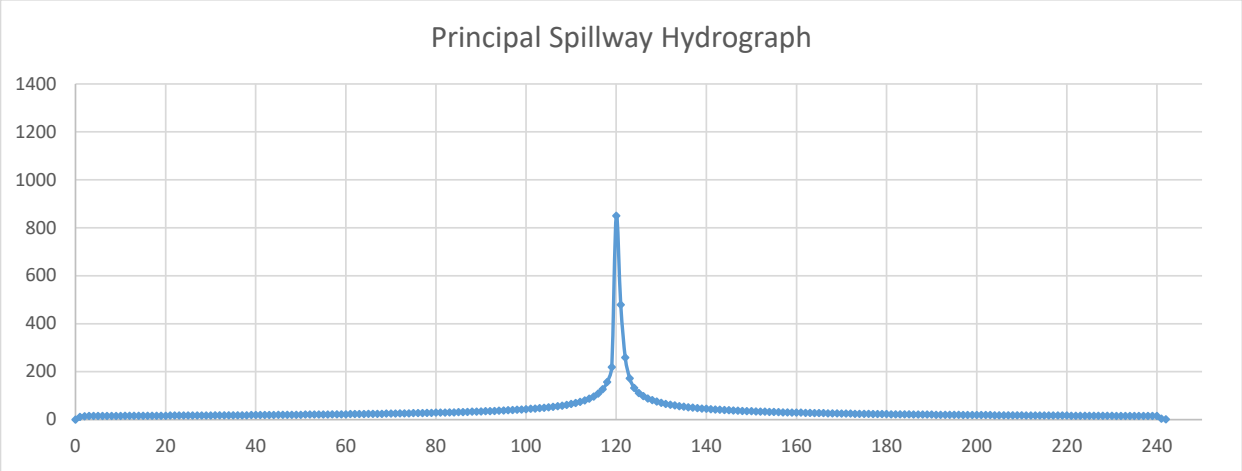
Time (hrs)	Inc. Volumes Rearranged	q (cfs)	Composite PSH (cfs)
0.0	0.0000	0	0
1.0	0.0050	2186	11
2.0	0.0051	612	14
3.0	0.0051	120	15
4.0	0.0051	24	15
5.0	0.0051	0	15
6.0	0.0052		15
7.0	0.0052		15
8.0	0.0052		15
9.0	0.0052		15
10.0	0.0053		15
11.0	0.0053		16
12.0	0.0053		16
13.0	0.0054		16
14.0	0.0054		16
15.0	0.0054		16
16.0	0.0055		16
17.0	0.0055		16
18.0	0.0055		16
19.0	0.0056		16
20.0	0.0056		16
21.0	0.0056		17
22.0	0.0057		17
23.0	0.0057		17
24.0	0.0057		17
25.0	0.0058		17
26.0	0.0058		17
27.0	0.0058		17
28.0	0.0059		17
29.0	0.0059		17

30.0	0.0060		17
31.0	0.0060		18
32.0	0.0060		18
33.0	0.0061		18
34.0	0.0061		18
35.0	0.0062		18
36.0	0.0062		18
37.0	0.0063		18
38.0	0.0063		18
39.0	0.0063		19
40.0	0.0064		19
41.0	0.0064		19
42.0	0.0065		19
43.0	0.0065		19
44.0	0.0066		19
45.0	0.0067		20
46.0	0.0067		20
47.0	0.0068		20
48.0	0.0068		20
49.0	0.0069		20
50.0	0.0069		20
51.0	0.0070		21
52.0	0.0071		21
53.0	0.0071		21
54.0	0.0072		21
55.0	0.0073		21
56.0	0.0073		21
57.0	0.0074		22
58.0	0.0075		22
59.0	0.0075		22
60.0	0.0076		22
61.0	0.0077		23
62.0	0.0078		23
63.0	0.0079		23
64.0	0.0079		23
65.0	0.0080		24
66.0	0.0081		24
67.0	0.0082		24
68.0	0.0083		24
69.0	0.0084		25
70.0	0.0085		25
71.0	0.0086		25
72.0	0.0087		26
73.0	0.0088		26
74.0	0.0090		26
75.0	0.0091		27
76.0	0.0092		27
77.0	0.0093		27
78.0	0.0095		28
79.0	0.0096		28
80.0	0.0097		29
81.0	0.0099		29
82.0	0.0101		29
83.0	0.0102		30
84.0	0.0104		30

85.0	0.0106		31
86.0	0.0108		31
87.0	0.0109		32
88.0	0.0112		33
89.0	0.0114		33
90.0	0.0116		34
91.0	0.0118		35
92.0	0.0121		35
93.0	0.0124		36
94.0	0.0126		37
95.0	0.0129		38
96.0	0.0133		39
97.0	0.0136		40
98.0	0.0140		41
99.0	0.0144		42
100.0	0.0148		43
101.0	0.0153		45
102.0	0.0158		46
103.0	0.0163		48
104.0	0.0169		49
105.0	0.0176		51
106.0	0.0183		53
107.0	0.0192		56
108.0	0.0201		58
109.0	0.0212		61
110.0	0.0224		65
111.0	0.0239		69
112.0	0.0256		74
113.0	0.0277		80
114.0	0.0303		87
115.0	0.0337		96
116.0	0.0384		109
117.0	0.0452		127
118.0	0.0567		157
119.0	0.0814		219
120.0	0.3624		850
121.0	0.1126		479
122.0	0.0661		259
123.0	0.0501		172
124.0	0.0414		132
125.0	0.0359		111
126.0	0.0319		98
127.0	0.0289		88
128.0	0.0266		81
129.0	0.0247		75
130.0	0.0231		70
131.0	0.0218		65
132.0	0.0206		62
133.0	0.0196		59
134.0	0.0188		56
135.0	0.0180		54
136.0	0.0173		51
137.0	0.0166		50
138.0	0.0160		48
139.0	0.0155		46

140.0	0.0150		45
141.0	0.0146		43
142.0	0.0142		42
143.0	0.0138		41
144.0	0.0134		40
145.0	0.0131		39
146.0	0.0128		38
147.0	0.0125		37
148.0	0.0122		36
149.0	0.0120		35
150.0	0.0117		35
151.0	0.0115		34
152.0	0.0113		33
153.0	0.0110		33
154.0	0.0108		32
155.0	0.0107		32
156.0	0.0105		31
157.0	0.0103		30
158.0	0.0101		30
159.0	0.0100		29
160.0	0.0098		29
161.0	0.0097		29
162.0	0.0095		28
163.0	0.0094		28
164.0	0.0093		27
165.0	0.0091		27
166.0	0.0090		27
167.0	0.0089		26
168.0	0.0088		26
169.0	0.0087		26
170.0	0.0086		25
171.0	0.0085		25
172.0	0.0084		25
173.0	0.0083		24
174.0	0.0082		24
175.0	0.0081		24
176.0	0.0080		24
177.0	0.0079		23
178.0	0.0078		23
179.0	0.0077		23
180.0	0.0077		23
181.0	0.0076		22
182.0	0.0075		22
183.0	0.0074		22
184.0	0.0074		22
185.0	0.0073		22
186.0	0.0072		21
187.0	0.0072		21
188.0	0.0071		21
189.0	0.0070		21
190.0	0.0070		21
191.0	0.0069		20
192.0	0.0068		20
193.0	0.0068		20
194.0	0.0067		20

195.0	0.0067		20
196.0	0.0066		20
197.0	0.0066		19
198.0	0.0065		19
199.0	0.0065		19
200.0	0.0064		19
201.0	0.0064		19
202.0	0.0063		19
203.0	0.0063		19
204.0	0.0062		18
205.0	0.0062		18
206.0	0.0061		18
207.0	0.0061		18
208.0	0.0061		18
209.0	0.0060		18
210.0	0.0060		18
211.0	0.0059		17
212.0	0.0059		17
213.0	0.0059		17
214.0	0.0058		17
215.0	0.0058		17
216.0	0.0057		17
217.0	0.0057		17
218.0	0.0057		17
219.0	0.0056		17
220.0	0.0056		17
221.0	0.0056		16
222.0	0.0055		16
223.0	0.0055		16
224.0	0.0055		16
225.0	0.0054		16
226.0	0.0054		16
227.0	0.0054		16
228.0	0.0053		16
229.0	0.0053		16
230.0	0.0053		16
231.0	0.0053		15
232.0	0.0052		15
233.0	0.0052		15
234.0	0.0052		15
235.0	0.0051		15
236.0	0.0051		15
237.0	0.0051		15
238.0	0.0051		15
239.0	0.0050		15
240.0	0.0050		15
241.0	0.0000		4
242.0	0.0000		1



Results

Peak Hydrograph Flow	850	cfs
Total Volume	749	ac-ft

ASH-L Hydrograph

Characteristics

Drainage Area	4.742	sq mi
Time of Concentration	1.58	hr
Curve Number	77.8	
Structure Hazard Classification	High	
Initial Abstraction	0.57	in
Maximum Potential Retention	2.85	in
Precipitation	4.03	in
ΔD	0.05	hr

5-Point Rainfall Distribution

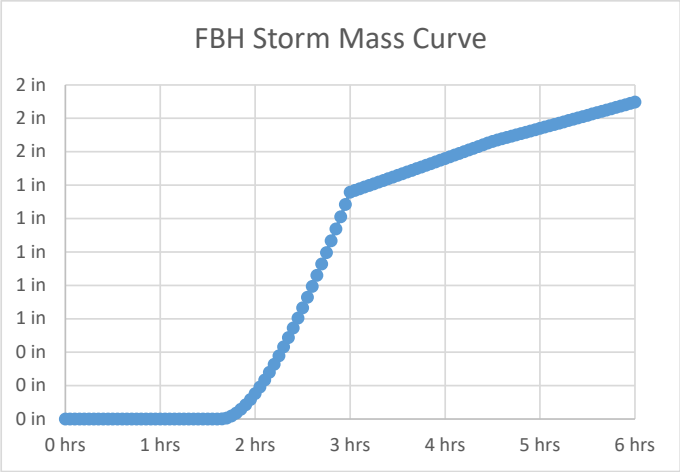
Time Increment	Incremental Rainfall	Rainfall Fractions for Each Time Increment	5 Point Rainfall Distribution
0 to 1.5	0.299 in	0.074	0.074
1.5 to 3	3.032 in	0.752	0.827
2 to 4.5	0.400 in	0.099	0.926
4.5 to 6	0.299 in	0.074	1.000

Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution
0.00	0.000	1.50	0.074	3.00	0.827	4.50	0.926
0.05	0.002	1.55	0.099	3.05	0.830	4.55	0.928
0.10	0.005	1.60	0.124	3.10	0.833	4.60	0.931
0.15	0.007	1.65	0.149	3.15	0.836	4.65	0.933
0.20	0.010	1.70	0.175	3.20	0.840	4.70	0.936
0.25	0.012	1.75	0.200	3.25	0.843	4.75	0.938
0.30	0.015	1.80	0.225	3.30	0.846	4.80	0.941
0.35	0.017	1.85	0.250	3.35	0.850	4.85	0.943
0.40	0.020	1.90	0.275	3.40	0.853	4.90	0.946
0.45	0.022	1.95	0.300	3.45	0.856	4.95	0.948
0.50	0.025	2.00	0.325	3.50	0.860	5.00	0.951
0.55	0.027	2.05	0.350	3.55	0.863	5.05	0.953
0.60	0.030	2.10	0.375	3.60	0.866	5.10	0.955
0.65	0.032	2.15	0.400	3.65	0.870	5.15	0.958
0.70	0.035	2.20	0.425	3.70	0.873	5.20	0.960
0.75	0.037	2.25	0.450	3.75	0.876	5.25	0.963
0.80	0.040	2.30	0.475	3.80	0.879	5.30	0.965
0.85	0.042	2.35	0.501	3.85	0.883	5.35	0.968
0.90	0.045	2.40	0.526	3.90	0.886	5.40	0.970
0.95	0.047	2.45	0.551	3.95	0.889	5.45	0.973
1.00	0.049	2.50	0.576	4.00	0.893	5.50	0.975
1.05	0.052	2.55	0.601	4.05	0.896	5.55	0.978
1.10	0.054	2.60	0.626	4.10	0.899	5.60	0.980
1.15	0.057	2.65	0.651	4.15	0.903	5.65	0.983
1.20	0.059	2.70	0.676	4.20	0.906	5.70	0.985
1.25	0.062	2.75	0.701	4.25	0.909	5.75	0.988
1.30	0.064	2.80	0.726	4.30	0.913	5.80	0.990
1.35	0.067	2.85	0.751	4.35	0.916	5.85	0.993
1.40	0.069	2.90	0.776	4.40	0.919	5.90	0.995
1.45	0.072	2.95	0.801	4.45	0.922	5.95	0.998
						6.00	1.000

Time (hr)	Rainfall Distribution	Total Rainfall (in)	Acc. Mass Curve of Runoff (in)	Inc. Mass Curve of Runoff (in)
0.00	0.000	0.000	0.000	0.000
0.05	0.002	0.010	0.000	0.000
0.10	0.005	0.020	0.000	0.000
0.15	0.007	0.030	0.000	0.000
0.20	0.010	0.040	0.000	0.000
0.25	0.012	0.050	0.000	0.000
0.30	0.015	0.060	0.000	0.000
0.35	0.017	0.070	0.000	0.000
0.40	0.020	0.080	0.000	0.000
0.45	0.022	0.090	0.000	0.000
0.50	0.025	0.100	0.000	0.000
0.55	0.027	0.110	0.000	0.000
0.60	0.030	0.120	0.000	0.000
0.65	0.032	0.130	0.000	0.000
0.70	0.035	0.140	0.000	0.000
0.75	0.037	0.150	0.000	0.000
0.80	0.040	0.159	0.000	0.000
0.85	0.042	0.169	0.000	0.000
0.90	0.045	0.179	0.000	0.000
0.95	0.047	0.189	0.000	0.000
1.00	0.049	0.199	0.000	0.000
1.05	0.052	0.209	0.000	0.000
1.10	0.054	0.219	0.000	0.000
1.15	0.057	0.229	0.000	0.000
1.20	0.059	0.239	0.000	0.000
1.25	0.062	0.249	0.000	0.000
1.30	0.064	0.259	0.000	0.000
1.35	0.067	0.269	0.000	0.000
1.40	0.069	0.279	0.000	0.000
1.45	0.072	0.289	0.000	0.000
1.50	0.074	0.299	0.000	0.000
1.55	0.099	0.400	0.000	0.000
1.60	0.124	0.501	0.000	0.000
1.65	0.149	0.602	0.000	0.000
1.70	0.175	0.703	0.006	0.006
1.75	0.200	0.804	0.018	0.012
1.80	0.225	0.905	0.035	0.018
1.85	0.250	1.006	0.058	0.023
1.90	0.275	1.108	0.085	0.027
1.95	0.300	1.209	0.117	0.032
2.00	0.325	1.310	0.152	0.036
2.05	0.350	1.411	0.192	0.039
2.10	0.375	1.512	0.234	0.042
2.15	0.400	1.613	0.279	0.045
2.20	0.425	1.714	0.328	0.048
2.25	0.450	1.815	0.379	0.051
2.30	0.475	1.916	0.432	0.053
2.35	0.501	2.017	0.487	0.056

2.40	0.526	2.118	0.545	0.058
2.45	0.551	2.219	0.605	0.060
2.50	0.576	2.320	0.666	0.061
2.55	0.601	2.421	0.729	0.063
2.60	0.626	2.522	0.794	0.065
2.65	0.651	2.624	0.860	0.066
2.70	0.676	2.725	0.928	0.068
2.75	0.701	2.826	0.997	0.069
2.80	0.726	2.927	1.067	0.070
2.85	0.751	3.028	1.138	0.071
2.90	0.776	3.129	1.211	0.072
2.95	0.801	3.230	1.284	0.074
3.00	0.827	3.331	1.359	0.075
3.05	0.830	3.344	1.369	0.010
3.10	0.833	3.358	1.378	0.010
3.15	0.836	3.371	1.388	0.010
3.20	0.840	3.384	1.398	0.010
3.25	0.843	3.398	1.408	0.010
3.30	0.846	3.411	1.418	0.010
3.35	0.850	3.424	1.428	0.010
3.40	0.853	3.438	1.438	0.010
3.45	0.856	3.451	1.448	0.010
3.50	0.860	3.464	1.458	0.010
3.55	0.863	3.478	1.468	0.010
3.60	0.866	3.491	1.478	0.010
3.65	0.870	3.504	1.489	0.010
3.70	0.873	3.518	1.499	0.010
3.75	0.876	3.531	1.509	0.010
3.80	0.879	3.544	1.519	0.010
3.85	0.883	3.558	1.529	0.010
3.90	0.886	3.571	1.539	0.010
3.95	0.889	3.584	1.549	0.010
4.00	0.893	3.598	1.560	0.010
4.05	0.896	3.611	1.570	0.010
4.10	0.899	3.624	1.580	0.010
4.15	0.903	3.638	1.590	0.010
4.20	0.906	3.651	1.600	0.010
4.25	0.909	3.664	1.611	0.010
4.30	0.913	3.678	1.621	0.010
4.35	0.916	3.691	1.631	0.010
4.40	0.919	3.704	1.642	0.010
4.45	0.922	3.718	1.652	0.010
4.50	0.926	3.731	1.662	0.010
4.55	0.928	3.741	1.670	0.008
4.60	0.931	3.751	1.678	0.008
4.65	0.933	3.761	1.685	0.008
4.70	0.936	3.771	1.693	0.008
4.75	0.938	3.781	1.701	0.008
4.80	0.941	3.791	1.709	0.008
4.85	0.943	3.801	1.717	0.008
4.90	0.946	3.811	1.724	0.008
4.95	0.948	3.821	1.732	0.008
5.00	0.951	3.831	1.740	0.008
5.05	0.953	3.841	1.748	0.008
5.10	0.955	3.851	1.756	0.008

5.15	0.958	3.861	1.763	0.008
5.20	0.960	3.871	1.771	0.008
5.25	0.963	3.881	1.779	0.008
5.30	0.965	3.890	1.787	0.008
5.35	0.968	3.900	1.795	0.008
5.40	0.970	3.910	1.803	0.008
5.45	0.973	3.920	1.810	0.008
5.50	0.975	3.930	1.818	0.008
5.55	0.978	3.940	1.826	0.008
5.60	0.980	3.950	1.834	0.008
5.65	0.983	3.960	1.842	0.008
5.70	0.985	3.970	1.850	0.008
5.75	0.988	3.980	1.858	0.008
5.80	0.990	3.990	1.866	0.008
5.85	0.993	4.000	1.873	0.008
5.90	0.995	4.010	1.881	0.008
5.95	0.998	4.020	1.889	0.008
6.00	1.000	4.030	1.897	0.008



Unit Hydrograph

Unit Storm Duration

ΔD 0.05

Time to Peak

Tp 0.99 << rounded to 1.0 hr

Unit Hydrograph Peak Discharge

qp 2295

Time Ratio	Discharge Ratio	Time (hr)	q (cfs)
0.0	0.000	0.000	0
0.1	0.030	0.100	69
0.2	0.100	0.200	230
0.3	0.190	0.300	436
0.4	0.310	0.400	711
0.5	0.470	0.500	1079
0.6	0.660	0.600	1515

Time (hr)	q (cfs)
0	**0**
0.05	230
0.10	711
0.15	1515
0.20	2134
0.25	**2295**
0.30	2134

0.7	0.820	0.700	1882
0.8	0.930	0.800	2134
0.9	0.990	0.900	2272
1.0	1.000	1.000	2295
1.1	0.990	1.100	2272
1.2	0.930	1.200	2134
1.3	0.860	1.300	1974
1.4	0.780	1.400	1790
1.5	0.680	1.500	1561
1.6	0.560	1.600	1285
1.7	0.460	1.700	1056
1.8	0.390	1.800	895
1.9	0.330	1.900	757
2.0	0.280	2.000	643
2.2	0.207	2.200	475
2.4	0.147	2.400	337
2.6	0.107	2.600	246
2.8	0.077	2.800	177
3.0	0.055	3.000	126
3.2	0.040	3.200	92
3.4	0.029	3.400	67
3.6	0.021	3.600	48
3.8	0.015	3.800	34
4.0	0.011	4.000	25
4.5	0.005	4.500	11
5.0	0.000	5.000	0

0.35	1790
0.40	1285
0.45	895
0.50	**643**
0.55	475
0.60	337
0.65	246
0.70	177
0.75	**126**
0.80	92
0.85	67
0.90	48
0.95	34
1.00	**25**
1.05	19
1.10	14
1.15	9
1.20	5
1.25	**0**
1.30	0
1.35	0
1.40	0
1.45	0
1.50	**0**
1.55	0
1.60	0

Sum	1531 cfs-h

Check

Unit Hydrograph (per 1 in. Unit Runoff)	3060.2
Variance	49.98%

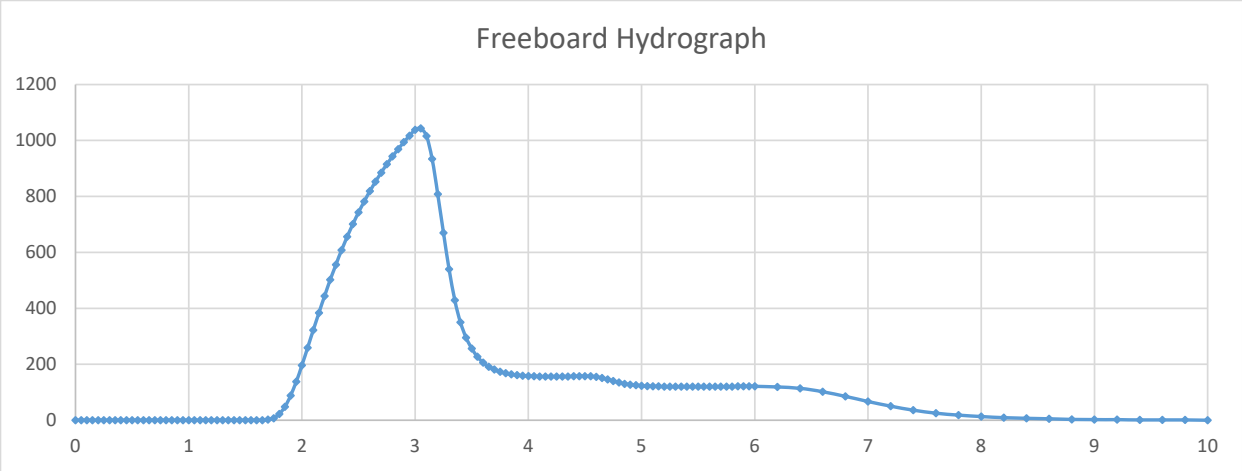
Freeboard Hydrograph

Time (hrs)	Inc. Runoff	q (cfs)	Composite FBH (cfs)
0.0	0.0000	0	0
0.1	0.0000	230	0
0.1	0.0000	711	0
0.2	0.0000	1515	0
0.2	0.0000	2134	0
0.3	0.0000	2295	0
0.3	0.0000	2134	0
0.4	0.0000	1790	0
0.4	0.0000	1285	0
0.5	0.0000	895	0
0.5	0.0000	643	0
0.6	0.0000	475	0
0.6	0.0000	337	0

0.7	0.0000	246	0
0.7	0.0000	177	0
0.8	0.0000	126	0
0.8	0.0000	92	0
0.9	0.0000	67	0
0.9	0.0000	48	0
1.0	0.0000	34	0
1.0	0.0000	25	0
1.1	0.0000	19	0
1.1	0.0000	14	0
1.2	0.0000	9	0
1.2	0.0000	5	0
1.3	0.0000	0	0
1.3	0.0000		0
1.4	0.0000		0
1.4	0.0000		0
1.5	0.0000		0
1.5	0.0000		0
1.6	0.0000		0
1.6	0.0000		0
1.7	0.0004		0
1.7	0.0056		2
1.8	0.0119		7
1.8	0.0175		22
1.9	0.0227		48
1.9	0.0273		88
2.0	0.0316		138
2.0	0.0355		196
2.1	0.0391		259
2.1	0.0424		322
2.2	0.0455		384
2.2	0.0483		444
2.3	0.0509		502
2.3	0.0533		556
2.4	0.0555		608
2.4	0.0576		656
2.5	0.0596		701
2.5	0.0614		743
2.6	0.0631		782
2.6	0.0647		819
2.7	0.0662		853
2.7	0.0676		885
2.8	0.0689		915
2.8	0.0702		943
2.9	0.0714		969
2.9	0.0725		994
3.0	0.0735		1017
3.0	0.0745		1038
3.1	0.0099		1043
3.1	0.0099		1016
3.2	0.0099		934
3.2	0.0099		808
3.3	0.0100		670
3.3	0.0100		540
3.4	0.0100		429

3.4	0.0100		350
3.5	0.0100		295
3.5	0.0100		256
3.6	0.0101		227
3.6	0.0101		206
3.7	0.0101		191
3.7	0.0101		181
3.7	0.0101		173
3.8	0.0101		168
3.8	0.0101		164
3.9	0.0102		161
3.9	0.0102		159
4.0	0.0102		158
4.0	0.0102		157
4.1	0.0102		156
4.1	0.0102		156
4.2	0.0102		156
4.2	0.0103		156
4.3	0.0103		156
4.3	0.0103		156
4.4	0.0103		157
4.4	0.0103		157
4.5	0.0103		157
4.5	0.0077		157
4.6	0.0077		155
4.6	0.0077		151
4.7	0.0078		146
4.7	0.0078		140
4.8	0.0078		135
4.8	0.0078		130
4.9	0.0078		127
4.9	0.0078		125
5.0	0.0078		123
5.0	0.0078		122
5.1	0.0078		121
5.1	0.0078		121
5.2	0.0078		120
5.2	0.0078		120
5.3	0.0078		120
5.3	0.0078		120
5.4	0.0079		120
5.4	0.0079		120
5.5	0.0079		120
5.5	0.0079		120
5.6	0.0079		120
5.6	0.0079		120
5.7	0.0079		120
5.7	0.0079		120
5.8	0.0079		120
5.8	0.0079		121
5.9	0.0079		121
5.9	0.0079		121
6.0	0.0079		121
6.2			119
6.4			114

6.6			102
6.8			85
7.0			67
7.2			50
7.4			36
7.6			25
7.8			18
8.0			13
8.2			9
8.4			7
8.6			5
8.8			3
9.0			2
9.2			2
9.4			1
9.6			1
9.8			1
10.0			0
10.2			0
10.4			0



Results

Peak Hydrograph Flow	1043	cfs
Total Volume	480	ac-ft

ASH-G Hydrograph

Characteristics

Drainage Area	4.742	sq mi	
Time of Concentration	1.58	hr	
Curve Number	77.8		
Structure Hazard Classification	High		
Initial Abstraction	0.57	in	
Maximum Potential Retention	2.85	in	
Precipitation	5.85	in	
ΔD	0.21	hr	<< 0.2-hr time increments are used

5-Point Rainfall Distribution

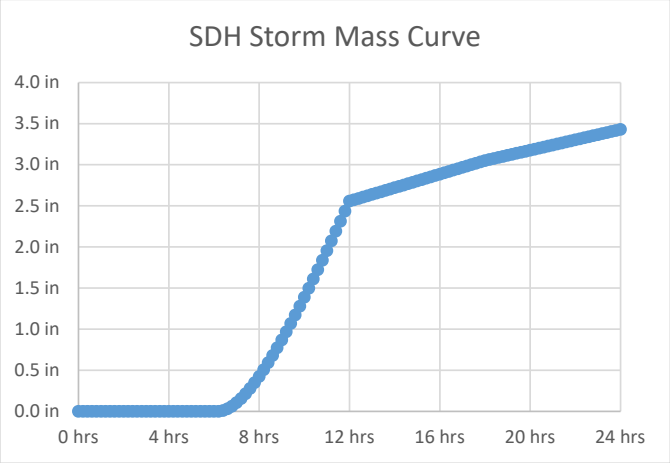
Time Increment	Incremental Rainfall		Rainfall Fractions for Each Time Increment		5 Point Rainfall Distribution	
0 to 6	0.436	in	0.075		0.075	
6 to 12	4.399	in	0.752		0.826	
12 to 18	0.580	in	0.099		0.926	
18 to 24	0.435	in	0.074		1.000	

Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution
0.00	0.000	6.00	0.075	12.00	0.826	18.00	0.926
0.20	0.002	6.20	0.100	12.20	0.830	18.20	0.928
0.40	0.005	6.40	0.125	12.40	0.833	18.40	0.931
0.60	0.007	6.60	0.150	12.60	0.836	18.60	0.933
0.80	0.010	6.80	0.175	12.80	0.840	18.80	0.936
1.00	0.012	7.00	0.200	13.00	0.843	19.00	0.938
1.20	0.015	7.20	0.225	13.20	0.846	19.20	0.941
1.40	0.017	7.40	0.250	13.40	0.850	19.40	0.943
1.60	0.020	7.60	0.275	13.60	0.853	19.60	0.945
1.80	0.022	7.80	0.300	13.80	0.856	19.80	0.948
2.00	0.025	8.00	0.325	14.00	0.860	20.00	0.950
2.20	0.027	8.20	0.350	14.20	0.863	20.20	0.953
2.40	0.030	8.40	0.375	14.40	0.866	20.40	0.955
2.60	0.032	8.60	0.400	14.60	0.869	20.60	0.958
2.80	0.035	8.80	0.425	14.80	0.873	20.80	0.960
3.00	0.037	9.00	0.451	15.00	0.876	21.00	0.963
3.20	0.040	9.20	0.476	15.20	0.879	21.20	0.965
3.40	0.042	9.40	0.501	15.40	0.883	21.40	0.968
3.60	0.045	9.60	0.526	15.60	0.886	21.60	0.970
3.80	0.047	9.80	0.551	15.80	0.889	21.80	0.973
4.00	0.050	10.00	0.576	16.00	0.893	22.00	0.975
4.20	0.052	10.20	0.601	16.20	0.896	22.20	0.978
4.40	0.055	10.40	0.626	16.40	0.899	22.40	0.980
4.60	0.057	10.60	0.651	16.60	0.903	22.60	0.983
4.80	0.060	10.80	0.676	16.80	0.906	22.80	0.985
5.00	0.062	11.00	0.701	17.00	0.909	23.00	0.988
5.20	0.065	11.20	0.726	17.20	0.912	23.20	0.990
5.40	0.067	11.40	0.751	17.40	0.916	23.40	0.993
5.60	0.070	11.60	0.776	17.60	0.919	23.60	0.995
5.80	0.072	11.80	0.801	17.80	0.922	23.80	0.998
						24.00	1.000

Time (hr)	Rainfall Distribution	Total Rainfall (in)	Acc. Mass Curve of Runoff (in)	Inc. Mass Curve of Runoff (in)
0.00	0.000	0.000	0.000	0.000
0.20	0.002	0.015	0.000	0.000
0.40	0.005	0.029	0.000	0.000
0.60	0.007	0.044	0.000	0.000
0.80	0.010	0.058	0.000	0.000
1.00	0.012	0.073	0.000	0.000
1.20	0.015	0.087	0.000	0.000
1.40	0.017	0.102	0.000	0.000
1.60	0.020	0.116	0.000	0.000
1.80	0.022	0.131	0.000	0.000
2.00	0.025	0.145	0.000	0.000
2.20	0.027	0.160	0.000	0.000
2.40	0.030	0.174	0.000	0.000
2.60	0.032	0.189	0.000	0.000
2.80	0.035	0.203	0.000	0.000
3.00	0.037	0.218	0.000	0.000
3.20	0.040	0.233	0.000	0.000
3.40	0.042	0.247	0.000	0.000
3.60	0.045	0.262	0.000	0.000
3.80	0.047	0.276	0.000	0.000
4.00	0.050	0.291	0.000	0.000
4.20	0.052	0.305	0.000	0.000
4.40	0.055	0.320	0.000	0.000
4.60	0.057	0.334	0.000	0.000
4.80	0.060	0.349	0.000	0.000
5.00	0.062	0.363	0.000	0.000
5.20	0.065	0.378	0.000	0.000
5.40	0.067	0.392	0.000	0.000
5.60	0.070	0.407	0.000	0.000
5.80	0.072	0.421	0.000	0.000
6.00	0.075	0.436	0.000	0.000
6.20	0.100	0.583	0.000	0.000
6.40	0.125	0.729	0.008	0.008
6.60	0.150	0.876	0.030	0.021
6.80	0.175	1.023	0.062	0.032
7.00	0.200	1.169	0.104	0.042
7.20	0.225	1.316	0.155	0.051
7.40	0.250	1.462	0.213	0.058
7.60	0.275	1.609	0.278	0.065
7.80	0.300	1.756	0.348	0.071
8.00	0.325	1.902	0.424	0.076
8.20	0.350	2.049	0.505	0.081
8.40	0.375	2.196	0.590	0.085
8.60	0.400	2.342	0.680	0.089
8.80	0.425	2.489	0.772	0.093
9.00	0.451	2.636	0.868	0.096
9.20	0.476	2.782	0.967	0.099
9.40	0.501	2.929	1.068	0.101
9.60	0.526	3.075	1.172	0.104
9.80	0.551	3.222	1.278	0.106
10.00	0.576	3.369	1.387	0.108

10.20	0.601	3.515	1.497	0.110
10.40	0.626	3.662	1.609	0.112
10.60	0.651	3.809	1.723	0.114
10.80	0.676	3.955	1.838	0.115
11.00	0.701	4.102	1.955	0.117
11.20	0.726	4.248	2.073	0.118
11.40	0.751	4.395	2.192	0.119
11.60	0.776	4.542	2.312	0.120
11.80	0.801	4.688	2.434	0.122
12.00	0.826	4.835	2.557	0.123
12.20	0.830	4.854	2.573	0.016
12.40	0.833	4.874	2.589	0.016
12.60	0.836	4.893	2.605	0.016
12.80	0.840	4.912	2.622	0.016
13.00	0.843	4.932	2.638	0.016
13.20	0.846	4.951	2.654	0.016
13.40	0.850	4.970	2.671	0.016
13.60	0.853	4.990	2.687	0.016
13.80	0.856	5.009	2.703	0.016
14.00	0.860	5.028	2.720	0.016
14.20	0.863	5.048	2.736	0.016
14.40	0.866	5.067	2.753	0.016
14.60	0.869	5.086	2.769	0.016
14.80	0.873	5.106	2.785	0.016
15.00	0.876	5.125	2.802	0.016
15.20	0.879	5.144	2.818	0.016
15.40	0.883	5.164	2.835	0.016
15.60	0.886	5.183	2.851	0.017
15.80	0.889	5.202	2.868	0.017
16.00	0.893	5.222	2.884	0.017
16.20	0.896	5.241	2.901	0.017
16.40	0.899	5.260	2.918	0.017
16.60	0.903	5.280	2.934	0.017
16.80	0.906	5.299	2.951	0.017
17.00	0.909	5.318	2.967	0.017
17.20	0.912	5.338	2.984	0.017
17.40	0.916	5.357	3.001	0.017
17.60	0.919	5.376	3.017	0.017
17.80	0.922	5.396	3.034	0.017
18.00	0.926	5.415	3.051	0.017
18.20	0.928	5.430	3.063	0.013
18.40	0.931	5.444	3.076	0.013
18.60	0.933	5.459	3.088	0.013
18.80	0.936	5.473	3.101	0.013
19.00	0.938	5.488	3.113	0.013
19.20	0.941	5.502	3.126	0.013
19.40	0.943	5.517	3.138	0.013
19.60	0.945	5.531	3.151	0.013
19.80	0.948	5.546	3.163	0.013
20.00	0.950	5.560	3.176	0.013
20.20	0.953	5.575	3.189	0.013
20.40	0.955	5.589	3.201	0.013
20.60	0.958	5.604	3.214	0.013
20.80	0.960	5.618	3.226	0.013
21.00	0.963	5.633	3.239	0.013
21.20	0.965	5.647	3.252	0.013

21.40	0.968	5.662	3.264	0.013
21.60	0.970	5.676	3.277	0.013
21.80	0.973	5.691	3.290	0.013
22.00	0.975	5.705	3.302	0.013
22.20	0.978	5.720	3.315	0.013
22.40	0.980	5.734	3.328	0.013
22.60	0.983	5.749	3.340	0.013
22.80	0.985	5.763	3.353	0.013
23.00	0.988	5.778	3.366	0.013
23.20	0.990	5.792	3.378	0.013
23.40	0.993	5.807	3.391	0.013
23.60	0.995	5.821	3.404	0.013
23.80	0.998	5.836	3.416	0.013
24.00	1.000	5.850	3.429	0.013



Unit Hydrograph

Unit Storm Duration

ΔD 0.21 << 0.2-hr time increments are used

Time to Peak

Tp 1.05 << rounded to 1.0 hr

Unit Hydrograph Peak Discharge

qp 2295

Time Ratio	Discharge Ratio	Time (hr)	q (cfs)
0.0	0.000	0.000	0
0.1	0.030	0.100	69
0.2	0.100	0.200	230
0.3	0.190	0.300	436
0.4	0.310	0.400	711
0.5	0.470	0.500	1079
0.6	0.660	0.600	1515
0.7	0.820	0.700	1882
0.8	0.930	0.800	2134
0.9	0.990	0.900	2272
1.0	1.000	1.000	2295
1.1	0.990	1.100	2272

Time (hr)	q (cfs)
0	**0**
0.20	230
0.40	711
0.60	1515
0.80	2134
1.00	**2295**
1.20	2134
1.40	1790
1.60	1285
1.80	895
2.00	**643**
2.20	475

1.2	0.930	1.200	2134
1.3	0.860	1.300	1974
1.4	0.780	1.400	1790
1.5	0.680	1.500	1561
1.6	0.560	1.600	1285
1.7	0.460	1.700	1056
1.8	0.390	1.800	895
1.9	0.330	1.900	757
2.0	0.280	2.000	643
2.2	0.207	2.200	475
2.4	0.147	2.400	337
2.6	0.107	2.600	246
2.8	0.077	2.800	177
3.0	0.055	3.000	126
3.2	0.040	3.200	92
3.4	0.029	3.400	67
3.6	0.021	3.600	48
3.8	0.015	3.800	34
4.0	0.011	4.000	25
4.5	0.005	4.500	11
5.0	0.000	5.000	0

2.40	337
2.60	246
2.80	177
3.00	**126**
3.20	92
3.40	67
3.60	48
3.80	34
4.00	**25**
4.20	19
4.40	14
4.60	9
4.80	5
5.00	**0**
5.20	0
5.40	0
5.60	0
5.80	0
6.00	**0**
6.20	0
6.40	0

Sum	3061 cfs-h

Check

Unit Hydrograph (per 1 in. Unit Runoff)	3060.2
Variance	-0.04%

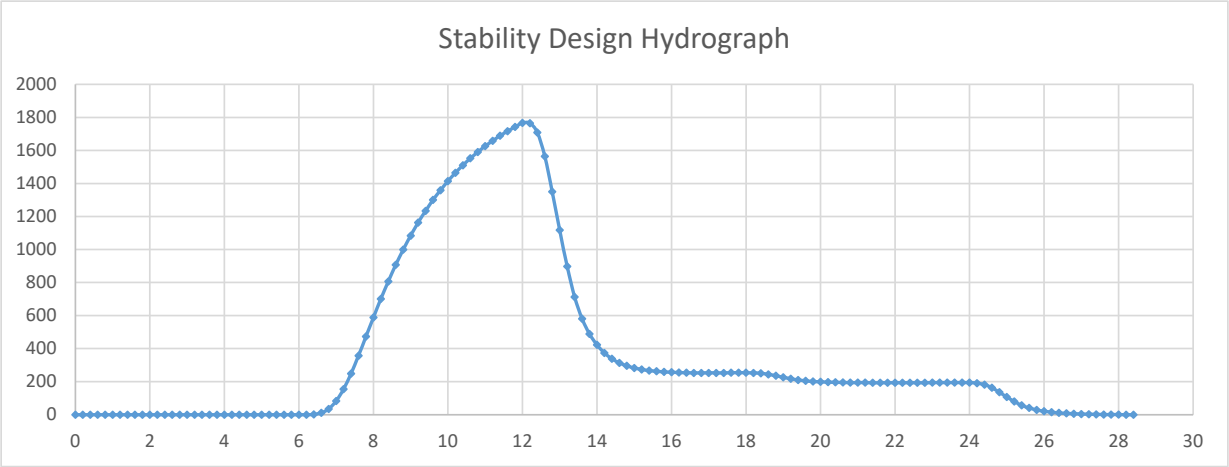
Stability Design Hydrograph

Time (hrs)	Inc. Runoff	q (cfs)	Composite SDH (cfs)
0.0	0.0000	0	0
0.2	0.0000	230	0
0.4	0.0000	711	0
0.6	0.0000	1515	0
0.8	0.0000	2134	0
1.0	0.0000	2295	0
1.2	0.0000	2134	0
1.4	0.0000	1790	0
1.6	0.0000	1285	0
1.8	0.0000	895	0
2.0	0.0000	643	0
2.2	0.0000	475	0
2.4	0.0000	337	0
2.6	0.0000	246	0
2.8	0.0000	177	0
3.0	0.0000	126	0
3.2	0.0000	92	0
3.4	0.0000	67	0
3.6	0.0000	48	0
3.8	0.0000	34	0
4.0	0.0000	25	0
4.2	0.0000	19	0
4.4	0.0000	14	0
4.6	0.0000	9	0

4.8	0.0000	5	0
5.0	0.0000	0	0
5.2	0.0000		0
5.4	0.0000		0
5.6	0.0000		0
5.8	0.0000		0
6.0	0.0000		0
6.2	0.0001		0
6.4	0.0084		2
6.6	0.0212		11
6.8	0.0324		35
7.0	0.0421		83
7.2	0.0506		155
7.4	0.0581		249
7.6	0.0648		357
7.8	0.0707		473
8.0	0.0761		589
8.2	0.0808		701
8.4	0.0852		807
8.6	0.0891		907
8.8	0.0926		999
9.0	0.0958		1084
9.2	0.0988		1163
9.4	0.1015		1234
9.6	0.1039		1300
9.8	0.1062		1359
10.0	0.1083		1414
10.2	0.1103		1464
10.4	0.1120		1510
10.6	0.1137		1552
10.8	0.1153		1590
11.0	0.1167		1626
11.2	0.1180		1658
11.4	0.1193		1689
11.6	0.1205		1716
11.8	0.1216		1742
12.0	0.1226		1766
12.2	0.0162		1764
12.4	0.0163		1708
12.6	0.0163		1564
12.8	0.0163		1350
13.0	0.0163		1117
13.2	0.0163		898
13.4	0.0163		713
13.6	0.0164		581
13.8	0.0164		489
14.0	0.0164		423
14.2	0.0164		374
14.4	0.0164		339
14.6	0.0164		314
14.8	0.0164		296
15.0	0.0165		283
15.2	0.0165		274
15.4	0.0165		267
15.6	0.0165		263
15.8	0.0165		259

16.0	0.0165		257
16.2	0.0166		255
16.4	0.0166		254
16.6	0.0166		253
16.8	0.0166		253
17.0	0.0166		253
17.2	0.0166		253
17.4	0.0166		253
17.6	0.0166		254
17.8	0.0167		254
18.0	0.0167		254
18.2	0.0125		253
18.4	0.0125		251
18.6	0.0125		244
18.8	0.0125		236
19.0	0.0125		226
19.2	0.0126		218
19.4	0.0126		210
19.6	0.0126		205
19.8	0.0126		201
20.0	0.0126		199
20.2	0.0126		197
20.4	0.0126		196
20.6	0.0126		195
20.8	0.0126		194
21.0	0.0126		194
21.2	0.0126		194
21.4	0.0126		193
21.6	0.0126		193
21.8	0.0126		193
22.0	0.0126		193
22.2	0.0127		193
22.4	0.0127		193
22.6	0.0127		193
22.8	0.0127		193
23.0	0.0127		194
23.2	0.0127		194
23.4	0.0127		194
23.6	0.0127		194
23.8	0.0127		194
24.0	0.0127		194
24.2			191
24.4			182
24.6			163
24.8			136
25.0			107
25.2			80
25.4			57
25.6			41
25.8			29
26.0			21
26.2			15
26.4			11
26.6			8
26.8			6
27.0			4

27.2			3
27.4			2
27.6			1
27.8			1
28.0			1
28.2			0
28.4			0



Results

Peak Hydrograph Flow	1766 cfs
Total Volume	868 ac-ft

FBH-L Hydrograph

Characteristics

Drainage Area	4.742	sq mi
Time of Concentration	1.58	hr
Curve Number	77.8	
Structure Hazard Classification	High	
Initial Abstraction	0.57	in
Maximum Potential Retention	2.85	in
$PMP_{6\text{-}hr}$	7.67	in
$PMP_{12\text{-}hr}$	8.68	in
$PMP_{24\text{-}hr}$	10.2	in
$PMP_{72\text{-}hr}$	12.5	in
ΔD	0.05	hr

5-Point Rainfall Distribution

Time Increment	Incremental Rainfall	Rainfall Fractions for Each Time Increment		5 Point Rainfall Distribution	
0 to 1.5	0.57 in	0.074		0.074	
1.5 to 3	5.77 in	0.752		0.827	
2 to 4.5	0.76 in	0.099		0.926	
4.5 to 6	0.57 in	0.074		1.000	

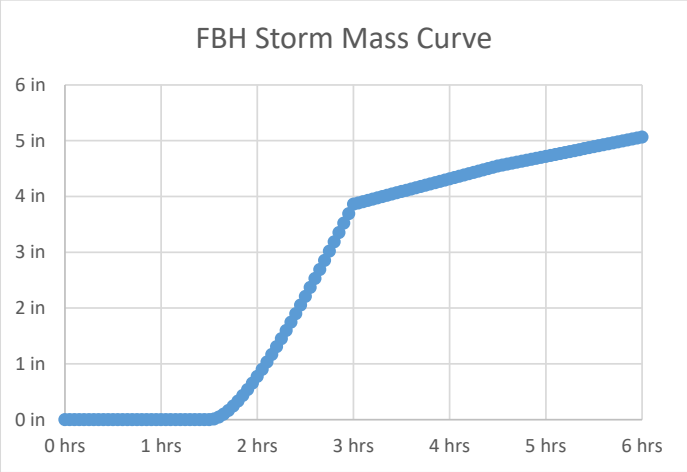
Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution
0.00	0.000	1.50	0.074	3.00	0.827	4.50	0.926
0.05	0.002	1.55	0.099	3.05	0.830	4.55	0.928
0.10	0.005	1.60	0.124	3.10	0.833	4.60	0.931
0.15	0.007	1.65	0.150	3.15	0.837	4.65	0.933
0.20	0.010	1.70	0.175	3.20	0.840	4.70	0.936
0.25	0.012	1.75	0.200	3.25	0.843	4.75	0.938
0.30	0.015	1.80	0.225	3.30	0.846	4.80	0.941
0.35	0.017	1.85	0.250	3.35	0.850	4.85	0.943
0.40	0.020	1.90	0.275	3.40	0.853	4.90	0.946
0.45	0.022	1.95	0.300	3.45	0.856	4.95	0.948
0.50	0.025	2.00	0.325	3.50	0.860	5.00	0.950
0.55	0.027	2.05	0.350	3.55	0.863	5.05	0.953
0.60	0.030	2.10	0.375	3.60	0.866	5.10	0.955
0.65	0.032	2.15	0.400	3.65	0.870	5.15	0.958
0.70	0.035	2.20	0.425	3.70	0.873	5.20	0.960
0.75	0.037	2.25	0.450	3.75	0.876	5.25	0.963
0.80	0.040	2.30	0.476	3.80	0.879	5.30	0.965
0.85	0.042	2.35	0.501	3.85	0.883	5.35	0.968
0.90	0.045	2.40	0.526	3.90	0.886	5.40	0.970
0.95	0.047	2.45	0.551	3.95	0.889	5.45	0.973
1.00	0.050	2.50	0.576	4.00	0.893	5.50	0.975
1.05	0.052	2.55	0.601	4.05	0.896	5.55	0.978
1.10	0.054	2.60	0.626	4.10	0.899	5.60	0.980
1.15	0.057	2.65	0.651	4.15	0.903	5.65	0.983
1.20	0.059	2.70	0.676	4.20	0.906	5.70	0.985
1.25	0.062	2.75	0.701	4.25	0.909	5.75	0.988
1.30	0.064	2.80	0.726	4.30	0.912	5.80	0.990

1.35	0.067	2.85	0.751	4.35	0.916	5.85	0.993
1.40	0.069	2.90	0.776	4.40	0.919	5.90	0.995
1.45	0.072	2.95	0.802	4.45	0.922	5.95	0.998
						6.00	1.000

Time (hr)	Rainfall Distribution	Total Rainfall (in)	Acc. Mass Curve of Runoff (in)	Inc. Mass Curve of Runoff (in)
0.00	0.000	0.000	0.000	0.000
0.05	0.002	0.019	0.000	0.000
0.10	0.005	0.038	0.000	0.000
0.15	0.007	0.057	0.000	0.000
0.20	0.010	0.076	0.000	0.000
0.25	0.012	0.095	0.000	0.000
0.30	0.015	0.114	0.000	0.000
0.35	0.017	0.133	0.000	0.000
0.40	0.020	0.152	0.000	0.000
0.45	0.022	0.171	0.000	0.000
0.50	0.025	0.190	0.000	0.000
0.55	0.027	0.209	0.000	0.000
0.60	0.030	0.228	0.000	0.000
0.65	0.032	0.247	0.000	0.000
0.70	0.035	0.266	0.000	0.000
0.75	0.037	0.285	0.000	0.000
0.80	0.040	0.304	0.000	0.000
0.85	0.042	0.323	0.000	0.000
0.90	0.045	0.342	0.000	0.000
0.95	0.047	0.361	0.000	0.000
1.00	0.050	0.380	0.000	0.000
1.05	0.052	0.399	0.000	0.000
1.10	0.054	0.418	0.000	0.000
1.15	0.057	0.437	0.000	0.000
1.20	0.059	0.456	0.000	0.000
1.25	0.062	0.475	0.000	0.000
1.30	0.064	0.494	0.000	0.000
1.35	0.067	0.513	0.000	0.000
1.40	0.069	0.532	0.000	0.000
1.45	0.072	0.551	0.000	0.000
1.50	0.074	0.570	0.000	0.000
1.55	0.099	0.762	0.012	0.012
1.60	0.124	0.955	0.046	0.034
1.65	0.150	1.147	0.097	0.051
1.70	0.175	1.339	0.164	0.066
1.75	0.200	1.532	0.243	0.079
1.80	0.225	1.724	0.333	0.090
1.85	0.250	1.916	0.432	0.099
1.90	0.275	2.109	0.539	0.108
1.95	0.300	2.301	0.654	0.115
2.00	0.325	2.493	0.775	0.121
2.05	0.350	2.686	0.901	0.126
2.10	0.375	2.878	1.033	0.131
2.15	0.400	3.070	1.168	0.136
2.20	0.425	3.263	1.308	0.140
2.25	0.450	3.455	1.451	0.143
2.30	0.476	3.647	1.598	0.146
2.35	0.501	3.840	1.747	0.149

2.40	0.526	4.032	1.899	0.152
2.45	0.551	4.224	2.053	0.154
2.50	0.576	4.417	2.210	0.156
2.55	0.601	4.609	2.368	0.158
2.60	0.626	4.801	2.528	0.160
2.65	0.651	4.994	2.690	0.162
2.70	0.676	5.186	2.854	0.164
2.75	0.701	5.378	3.019	0.165
2.80	0.726	5.571	3.185	0.166
2.85	0.751	5.763	3.353	0.168
2.90	0.776	5.955	3.522	0.169
2.95	0.802	6.148	3.691	0.170
3.00	0.827	6.340	3.862	0.171
3.05	0.830	6.365	3.885	0.023
3.10	0.833	6.391	3.907	0.023
3.15	0.837	6.416	3.930	0.023
3.20	0.840	6.441	3.953	0.023
3.25	0.843	6.467	3.975	0.023
3.30	0.846	6.492	3.998	0.023
3.35	0.850	6.517	4.021	0.023
3.40	0.853	6.543	4.043	0.023
3.45	0.856	6.568	4.066	0.023
3.50	0.860	6.593	4.089	0.023
3.55	0.863	6.619	4.111	0.023
3.60	0.866	6.644	4.134	0.023
3.65	0.870	6.669	4.157	0.023
3.70	0.873	6.695	4.180	0.023
3.75	0.876	6.720	4.203	0.023
3.80	0.879	6.745	4.225	0.023
3.85	0.883	6.771	4.248	0.023
3.90	0.886	6.796	4.271	0.023
3.95	0.889	6.821	4.294	0.023
4.00	0.893	6.847	4.317	0.023
4.05	0.896	6.872	4.340	0.023
4.10	0.899	6.897	4.362	0.023
4.15	0.903	6.923	4.385	0.023
4.20	0.906	6.948	4.408	0.023
4.25	0.909	6.973	4.431	0.023
4.30	0.912	6.999	4.454	0.023
4.35	0.916	7.024	4.477	0.023
4.40	0.919	7.049	4.500	0.023
4.45	0.922	7.075	4.523	0.023
4.50	0.926	7.100	4.546	0.023
4.55	0.928	7.119	4.563	0.017
4.60	0.931	7.138	4.580	0.017
4.65	0.933	7.157	4.598	0.017
4.70	0.936	7.176	4.615	0.017
4.75	0.938	7.195	4.632	0.017
4.80	0.941	7.214	4.650	0.017
4.85	0.943	7.233	4.667	0.017
4.90	0.946	7.252	4.684	0.017
4.95	0.948	7.271	4.701	0.017
5.00	0.950	7.290	4.719	0.017
5.05	0.953	7.309	4.736	0.017
5.10	0.955	7.328	4.753	0.017

5.15	0.958	7.347	4.771	0.017
5.20	0.960	7.366	4.788	0.017
5.25	0.963	7.385	4.805	0.017
5.30	0.965	7.404	4.823	0.017
5.35	0.968	7.423	4.840	0.017
5.40	0.970	7.442	4.857	0.017
5.45	0.973	7.461	4.875	0.017
5.50	0.975	7.480	4.892	0.017
5.55	0.978	7.499	4.910	0.017
5.60	0.980	7.518	4.927	0.017
5.65	0.983	7.537	4.944	0.017
5.70	0.985	7.556	4.962	0.017
5.75	0.988	7.575	4.979	0.017
5.80	0.990	7.594	4.997	0.017
5.85	0.993	7.613	5.014	0.017
5.90	0.995	7.632	5.031	0.017
5.95	0.998	7.651	5.049	0.017
6.00	1.000	7.670	5.066	0.017



Unit Hydrograph

Unit Storm Duration

ΔD 0.05

Time to Peak

Tp 0.99 << rounded to 1.0 hr

Unit Hydrograph Peak Discharge

qp 2295

Time Ratio	Discharge Ratio	Time (hr)	q (cfs)
0.0	0.000	0.000	0
0.1	0.030	0.100	69
0.2	0.100	0.200	230
0.3	0.190	0.300	436
0.4	0.310	0.400	711
0.5	0.470	0.500	1079
0.6	0.660	0.600	1515
0.7	0.820	0.700	1882
0.8	0.930	0.800	2134
0.9	0.990	0.900	2272
1.0	1.000	1.000	2295
1.1	0.990	1.100	2272
1.2	0.930	1.200	2134
1.3	0.860	1.300	1974
1.4	0.780	1.400	1790
1.5	0.680	1.500	1561
1.6	0.560	1.600	1285
1.7	0.460	1.700	1056
1.8	0.390	1.800	895
1.9	0.330	1.900	757
2.0	0.280	2.000	643
2.2	0.207	2.200	475
2.4	0.147	2.400	337
2.6	0.107	2.600	246
2.8	0.077	2.800	177
3.0	0.055	3.000	126
3.2	0.040	3.200	92
3.4	0.029	3.400	67
3.6	0.021	3.600	48
3.8	0.015	3.800	34
4.0	0.011	4.000	25
4.5	0.005	4.500	11
5.0	0.000	5.000	0

Time (hr)	q (cfs)
0	**0**
0.05	230
0.10	711
0.15	1515
0.20	2134
0.25	**2295**
0.30	2134
0.35	1790
0.40	1285
0.45	895
0.50	**643**
0.55	475
0.60	337
0.65	246
0.70	177
0.75	**126**
0.80	92
0.85	67
0.90	48
0.95	34
1.00	**25**
1.05	19
1.10	14
1.15	9
1.20	5
1.25	**0**
1.30	0
1.35	0
1.40	0
1.45	0
1.50	**0**
1.55	0
1.60	0

Sum	1531 cfs-h

Check

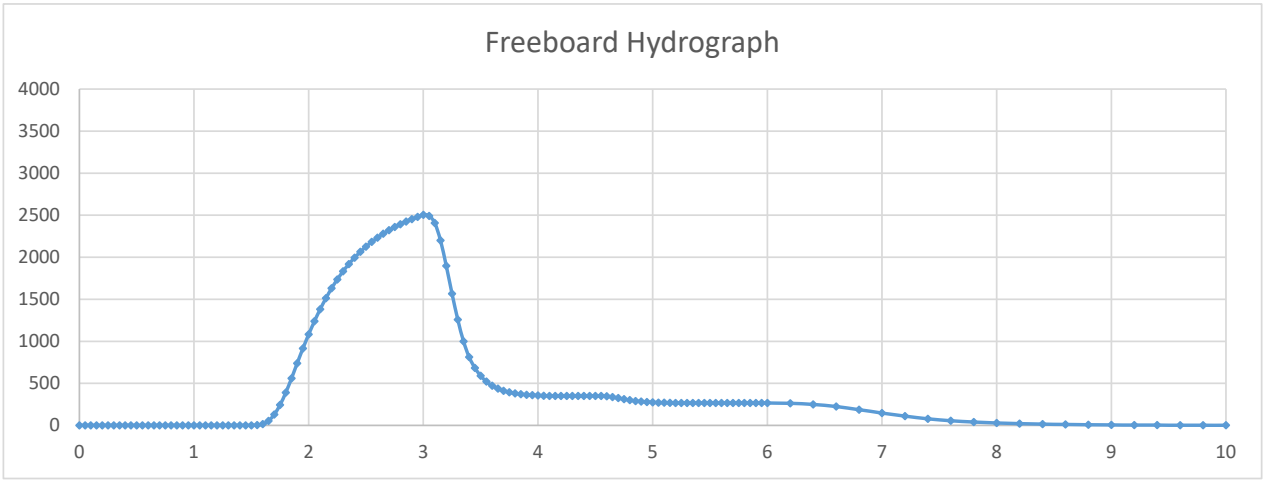
Unit Hydrograph (per 1 in. Unit Runoff)	3060.2
Variance	49.98%

Freeboard Hydrograph

Time (hrs)	Inc. Runoff	q (cfs)	Composite FBH (cfs)
0.0	0.0000	0	0
0.1	0.0000	230	0
0.1	0.0000	711	0
0.2	0.0000	1515	0
0.2	0.0000	2134	0
0.3	0.0000	2295	0
0.3	0.0000	2134	0
0.4	0.0000	1790	0
0.4	0.0000	1285	0
0.5	0.0000	895	0
0.5	0.0000	643	0
0.6	0.0000	475	0
0.6	0.0000	337	0
0.7	0.0000	246	0
0.7	0.0000	177	0
0.8	0.0000	126	0
0.8	0.0000	92	0
0.9	0.0000	67	0
0.9	0.0000	48	0
1.0	0.0000	34	0
1.0	0.0000	25	0
1.1	0.0000	19	0
1.1	0.0000	14	0
1.2	0.0000	9	0
1.2	0.0000	5	0
1.3	0.0000	0	0
1.3	0.0000		0
1.4	0.0000		0
1.4	0.0000		0
1.5	0.0000		0
1.5	0.0000		0
1.6	0.0122		3
1.6	0.0336		16
1.7	0.0514		54
1.7	0.0664		129
1.8	0.0791		243
1.8	0.0900		390
1.9	0.0994		560
1.9	0.1075		738
2.0	0.1146		915
2.0	0.1209		1082
2.1	0.1264		1238
2.1	0.1313		1382
2.2	0.1357		1512
2.2	0.1397		1630
2.3	0.1432		1736
2.3	0.1464		1832

2.4	0.1493		1918
2.4	0.1519		1995
2.5	0.1543		2064
2.5	0.1565		2126
2.6	0.1585		2182
2.6	0.1603		2233
2.7	0.1620		2279
2.7	0.1636		2321
2.8	0.1650		2359
2.8	0.1663		2393
2.9	0.1676		2425
2.9	0.1687		2453
3.0	0.1698		2480
3.0	0.1708		2504
3.1	0.0226		2492
3.1	0.0226		2407
3.2	0.0226		2199
3.2	0.0226		1897
3.3	0.0226		1567
3.3	0.0227		1258
3.4	0.0227		999
3.4	0.0227		812
3.5	0.0227		683
3.5	0.0227		590
3.6	0.0227		521
3.6	0.0227		472
3.7	0.0228		437
3.7	0.0228		411
3.7	0.0228		393
3.8	0.0228		380
3.8	0.0228		371
3.9	0.0228		364
3.9	0.0228		359
4.0	0.0229		356
4.0	0.0229		353
4.1	0.0229		351
4.1	0.0229		350
4.2	0.0229		350
4.2	0.0229		350
4.3	0.0229		350
4.3	0.0229		350

4.4	0.0230		350
4.4	0.0230		351
4.5	0.0230		351
4.5	0.0172		350
4.6	0.0173		346
4.6	0.0173		337
4.7	0.0173		325
4.7	0.0173		312
4.8	0.0173		300
4.8	0.0173		290
4.9	0.0173		283
4.9	0.0173		278
5.0	0.0173		274
5.0	0.0173		271
5.1	0.0173		270
5.1	0.0173		268
5.2	0.0173		267
5.2	0.0173		267
5.3	0.0174		266
5.3	0.0174		266
5.4	0.0174		266
5.4	0.0174		266
5.5	0.0174		266
5.5	0.0174		266
5.6	0.0174		266
5.6	0.0174		266
5.7	0.0174		266
5.7	0.0174		266
5.8	0.0174		266
5.8	0.0174		266
5.9	0.0174		266
5.9	0.0174		266
6.0	0.0174		266
6.2			262
6.4			250
6.6			224
6.8			187
7.0			147
7.2			110
7.4			78
7.6			56
7.8			40
8.0			29
8.2			21
8.4			15
8.6			11
8.8			8
9.0			5
9.2			4
9.4			3
9.6			2
9.8			1
10.0			1
10.2			0
10.4			0



Results

Peak Hydrograph Flow	2504 cfs
Total Volume	1282 ac-ft

FBH-G Hydrograph

Characteristics

Drainage Area	4.742	sq mi	
Time of Concentration	1.58	hr	
Curve Number	77.8		
Structure Hazard Classification	High		
Initial Abstraction	0.57	in	
Maximum Potential Retention	2.85	in	
$PMP_{6\text{-hr}}$	7.67	in	
$PMP_{12\text{-hr}}$	8.68	in	
$PMP_{24\text{-hr}}$	10.2	in	
$PMP_{72\text{-hr}}$	12.5	in	
ΔD	0.21	hr	<< 0.2-hr time increments are used

5-Point Rainfall Distribution

Time Increment	Incremental Rainfall	Rainfall Fractions for Each Time Increment		5 Point Rainfall Distribution	
0 to 6	0.76 in	0.075		0.075	
6 to 12	7.67 in	0.752		0.826	
12 to 18	1.01 in	0.099		0.925	
18 to 24	0.76 in	0.075		1.000	

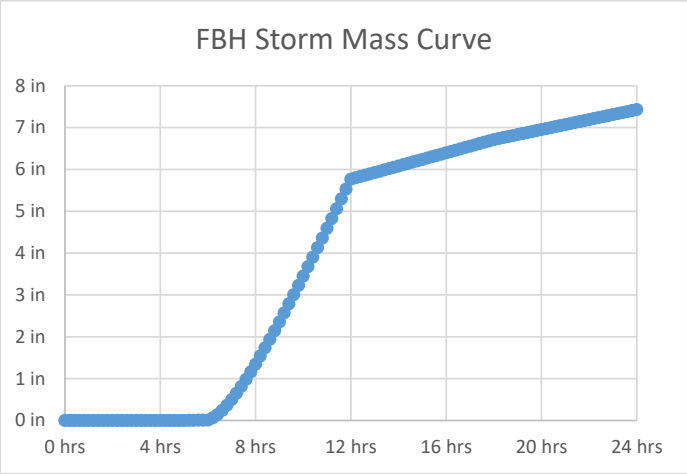
Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution
0.00	0.000	6.00	0.075	12.00	0.826	18.00	0.925
0.20	0.002	6.20	0.100	12.20	0.830	18.20	0.928
0.40	0.005	6.40	0.125	12.40	0.833	18.40	0.930
0.60	0.007	6.60	0.150	12.60	0.836	18.60	0.933
0.80	0.010	6.80	0.175	12.80	0.840	18.80	0.935
1.00	0.012	7.00	0.200	13.00	0.843	19.00	0.938
1.20	0.015	7.20	0.225	13.20	0.846	19.20	0.940
1.40	0.017	7.40	0.250	13.40	0.850	19.40	0.943
1.60	0.020	7.60	0.275	13.60	0.853	19.60	0.945
1.80	0.022	7.80	0.300	13.80	0.856	19.80	0.948
2.00	0.025	8.00	0.325	14.00	0.859	20.00	0.950
2.20	0.027	8.20	0.350	14.20	0.863	20.20	0.953
2.40	0.030	8.40	0.375	14.40	0.866	20.40	0.955
2.60	0.032	8.60	0.400	14.60	0.869	20.60	0.958
2.80	0.035	8.80	0.425	14.80	0.873	20.80	0.960
3.00	0.037	9.00	0.450	15.00	0.876	21.00	0.963
3.20	0.040	9.20	0.476	15.20	0.879	21.20	0.965
3.40	0.042	9.40	0.501	15.40	0.883	21.40	0.968
3.60	0.045	9.60	0.526	15.60	0.886	21.60	0.970
3.80	0.047	9.80	0.551	15.80	0.889	21.80	0.973
4.00	0.050	10.00	0.576	16.00	0.892	22.00	0.975
4.20	0.052	10.20	0.601	16.20	0.896	22.20	0.978
4.40	0.055	10.40	0.626	16.40	0.899	22.40	0.980
4.60	0.057	10.60	0.651	16.60	0.902	22.60	0.983
4.80	0.060	10.80	0.676	16.80	0.906	22.80	0.985
5.00	0.062	11.00	0.701	17.00	0.909	23.00	0.988
5.20	0.065	11.20	0.726	17.20	0.912	23.20	0.990

5.40	0.067	11.40	0.751	17.40	0.916	23.40	0.993
5.60	0.070	11.60	0.776	17.60	0.919	23.60	0.995
5.80	0.072	11.80	0.801	17.80	0.922	23.80	0.998
						24.00	1.000

Time (hr)	Rainfall Distribution	Total Rainfall (in)	Acc. Mass Curve of Runoff (in)	Inc. Mass Curve of Runoff (in)
0.00	0.000	0.000	0.000	0.000
0.20	0.002	0.025	0.000	0.000
0.40	0.005	0.051	0.000	0.000
0.60	0.007	0.076	0.000	0.000
0.80	0.010	0.101	0.000	0.000
1.00	0.012	0.127	0.000	0.000
1.20	0.015	0.152	0.000	0.000
1.40	0.017	0.177	0.000	0.000
1.60	0.020	0.203	0.000	0.000
1.80	0.022	0.228	0.000	0.000
2.00	0.025	0.253	0.000	0.000
2.20	0.027	0.279	0.000	0.000
2.40	0.030	0.304	0.000	0.000
2.60	0.032	0.329	0.000	0.000
2.80	0.035	0.355	0.000	0.000
3.00	0.037	0.380	0.000	0.000
3.20	0.040	0.405	0.000	0.000
3.40	0.042	0.431	0.000	0.000
3.60	0.045	0.456	0.000	0.000
3.80	0.047	0.481	0.000	0.000
4.00	0.050	0.507	0.000	0.000
4.20	0.052	0.532	0.000	0.000
4.40	0.055	0.557	0.000	0.000
4.60	0.057	0.583	0.000	0.000
4.80	0.060	0.608	0.001	0.000
5.00	0.062	0.633	0.001	0.001
5.20	0.065	0.659	0.003	0.001
5.40	0.067	0.684	0.004	0.002
5.60	0.070	0.709	0.006	0.002
5.80	0.072	0.735	0.009	0.003
6.00	0.075	0.760	0.012	0.003
6.20	0.100	1.016	0.060	0.048
6.40	0.125	1.271	0.139	0.078
6.60	0.150	1.527	0.241	0.102
6.80	0.175	1.783	0.362	0.121
7.00	0.200	2.038	0.499	0.137
7.20	0.225	2.294	0.650	0.151
7.40	0.250	2.550	0.811	0.162
7.60	0.275	2.805	0.983	0.171
7.80	0.300	3.061	1.162	0.179
8.00	0.325	3.317	1.348	0.186
8.20	0.350	3.572	1.540	0.192
8.40	0.375	3.828	1.738	0.198
8.60	0.400	4.084	1.940	0.202

8.80	0.425	4.339	2.146	0.206
9.00	0.450	4.595	2.356	0.210
9.20	0.476	4.851	2.570	0.213
9.40	0.501	5.106	2.786	0.216
9.60	0.526	5.362	3.005	0.219
9.80	0.551	5.618	3.226	0.221
10.00	0.576	5.873	3.450	0.223
10.20	0.601	6.129	3.675	0.225
10.40	0.626	6.385	3.902	0.227
10.60	0.651	6.640	4.131	0.229
10.80	0.676	6.896	4.361	0.230
11.00	0.701	7.152	4.593	0.232
11.20	0.726	7.407	4.826	0.233
11.40	0.751	7.663	5.060	0.234
11.60	0.776	7.919	5.295	0.235
11.80	0.801	8.174	5.531	0.236
12.00	0.826	8.430	5.768	0.237
12.20	0.830	8.464	5.800	0.031
12.40	0.833	8.497	5.831	0.031
12.60	0.836	8.531	5.862	0.031
12.80	0.840	8.565	5.894	0.031
13.00	0.843	8.598	5.925	0.031
13.20	0.846	8.632	5.956	0.031
13.40	0.850	8.666	5.988	0.031
13.60	0.853	8.699	6.019	0.031
13.80	0.856	8.733	6.051	0.031
14.00	0.859	8.767	6.082	0.031
14.20	0.863	8.800	6.113	0.031
14.40	0.866	8.834	6.145	0.031
14.60	0.869	8.868	6.176	0.031
14.80	0.873	8.901	6.208	0.031
15.00	0.876	8.935	6.239	0.031
15.20	0.879	8.969	6.271	0.031
15.40	0.883	9.002	6.302	0.032
15.60	0.886	9.036	6.334	0.032
15.80	0.889	9.070	6.365	0.032
16.00	0.892	9.103	6.397	0.032
16.20	0.896	9.137	6.428	0.032
16.40	0.899	9.171	6.460	0.032
16.60	0.902	9.204	6.492	0.032
16.80	0.906	9.238	6.523	0.032
17.00	0.909	9.272	6.555	0.032
17.20	0.912	9.305	6.586	0.032
17.40	0.916	9.339	6.618	0.032
17.60	0.919	9.373	6.650	0.032
17.80	0.922	9.406	6.681	0.032
18.00	0.925	9.440	6.713	0.032
18.20	0.928	9.465	6.737	0.024
18.40	0.930	9.491	6.761	0.024
18.60	0.933	9.516	6.785	0.024
18.80	0.935	9.541	6.808	0.024
19.00	0.938	9.567	6.832	0.024
19.20	0.940	9.592	6.856	0.024
19.40	0.943	9.617	6.880	0.024
19.60	0.945	9.643	6.904	0.024

19.80	0.948	9.668	6.928	0.024
20.00	0.950	9.693	6.952	0.024
20.20	0.953	9.719	6.976	0.024
20.40	0.955	9.744	7.000	0.024
20.60	0.958	9.769	7.023	0.024
20.80	0.960	9.795	7.047	0.024
21.00	0.963	9.820	7.071	0.024
21.20	0.965	9.845	7.095	0.024
21.40	0.968	9.871	7.119	0.024
21.60	0.970	9.896	7.143	0.024
21.80	0.973	9.921	7.167	0.024
22.00	0.975	9.947	7.191	0.024
22.20	0.978	9.972	7.215	0.024
22.40	0.980	9.997	7.239	0.024
22.60	0.983	10.023	7.263	0.024
22.80	0.985	10.048	7.287	0.024
23.00	0.988	10.073	7.311	0.024
23.20	0.990	10.099	7.335	0.024
23.40	0.993	10.124	7.359	0.024
23.60	0.995	10.149	7.383	0.024
23.80	0.998	10.175	7.407	0.024
24.00	1.000	10.200	7.431	0.024



Unit Hydrograph

Unit Storm Duration

ΔD — 0.21 << 0.2-hr time increments are used

Time to Peak

Tp — 1.05 << rounded to 1.0 hr

Unit Hydrograph Peak Discharge

qp — 2295

Time Ratio	Discharge Ratio	Time (hr)	q (cfs)
0.0	0.000	0.000	0
0.1	0.030	0.100	69
0.2	0.100	0.200	230

Time (hr)	q (cfs)
0	**0**
0.20	230
0.40	711

0.3	0.190	0.300	436
0.4	0.310	0.400	711
0.5	0.470	0.500	1079
0.6	0.660	0.600	1515
0.7	0.820	0.700	1882
0.8	0.930	0.800	2134
0.9	0.990	0.900	2272
1.0	1.000	1.000	2295
1.1	0.990	1.100	2272
1.2	0.930	1.200	2134
1.3	0.860	1.300	1974
1.4	0.780	1.400	1790
1.5	0.680	1.500	1561
1.6	0.560	1.600	1285
1.7	0.460	1.700	1056
1.8	0.390	1.800	895
1.9	0.330	1.900	757
2.0	0.280	2.000	643
2.2	0.207	2.200	475
2.4	0.147	2.400	337
2.6	0.107	2.600	246
2.8	0.077	2.800	177
3.0	0.055	3.000	126
3.2	0.040	3.200	92
3.4	0.029	3.400	67
3.6	0.021	3.600	48
3.8	0.015	3.800	34
4.0	0.011	4.000	25
4.5	0.005	4.500	11
5.0	0.000	5.000	0

0.60	1515
0.80	2134
1.00	**2295**
1.20	2134
1.40	1790
1.60	1285
1.80	895
2.00	**643**
2.20	475
2.40	337
2.60	246
2.80	177
3.00	**126**
3.20	92
3.40	67
3.60	48
3.80	34
4.00	**25**
4.20	19
4.40	14
4.60	9
4.80	5
5.00	**0**
5.20	0
5.40	0
5.60	0
5.80	0
6.00	**0**
6.20	0
6.40	0

Sum	3061 cfs-h

Check

Unit Hydrograph (per 1 in. Unit Runoff)	3060.2
Variance	-0.04%

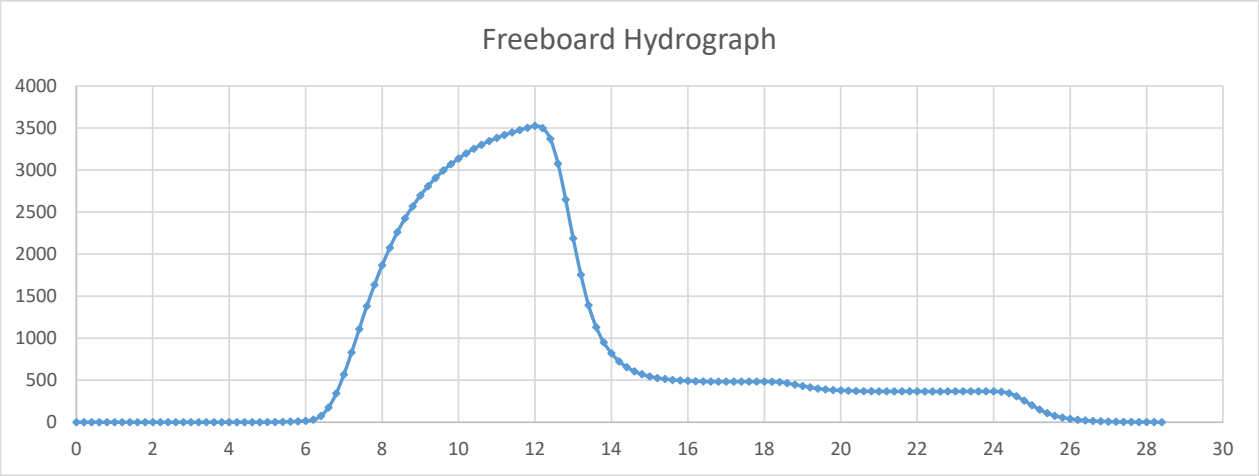
Freeboard Hydrograph

Time (hrs)	Inc. Runoff	q (cfs)	Composite FBH (cfs)
0.0	0.0000	0	0
0.2	0.0000	230	0
0.4	0.0000	711	0
0.6	0.0000	1515	0
0.8	0.0000	2134	0
1.0	0.0000	2295	0
1.2	0.0000	2134	0
1.4	0.0000	1790	0
1.6	0.0000	1285	0
1.8	0.0000	895	0
2.0	0.0000	643	0
2.2	0.0000	475	0
2.4	0.0000	337	0
2.6	0.0000	246	0

2.8	0.0000	177	0
3.0	0.0000	126	0
3.2	0.0000	92	0
3.4	0.0000	67	0
3.6	0.0000	48	0
3.8	0.0000	34	0
4.0	0.0000	25	0
4.2	0.0000	19	0
4.4	0.0000	14	0
4.6	0.0001	9	0
4.8	0.0004	5	0
5.0	0.0009	0	1
5.2	0.0013		2
5.4	0.0017		4
5.6	0.0021		7
5.8	0.0025		10
6.0	0.0029		15
6.2	0.0484		30
6.4	0.0782		74
6.6	0.1021		175
6.8	0.1214		342
7.0	0.1373		567
7.2	0.1505		829
7.4	0.1617		1108
7.6	0.1711		1380
7.8	0.1792		1634
8.0	0.1862		1866
8.2	0.1923		2074
8.4	0.1976		2260
8.6	0.2022		2424
8.8	0.2064		2568
9.0	0.2100		2696
9.2	0.2133		2807
9.4	0.2162		2906
9.6	0.2189		2993
9.8	0.2213		3069
10.0	0.2234		3137
10.2	0.2254		3198
10.4	0.2272		3252
10.6	0.2288		3300
10.8	0.2303		3343
11.0	0.2317		3381
11.2	0.2329		3416
11.4	0.2341		3447
11.6	0.2352		3475
11.8	0.2362		3501
12.0	0.2371		3524
12.2	0.0313		3498
12.4	0.0313		3371
12.6	0.0313		3075
12.8	0.0313		2649
13.0	0.0313		2187
13.2	0.0314		1755
13.4	0.0314		1392
13.6	0.0314		1131

13.8	0.0314		950
14.0	0.0314		820
14.2	0.0314		724
14.4	0.0314		655
14.6	0.0315		606
14.8	0.0315		570
15.0	0.0315		545
15.2	0.0315		526
15.4	0.0315		513
15.6	0.0315		503
15.8	0.0315		496
16.0	0.0316		492
16.2	0.0316		488
16.4	0.0316		485
16.6	0.0316		483
16.8	0.0316		483
17.0	0.0316		483
17.2	0.0316		483
17.4	0.0316		483
17.6	0.0316		483
17.8	0.0317		484
18.0	0.0317		484
18.2	0.0238		482
18.4	0.0238		477
18.6	0.0239		465
18.8	0.0239		448
19.0	0.0239		431
19.2	0.0239		414
19.4	0.0239		400
19.6	0.0239		390
19.8	0.0239		383
20.0	0.0239		378
20.2	0.0239		375
20.4	0.0239		372
20.6	0.0239		370
20.8	0.0239		369
21.0	0.0239		368
21.2	0.0239		368
21.4	0.0239		367
21.6	0.0239		367
21.8	0.0239		367
22.0	0.0240		367
22.2	0.0240		366
22.4	0.0240		366
22.6	0.0240		366
22.8	0.0240		367
23.0	0.0240		367
23.2	0.0240		367
23.4	0.0240		367
23.6	0.0240		367
23.8	0.0240		367
24.0	0.0240		367
24.2			362
24.4			345
24.6			308

24.8			257
25.0			202
25.2			151
25.4			108
25.6			77
25.8			56
26.0			40
26.2			29
26.4			21
26.6			15
26.8			11
27.0			8
27.2			5
27.4			4
27.6			3
27.8			2
28.0			1
28.2			1
28.4			0



Results

Peak Hydrograph Flow	3524 cfs
Total Volume	1880 ac-ft

Section 3. Precipitation Values

Precipitation Value - Limited Frequency Hydrographs (Storm Events 01-09 and 12)

Description: The NOAA Precipitation Value is taken from the NOAA Precipitation Frequency Data Server (PFDS). As outlined in NOAA Atlas 2 and Atlas 14, an average precipitation value for entire the basin area is calculated by deriving the values on a grid throughout the drainage basin and taking the average of these values. The exhibit on the following page, *NOAA Atlas 14 Precipitation Grid Exhibit* , shows the grid points where the point precipitation values were taken and averaged out.

NOAA Point Precipitation Value:

	6-hour	24-hour							10-day
	100-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	100-yr
	3.71	1.62	2.02	2.36	2.81	3.16	3.54	4.73	6.86
	3.69	1.62	2.02	2.35	2.80	3.16	3.53	4.72	6.85
	3.68	1.61	2.01	2.34	2.79	3.15	3.52	4.70	6.84
	3.67	1.61	2.01	2.33	2.79	3.14	3.51	4.69	6.83
	3.67	1.60	2.00	2.33	2.78	3.14	3.51	4.69	6.83
	3.66	1.60	2.00	2.33	2.78	3.13	3.50	4.68	6.82
	3.66	1.60	2.00	2.33	2.78	3.13	3.50	4.68	6.82
	3.65	1.60	1.99	2.32	2.77	3.13	3.49	4.66	6.82
	3.66	1.60	2.00	2.32	2.77	3.13	3.50	4.68	6.82
	3.67	1.60	2.00	2.33	2.78	3.13	3.51	4.69	6.83
	3.67	1.61	2.01	2.34	2.79	3.14	3.51	4.69	6.83
	3.67	1.61	2.01	2.34	2.79	3.14	3.51	4.69	6.83
	3.69	1.62	2.02	2.35	2.80	3.15	3.53	4.72	6.85
	3.69	1.62	2.01	2.35	2.80	3.15	3.53	4.72	6.85
Average >>	**3.68**	**1.61**	**2.01**	**2.34**	**2.79**	**3.14**	**3.51**	**4.69**	**6.83**

(*NOAA Atlas 14*)

Precipitation Value - Local SEP Hydrograph (Storm Event 10)

Description: The Local SEP Value is the Probable Maximum Precipitation to occur ever for a period of 6 hours. It involves evaluation of the average PMP and the areal distribution of the PMP within the drainage area using methods outlined in HMR 49. Donald T. Jensen with Utah State University was commissioned to provide an update to HMR 49 resulting in the *Probable Maximum Precipitation Estimates for Short-Duration, Small-Area Storms in Utah* . The study uses the 1-hour Point PMP Value for 1 mi^2, taken from HMR 49, and applies updated reduction factors for elevation, duration, and area to adjust the value to match the characteristics of the drainage basin.

Local SEP

Initial Precipitation Value (1-hr, 1-mi^2):

9.5 in (Fig. 4.5. *HMR 49* , 1984)

Elevation Variation:

Mean Elevation: 6271'

93.6% (Section 4.3.2, *HMR 49* , 1984)

Adjusted Value 8.90 in

Duration and Areal Variation:

Duration: 6 hrs

Area: 5 sq mi

86.15% (Table 15. *Probable Maximum Precipitation for Short-Duration, Short-Area Storms in Utah* , Jensen. 1995, 2002)

Adjusted Value 7.67 in

Total Local SEP	**7.67 in**

Precipitation Value - General SEP Hydrograph (Storm Event 11)

Description

The General SEP Value is the Probable Maximum Precipitation to occur ever for a period of 72 hours. It involves evaluation of the Convergance PMP (precipitation resulting from atmospheric processes not affected by terrain) and the Orographic PMP (precipitation resulting from atmospheric processes affected by terrain) using methods outlined in HMR 49. Convergance and orographic precipitation can occur simultaneously. Donald T. Jensen with Utah State University was commissioned to provide an update to HMR 49 resulting in the *2002 Update for Probable Maximum Precipitation, Utah, 72-Hour Estimates, Areas to 5,000 mi^2* . The study updates the 72-hour Point PMP Value for 10 mi^2, as shown in Figure 1 of the said study, from which the SEP value is calculated. This point value includes adjustments from barrier and elevation variations and the orographic component. An area reduction factor is applied to adjust the value to match the size of the drainage basin.

General SEP

Point PMP 72-hr Precipitation Value:

12.5 in (Fig. 1. *2002 Update for Probably Maximum Precipitation, Utah, 72-Hour Estimates, Areas to 5,000 mi^2* , Jensen. 2003)

Total General PMP	12.50 in

Areal Variation:

Area: 5 sq mi

100.00% (Table 1. *2002 Update for Probably Maximum Precipitation, Utah, 72-Hour Estimates, Areas to 5,000 mi^2* , Jensen. 2003)

Total General SEP	**12.50 in**
Total General SEP Used	**12.50 in**

Precipitation Value - Auxiliary Spillway Hydrographs (Storm Events 13 and 14)

Description The ASH Storm Events are the maximum precipitation events used to design the auxiliary spillway and top of dam elevation as determined by the equations set forth in TR-60, Table Figure 2-2, using the PMP precipitation value and the 100-year precipitation value.

Local ASH	P100:	2.75 in	< 100-yr, 6-hr NWS	(TR-60, Figure 2-2)
	PMP:	7.67 in	< Local SEP	

ASH-L Precipitation Value	**4.03 in**

General ASH	P100:	3.51 in	< 100-yr, 24-hr NWS	(TR-60, Figure 2-2)
	PMP:	12.50 in	< General SEP	

ASH-G Precipitation Value	**5.85 in**

Precipitation Value - Freeboard Hydrographs (Storm Events 15 and 16)

Description The FBH Storm Events are the maximum precipitation events used to design the spillway and top of dam elevation as determined by the equations set forth in TR-60, Table Figure 2-2, using the PMP precipitation value (and applying a duration reduction factor for the 24-hour General FBH).

Local FBH PMP: 7.67 in < Local (6-hr) SEP (TR-60, Figure 2-2)

FBH-L Precipitation Value	**7.67 in**

General FBH PMP: 12.50 in < Local (72-hr) SEP (TR-60, Figure 2-2)

24-hour Duration Reduction Factor:
81.6%

FBH-G Precipitation Value	**10.20 in**

Section 4. Wave Runup

Wave Runup - 50 mph Wind

Design Wind

Fastest Mile Wind:
50 mph

Maximum 1-hr wind
45 mph (Fig. 6, McCartney)

Fetch (F) Length:
0.42 miles (see attached *Fetch Length Exhibit*)

Water-Land Velocity Ratio:
1.07 (Page 11, McCartney)

Note: 120-minute velocity is calculated by multiplying the 60-minute velocity by 0.95.

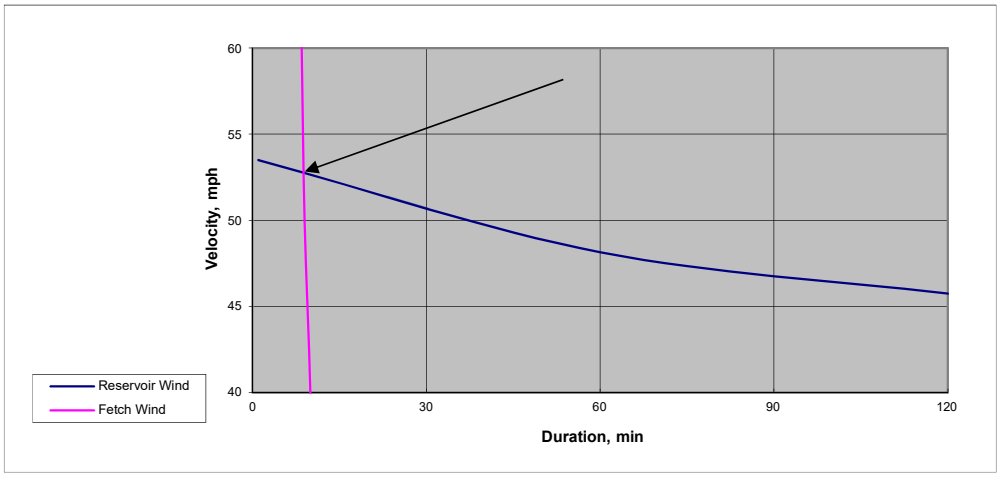
Reservoir Wind:

Duration	Velocity (Land)	Velocity (Water)
min	mph	mph
1	50	53.5
60	45	48.2
120	43	45.7

0.42-mi. Fetch Wind:

Duration	Velocity (Land)	Velocity (Water)
min	mph	mph
10	-	40
9	-	50
8.5	-	60

Note: Duration taken from Fig. 11, McCartney.



The Design Wind is taken from the intersection of the curves in the above chart:

U = 52.8 mph for 8.8 min.

Design Wave

Using a Design Wind of 52.8 mph for 8.8 minutes, the Design Wave is:

H_s = 1.40 ft (Fig. 11, McCartney)

Design Wave Significant Time Period

Using a Design Wind of 52.8 mph over a 0.42-mi. fetch, the Design Wave Significant Period is:

T_s = 2.2 sec (Fig. 12, McCartney)

Wave Runup - 50 mph Wind (cont.)

Wave Runup

Wave Runup, $\mathbf{R_s}$, is calculated using the following equation:

$$\frac{R_s}{H_s} = \frac{1}{0.4 + \left(\frac{H_s}{L_o}\right)^{1/2} \cot\theta}$$

where:

H_s =		1.40 ft
L_o =	$5.12(T_s)^2$ =	24.8 ft
cotθ =		1.5

Therefore:

R_s = 1.85 ft

Maximum Wave Runup, $\mathbf{R_{max}}$, is calculated using the following equation:

$$R_{max} = R_s \times 1.5$$

Therefore:

R_{max} = 2.78 ft

Wind Setup

Wind Setup, **S**, is calculated using the following equation:

$$S = \frac{2U^2F}{1400D}$$

where:

U =	52.8 mph
F =	0.42 mi
D (ave. water depth) =	50 ft

Therefore:

S = 0.03 ft

Required Freeboard

The required amount of freeboard is the sum of the maximum wave runup and the wind setup.

Required Freeboard = 2.81 ft

Wave Runup - 100 mph Wind

Design Wind

Fastest Mile Wind:
100 mph

Maximum 1-hr wind
45 mph (Fig. 6, McCartney)

Fetch (F) Length:
0.42 miles (see attached *Fetch Length Exhibit*)

Water-Land Velocity Ratio:
1.07 (Page 11, McCartney)

Note: 120-minute velocity is calculated by multiplying the 60-minute velocity by 0.95.

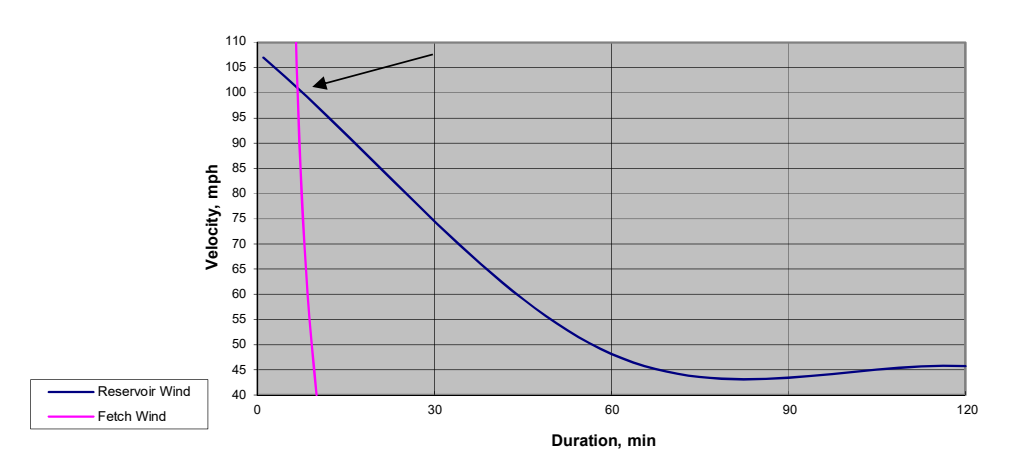
Reservoir Wind:

Duration	Velocity (Land)	Velocity (Water)
min	mph	mph
1	100	107.0
60	45	48.2
120	43	45.7

0.42-mi. Fetch Wind:

Duration	Velocity (Land)	Velocity (Water)
min	mph	mph
10	-	40
8.5	-	60
7.5	-	80
6.8	-	100
6.3	-	120

Note: Duration taken from Fig. 11, McCartney.



The Design Wind is taken from the intersection of the curves in the above chart:

U = 101 mph for 7.0 min.

Design Wave

Using a Design Wind of 101 mph for 7.0 minutes, the Design Wave is:

H_s = 3.10 ft (Fig. 11, McCartney)

Design Wave Significant Time Period

Using a Design Wind of 101 mph over a 0.42-mi. fetch, the Design Wave Significant Period is:

T_s = 2.9 sec (Fig. 12, McCartney)

Wave Runup - 100 mph Wind (cont.)

Wave Runup

Wave Runup, $\mathbf{R_s}$, is calculated using the following equation:

$$\frac{R_s}{H_s} = \frac{1}{0.4 + \left(\frac{H_s}{L_o}\right)^{1/2} \cot\theta}$$

where:

H_s =		3.10 ft
L_o =	$5.12(T_s)^2$ =	43.1 ft
cotθ =		1.5

Therefore:

R_s = 3.86 ft

Maximum Wave Runup, $\mathbf{R_{max}}$, is calculated using the following equation:

$$R_{max} = R_s \times 1.5$$

Therefore:

R_{max} = 5.79 ft

Wind Setup

Wind Setup, **S**, is calculated using the following equation:

$$S = \frac{2U^2F}{1400D}$$

where:

U =	101 mph
F =	0.42 mi
D (ave. water depth) =	50 ft

Therefore:

S = 0.12 ft

Required Freeboard

The required amount of freeboard is the sum of the maximum wave runup and the wind setup.

Required Freeboard = 5.92 ft

Wave Action

Wave Action

Fetch (F) Length:
0.42 miles (see attached *Fetch Length Exhibit*)

Maximum Land Wind Velocity:
81 mph (TR-56, Figure 4)

Water-Land Velocity Ratio:
1.07 (TR-56, Figure 5)

Overwater Wind Velocity
87 mph (TR-56, Equation 2)

Significant Wave Height
1.75 ft (TR-56, Equation 3)

Section 5. Emergency Drain

Emergency Drain Pipeline Design

OUTLET WORKS	
24" DI Pipe Inner Diameter (in)	24
Pipe Cross-Section Area (sf)	3.1
Pipe Circumference (ft)	6.3.
Pipe Length (ft)	375
Trash Loss Coefficient, K_t	1.23
Trash Rack Gross-Net Area Ratio	0.3
Trash Rack Area (sf)	100
Entrance Loss Coefficient, K_e	0.5
Friction Loss Coefficient, K_f	4.05
Manning's Coefficient	0.012

EMERGENCY DRAIN	
30" DI Pipe Inner Diameter (in)	30
Pipe Cross-Section Area (sf)	5.7
Pipe Circumference (ft)	8.5
Pipe Length (ft)	300
Bend Loss Coefficient, K_b	0.7
45° Bend Loss Coefficient	0.7
Friction Loss Coefficient, Kf	2.38
Manning's Coefficient	0.012
Discharge Loss Coefficient, Kd	1
Pipe Discharge Elevation (ft)	5450

Water Surface Elev (ft)	Water Storage (ac-ft)	Discharge Volume (ac-ft)	Cum. Discharge Vol. (ac-ft)	Height (ft)	Velocity (fps)	Discharge (cfs)	Discharge (ac-ft/day)	Discharge Time (days)	Cum. Discharge Time (days)
5546									
5545.5	6055		0	95.8	26.7	131.0	259.9		
5545	5916	139	139	95.3	26.7	130.7	259.2	0.536	0.5
5544	5777	139	278	94.5	26.6	130.2	258.2	0.538	1.1
5542	5419	179	636	92.5	26.3	128.8	255.5	0.701	2.5
5540	5074	173	981	90.5	26.0	127.4	252.7	0.685	3.8
5538	4742	166	1313	88.5	25.7	126.0	249.9	0.664	5.2
5536	4423	160	1632	86.5	25.4	124.5	247.0	0.648	6.4
5534	4116	154	1939	84.5	25.1	123.1	244.2	0.631	7.7
5532	3823	147	2232	82.5	24.8	121.6	241.3	0.609	8.9
5530	3542	141	2513	80.5	24.5	120.1	238.3	0.592	10.1
5528	3274	134	2781	78.5	24.2	118.6	235.3	0.569	11.2
5526	3018	128	3037	76.5	23.9	117.1	232.3	0.551	12.3
5524	2773	123	3282	74.5	23.6	115.6	229.3	0.537	13.4
5522	2542	116	3513	72.5	23.3	114.0	226.2	0.513	14.4
5520	2323	110	3732	70.5	22.9	112.4	223.0	0.493	15.4
5518	2117	103	3938	68.5	22.6	110.8	219.8	0.469	16.3
5516	1922	98	4133	66.5	22.3	109.2	216.6	0.452	17.2
5514	1737	93	4318	64.5	21.9	107.5	213.3	0.436	18.1
5512	1563	87	4492	62.5	21.6	105.9	210.0	0.414	18.9
5508	1248	76	4807	58.5	20.9	102.4	203.2	0.374	20.4
5506	1106	71	4949	56.5	20.5	100.7	199.7	0.356	21.1
5504	973	67	5082	54.5	20.2	98.9	196.1	0.342	21.8
5502	851	61	5204	52.5	19.8	97.0	192.5	0.317	22.4
5500	738	57	5317	50.5	19.4	95.2	188.8	0.302	23.0
5498	634	52	5421	48.5	19.0	93.3	185.0	0.281	23.6
5497	587	47	5468	47.5	18.8	92.3	183.1	0.257	23.9
5496	539	48	5516	46.5	18.6	91.3	181.1	0.265	24.1

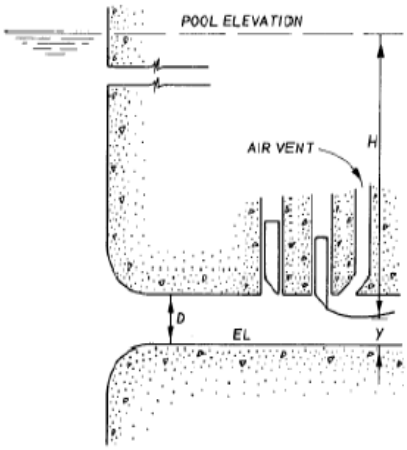
RESULTS	
Water Surface Elevation @ 24 Days	5497
Vol. Drained @ 24 Days (ac-ft)	5468
% Drained @ 24 Days	90%
Vol. Remaining @ 24 Days (ac-ft)	587
Average Flow Rate (cfs)	117

Air Vent Design

This program is to aid in the design of air vents for low level outlet works of medium size dams. The design assumption is that 80 percent gate opening the maximum air requirement will occur. Also, the maximum air velocity is not to exceed 150 fps. Although both parameters can be defined by the user. The method used below was developed by the U.S. Army Corps of Engineers in 1946.

User Defined Parameters

Gravity (ft/s)	32.2
Elev. Sluice Invert at Gate (ft)	5493.00
Design Pool Elevation (ft)	5517.00
Diameter (ft)	2.50
Discharge Coefficient	0.60
Gate Opening (%)	80%
Maximum Air Velocity (ft/s)	150.00



Slope of Outlet	0.007
Pipe Length (ft)	675
Cu	1.486
Manning's n	0.012

Calculated Parameters

Depth of Water at Vena Contracta (y) in (ft) = 1.200

y = Discharge Coefficient x Gate Opening x Diameter (D)

a (radians) =1.531 $\qquad a = a\cos\left(1 - \frac{Y}{R}\right)$

Area at Vena Contracta (ft^2) = 2.329 $\qquad A_{vc} = R^2 \cdot (\alpha - \cos\alpha \cdot \sin\alpha)$

Effective Head (H) in (ft) = 22.800

H = Design Pool Elev.- Elev. Sluice Invert at Gate – Depth of Water at Vena Contracta (y)

Water Discharge (Q_W) in (ft^3/s) = 89.260 $\qquad Q = A_{vc}\sqrt{2 \cdot g \cdot H}$

Water Velocity (V_W) in (ft/s) = 38.319 $\qquad V_w = \frac{Q_w}{A_{vc}}$

Froude Number at Vena Contracta = 6.164 $\qquad F_r = \frac{V_w}{\sqrt{g \cdot y}}$

$\beta = 0.171 \qquad \beta = 0.03(F_r - 1)^{1.06}$

Air Discharge (Q_a) in (ft^3/s) = 15.261 $\qquad Q_a = \beta \cdot Q_w$

Area of Air Vent Required (ft^2) = 0.102 $$A_v = \frac{Q_a}{Maximum_Air_Velocity}$$

Diameter for Circular Vent (ft) = 0.360 $$D_v = \sqrt{\frac{A_v \cdot 4}{\pi}}$$

Normal Depth (Y_n) in (ft) = Full Pipe

Vent Ring Design

Air Vent Diameter (in) = 6.0
Air Vent Area (in^2) = 28.27

Combined Req'd Area of Vent Ring Holes (in^2) = 56.55

Vent Ring Hole Diameter (in) = 1
Vent Ring Hole Area (in^2) = 0.79

Req'd Number of Vent Rings Holes = 36.0

Appendix C. Model Output

Storm Event 1. ***2-year, 24-hour [HEC-1]***

Storm Event 2. ***5-year, 24-hour [HEC-1]***

Storm Event 3. ***10-year, 24-hour [HEC-1]***

Storm Event 4. ***25-year, 24-hour [HEC-1]***

Storm Event 5. ***50-year, 24-hour [HEC-1]***

Storm Event 6. ***100-year, 24-hour [HEC-1]***

Storm Event 7. ***500-year, 24-hour [HEC-1]***

Storm Event 8. ***100-year, 6-hour AMC III [HEC-1]***

Storm Event 9. ***100-year, 24-hour AMC III [HEC-1]***

Storm Event 10. ***Local SEP Hydrograph [HEC-1]***

Storm Event 11. ***General SEP Hydrograph [HEC-1]***

Storm Event 12. ***Principal Spillway Hydrograph [HEC-1]***

Storm Event 13. ***Local Auxiliary Spillway Hydrograph [HEC-1]***

Storm Event 14. ***General Auxiliary Spillway Hydrograph [HEC-1]***

Storm Event 15. ***Local Freeboard Hydrograph [HEC-1]***

Storm Event 16. ***General Freeboard Hydrograph [HEC-1]***

Spillway Analysis [SITES]

Breach Analysis [HEC-RAS]

Storm Event 1. 2-year, 24-hour

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1****************************************                                  ****************************************
 *                                      *                                  *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                  *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                  *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1               *                                  *         609 SECOND STREET            *
 *                                      *                                  *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   06AUG20  TIME  02:50:18  *                                  *           (916) 756-1104             *
 *                                      *                                  *                                      *
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                                                X     X  X        X     X         XX
                                                X     X  X        X                X
                                                XXXXXXX  XXXX     X        XXXXX   X
                                                X     X  X        X                X
                                                X     X  X        X     X          X
                                                X     X  XXXXXXX   XXXXX          XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   2-YR, 24-HR, AMC II
           13           ID
                        *Diagram
           14           JR    PREC     1.0
           15           IT      72       0       0      50
           16           IO       0
           17           IN      72
                        *

           18           KK   B1
           19           KM   Runoff from Basin 1
           20           BA   0.503
           21           PB    1.61
           22           PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
           23           PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
           24           PC   1.000
           25           LS       0    72.8
           26           UD    0.51
                        *

           27           KK   RB1
           28           KM   Route B1
           29           RD    4928    .045    .050           TRAP      20      20
                        *

           30           KK   B2
           31           KM   Runoff from Basin 2
           32           BA   0.436
           33           LS       0    72.5
           34           UD    0.52
                        *

           35           KK   B3
           36           KM   Runoff from Basin 3
           37           BA   0.279
           38           LS       0    71.0
           39           UD    0.39
                        *
1                                                HEC-1 INPUT                                                PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
             40          KK   C1
             41          KM   Combine RB1, B2, B3
             42          HC       3
                         *

             43          KK   RC1
             44          KM   Route RC1
             45          RD    7255    .060    .030           TRAP      20      20
                         *

             46          KK   B4
             47          KM   Runoff from Basin 4
             48          BA   0.453
             49          LS       0    73.3
             50          UD    0.48
                         *

             51          KK   B5
             52          KM   Runoff from Basin 5
             53          BA   0.805
             54          LS       0    74.1
             55          UD    0.63
                         *

             56          KK   C2
             57          KM   Combine RC1, B4, B5
             58          HC       3
                         *

             59          KK   RC2
             60          KM   Route C2
             61          RD    2380    .039    .030           TRAP      40       2
                         *

             62          KK   B6
             63          KM   Runoff from Basin 6
             64          BA   0.150
             65          LS       0    84.3
             66          UD    0.19
                         *

             67          KK   B7
             68          KM   Runoff from Basin 7
             69          BA   0.327
             70          LS       0    75.7
             71          UD    0.46
                         *

             72          KK   C3
             73          KM   Combine RC2, B6, B7
             74          HC       3
                         *
1                                          HEC-1 INPUT                                          PAGE  3

            LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             75          KK   RC3
             76          KM   Route C3
             77          RD   11323    .023    .030           TRAP      40      20
                         *

             78          KK   B8
             79          KM   Runoff from Basin 8
             80          BA   1.012
             81          LS       0    84.0
             82          UD    0.67
                         *

             83          KK   B9
             84          KM   Runoff from Basin 9
             85          BA   0.242
             86          LS       0    85.5
             87          UD    0.26
                         *

             88          KK   B10
             89          KM   Runoff from Basin 10
             90          BA   0.129
             91          LS       0    86.7
             92          UD    0.18
                         *

             93          KK   C4
             94          KM   Combine B9, B10
             95          HC       2
                         *

             96          KK   RC4
             97          KM   Route C4
             98          RD    3380    .037    .030           TRAP      40      20
                         *
```

```
             99           KK   B11
            100           KM   Runoff from Basin 11
            101           BA   0.279
            102           LS       0    84.8
            103           UD    0.39
                          *

            104           KK   C5
            105           KM   Combine RC3, B8, RC4, B11
            106           HC       4
                          *

            107           KK   B12
            108           KM   Runoff from Basin 12
            109           BA   0.127
            110           LS       0    81.2
            111           UD    0.40
                          *
1                                              HEC-1 INPUT                                              PAGE  4

           LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

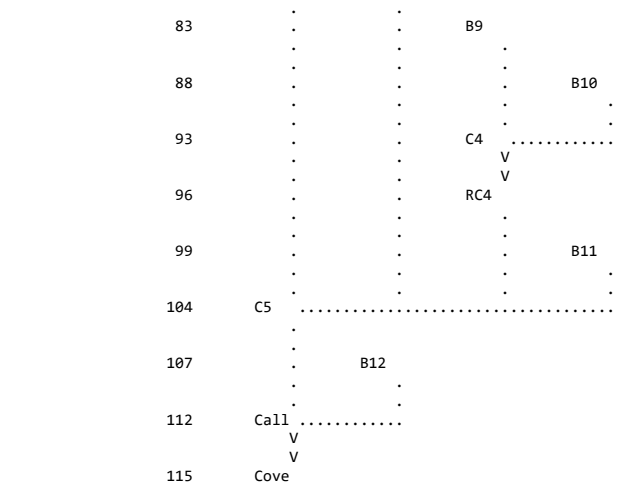

            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            115           KK   Cove Reservoir
            116           KM   Routing through Res'v
            117           RS       1    ELEV  5545.5
            118           SV       0      19      95     240     453     738    1105    1563    2217    2773
            119           SV    3542    4423    5419    6149    7347    8000
            120           SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
            121           SE    5530    5536    5542    5548    5552    5558
            122           SL  5545.5   4.909     0.6     0.5
            123           SS  5549.2      30    2.67     1.5
            124           ST  5552.0    1892     2.9     1.5
                          *
            125           ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK

 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

    NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     18       B1
                  V
                  V
     27       RB1
                  .
                  .
     30           .       B2
                  .           .
                  .           .
     35           .           .       B3
                  .           .           .
                  .           .           .
     40       C1   .......................
                  V
                  V
     43       RC1
                  .
                  .
     46           .       B4
                  .           .
                  .           .
     51           .           .       B5
                  .           .           .
                  .           .           .
     56       C2   .......................
                  V
                  V
     59       RC2
                  .
                  .
     62           .       B6
                  .           .
                  .           .
     67           .           .       B7
                  .           .           .
                  .           .           .
     72       C3   .......................
                  V
                  V
     75       RC3
                  .
                  .
     78           .       B8
                  .           .
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************                    *****************************************
 *                                       *                    *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *    U.S. ARMY CORPS OF ENGINEERS       *
 *              JUN   1998               *                    *    HYDROLOGIC ENGINEERING CENTER      *
 *            VERSION 4.1                *                    *          609 SECOND STREET            *
 *                                       *                    *       DAVIS, CALIFORNIA 95616         *
 *  RUN DATE   06AUG20  TIME  02:50:18   *                    *           (916) 756-1104              *
 *                                       *                    *                                       *
 *****************************************                    *****************************************
```

HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

2-YR, 24-HR, AMC II

```
  16 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           0  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN          72  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ          50  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      3    0  ENDING DATE
                     NDTIME        1048  ENDING TIME
                     ICENT           19  CENTURY MARK

                   COMPUTATION INTERVAL    1.20 HOURS
                        TOTAL TIME BASE   58.80 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                       NPLAN           1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                    1.00


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
```

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 112 KK    *     Call   *
           *            *
           **************
                        Combine C5, B12

 114 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

**********************************************************************************************************************************************

                                                HYDROGRAPH AT STATION    Call
                                                     SUM OF  2 HYDROGRAPHS
                                                    PLAN 1,   RATIO =  1.00

**********************************************************************************************************************************************
                                *                                *                                *                                *
   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW
                                *                                *                                *
    1     0000    1        0.   *    1     1536   14        56.   *    2     0712   27        0.   *    2     2248   40        0.
    1     0112    2        0.   *    1     1648   15        52.   *    2     0824   28        0.   *    3     0000   41        0.
    1     0224    3        0.   *    1     1800   16        50.   *    2     0936   29        0.   *    3     0112   42        0.
    1     0336    4        0.   *    1     1912   17        47.   *    2     1048   30        0.   *    3     0224   43        0.
    1     0448    5        0.   *    1     2024   18        45.   *    2     1200   31        0.   *    3     0336   44        0.
    1     0600    6        0.   *    1     2136   19        45.   *    2     1312   32        0.   *    3     0448   45        0.
    1     0712    7        0.   *    1     2248   20        46.   *    2     1424   33        0.   *    3     0600   46        0.
    1     0824    8        4.   *    2     0000   21        43.   *    2     1536   34        0.   *    3     0712   47        0.
    1     0936    9       59.   *    2     0112   22        25.   *    2     1648   35        0.   *    3     0824   48        0.
    1     1048   10       89.   *    2     0224   23        10.   *    2     1800   36        0.   *    3     0936   49        0.
    1     1200   11       78.   *    2     0336   24         5.   *    2     1912   37        0.   *    3     1048   50        0.
    1     1312   12       65.   *    2     0448   25         2.   *    2     2024   38        0.   *
    1     1424   13       60.   *    2     0600   26         1.   *    2     2136   39        0.   *
                                *                                *                                *
**********************************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR     58.80-HR
+   (CFS)       (HR)
                        (CFS)
+      89.     10.80                 70.          39.          16.          16.
                       (INCHES)      .137         .306         .306         .306
                        (AC-FT)       35.          77.          77.          77.

                        CUMULATIVE AREA =    4.74 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 115 KK    *     Cove   *     Reservoir
           *            *
           **************
                        Routing through Res'v

              HYDROGRAPH ROUTING DATA

 117 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC     5545.50  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

 118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                  3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

 120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                               5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

 122 SL          LOW-LEVEL OUTLET
                       ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                       CAREA        4.91  CROSS-SECTIONAL AREA
                        COQL         .60  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

 123 SS          SPILLWAY
                        CREL     5549.20  SPILLWAY CREST ELEVATION
                       SPWID       30.00  SPILLWAY WIDTH
                        COQW        2.67  WEIR COEFFICIENT
                        EXPW        1.50  EXPONENT OF HEAD

 124 ST          TOP OF DAM
```

TOPEL	5552.00	ELEVATION AT TOP OF DAM
DAMWID	1892.00	DAM WIDTH
COQD	2.90	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1	0000	1	1	0.	5844.8	5545.5	1	2024	18	15.	5892.4	5545.9	2	1648	35	14.	5886.3	5545.8		
1	0112	2	1	0.	5844.8	5545.5	1	2136	19	15.	5895.4	5545.9	2	1800	36	14.	5884.9	5545.8		
1	0224	3	1	0.	5844.8	5545.5	1	2248	20	16.	5898.4	5545.9	2	1912	37	13.	5883.6	5545.8		
1	0336	4	2	0.	5844.8	5545.5	2	0000	21	16.	5901.2	5546.0	2	2024	38	13.	5882.3	5545.8		
1	0448	5	2	0.	5844.8	5545.5	2	0112	22	16.	5902.9	5546.0	2	2136	39	13.	5881.0	5545.8		
1	0600	6	2	0.	5844.8	5545.5	2	0224	23	16.	5903.0	5546.0	2	2248	40	13.	5879.8	5545.8		
1	0712	7	2	0.	5844.8	5545.5	2	0336	24	16.	5902.1	5546.0	3	0000	41	12.	5878.5	5545.8		
1	0824	8	2	1.	5845.0	5545.5	2	0448	25	16.	5900.9	5546.0	3	0112	42	12.	5877.3	5545.8		
1	0936	9	2	4.	5847.9	5545.5	2	0600	26	16.	5899.4	5545.9	3	0224	43	12.	5876.1	5545.8		
1	1048	10	2	7.	5854.8	5545.6	2	0712	27	16.	5897.9	5545.9	3	0336	44	12.	5874.9	5545.7		
1	1200	11	2	9.	5862.2	5545.6	2	0824	28	15.	5896.4	5545.9	3	0448	45	12.	5873.8	5545.7		
1	1312	12	2	10.	5868.4	5545.7	2	0936	29	15.	5894.9	5545.9	3	0600	46	11.	5872.6	5545.7		
1	1424	13	2	11.	5873.5	5545.7	2	1048	30	15.	5893.4	5545.9	3	0712	47	11.	5871.5	5545.7		
1	1536	14	2	12.	5878.0	5545.8	2	1200	31	15.	5891.9	5545.9	3	0824	48	11.	5870.4	5545.7		
1	1648	15	2	13.	5882.1	5545.8	2	1312	32	14.	5890.5	5545.9	3	0936	49	11.	5869.4	5545.7		
1	1800	16	2	14.	5885.9	5545.8	2	1424	33	14.	5889.1	5545.9	3	1048	50	10.	5868.3	5545.7		
1	1912	17	2	14.	5889.3	5545.9	2	1536	34	14.	5887.7	5545.9								

PEAK OUTFLOW IS 16. AT TIME 26.40 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	58.80-HR
+ (CFS)	(HR)				
		(CFS)			
+ 16.	26.40	16.	15.	11.	11.
		(INCHES) .032	.119	.214	.214
		(AC-FT) 8.	30.	54.	54.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (AC-FT)	(HR)				
5903.	26.40	5902.	5895.	5878.	5878.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (FEET)	(HR)				
5545.98	26.40	5545.97	5545.91	5545.77	5545.77

CUMULATIVE AREA = 4.74 SQ MI

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1
					1.00
HYDROGRAPH AT					
+	B1	.50	1	FLOW	4.
				TIME	10.80
ROUTED TO					
+	RB1	.50	1	FLOW	4.
				TIME	12.00
HYDROGRAPH AT					
+	B2	.44	1	FLOW	3.
				TIME	10.80
HYDROGRAPH AT					
+	B3	.28	1	FLOW	2.
				TIME	22.80
3 COMBINED AT					
+	C1	1.22	1	FLOW	9.
				TIME	14.40
ROUTED TO					
+	RC1	1.22	1	FLOW	9.
				TIME	14.40
HYDROGRAPH AT					
+	B4	.45	1	FLOW	4.
				TIME	10.80
HYDROGRAPH AT					
+	B5	.81	1	FLOW	9.
				TIME	10.80
3 COMBINED AT					
+	C2	2.48	1	FLOW	19.
				TIME	14.40
ROUTED TO					
+	RC2	2.48	1	FLOW	19.
				TIME	14.40
HYDROGRAPH AT					
+	B6	.15	1	FLOW	7.
				TIME	10.80
HYDROGRAPH AT					
+	B7	.33	1	FLOW	5.
				TIME	10.80
3 COMBINED AT					
+	C3	2.95	1	FLOW	27.
				TIME	10.80
ROUTED TO					
+	RC3	2.95	1	FLOW	27.
				TIME	12.00
HYDROGRAPH AT					
+	B8	1.01	1	FLOW	43.
				TIME	10.80
HYDROGRAPH AT					
+	B9	.24	1	FLOW	12.
				TIME	10.80
HYDROGRAPH AT					
+	B10	.13	1	FLOW	7.
				TIME	10.80
2 COMBINED AT					
+	C4	.37	1	FLOW	19.
				TIME	10.80
ROUTED TO					
+	RC4	.37	1	FLOW	19.
				TIME	10.80
HYDROGRAPH AT					
+	B11	.28	1	FLOW	13.
				TIME	10.80
4 COMBINED AT					
+	C5	4.61	1	FLOW	85.
				TIME	10.80

```
 HYDROGRAPH AT
+                  B12          .13     1   FLOW           4.
                                            TIME        10.80

  2 COMBINED AT
+                  Call        4.74     1   FLOW          89.
                                            TIME        10.80

 ROUTED TO
+                  Cove        4.74     1   FLOW          16.
                                            TIME        26.40

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     5545.98
                                            TIME        26.40
1
                                            SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                                (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                    INTERPOLATED TO
                                                                                 COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

          FOR PLAN = 1  RATIO=  .00
             RB1    MANE         7.20      4.28    691.20       .16     72.00      3.95    720.00         .16


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .4342E+01 EXCESS= .0000E+00 OUTFLOW= .4342E+01 BASIN STORAGE= .3500E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
             RC1    MANE        14.40      8.59    763.20       .15     72.00      8.52    864.00         .15


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .9892E+01 EXCESS= .0000E+00 OUTFLOW= .9895E+01 BASIN STORAGE= .3327E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
             RC2    MANE        10.57     19.01    856.25       .17     72.00     19.01    864.00         .17


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2218E+02 EXCESS= .0000E+00 OUTFLOW= .2218E+02 BASIN STORAGE= .2800E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC3    MANE        10.80     27.32    702.00       .19     72.00     26.74    720.00         .19


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3011E+02 EXCESS= .0000E+00 OUTFLOW= .3013E+02 BASIN STORAGE= .8425E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
             RC4    MANE        10.80     18.94    658.80       .56     72.00     18.68    648.00         .57


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1115E+02 EXCESS= .0000E+00 OUTFLOW= .1115E+02 BASIN STORAGE= .2705E-02 PERCENT ERROR=    .0


1                              SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                             (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


       PLAN  1 .............                  INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                ELEVATION        5545.50           5549.20          5552.00
                                STORAGE             5845.             6508.            7347.
                                OUTFLOW                0.               45.              435.


                        RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                          OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                         PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                        1.00      5545.98         .00       5903.        16.       .00        26.40         .00


 *** NORMAL END OF HEC-1 ***
```

Storm Event 2. 5-year, 24-hour

```
1****************************************                                  ****************************************
 *                                      *                                  *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                  *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                  *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1               *                                  *         609 SECOND STREET            *
 *                                      *                                  *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   06AUG20  TIME  02:51:41  *                                  *           (916) 756-1104             *
 *                                      *                                  *                                      *
 ****************************************                                  ****************************************

                                                X     X  XXXXXXX   XXXXX           X
                                                X     X  X        X     X         XX
                                                X     X  X        X                X
                                                XXXXXXX  XXXX     X        XXXXX   X
                                                X     X  X        X                X
                                                X     X  X        X     X          X
                                                X     X  XXXXXXX   XXXXX          XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   5-YR, 24-HR, AMC II
           13           ID
                        *Diagram
           14           JR    PREC     1.0
           15           IT      72       0       0      50
           16           IO       0
           17           IN      72
                        *

           18           KK   B1
           19           KM   Runoff from Basin 1
           20           BA   0.503
           21           PB    2.01
           22           PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
           23           PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
           24           PC   1.000
           25           LS       0    72.8
           26           UD    0.51
                        *

           27           KK   RB1
           28           KM   Route B1
           29           RD    4928    .045    .050           TRAP      20      20
                        *

           30           KK   B2
           31           KM   Runoff from Basin 2
           32           BA   0.436
           33           LS       0    72.5
           34           UD    0.52
                        *

           35           KK   B3
           36           KM   Runoff from Basin 3
           37           BA   0.279
           38           LS       0    71.0
           39           UD    0.39
                        *
1                                                HEC-1 INPUT                                                PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
             40          KK   C1
             41          KM   Combine RB1, B2, B3
             42          HC       3
                         *

             43          KK   RC1
             44          KM   Route RC1
             45          RD    7255    .060    .030           TRAP      20      20
                         *

             46          KK   B4
             47          KM   Runoff from Basin 4
             48          BA   0.453
             49          LS       0    73.3
             50          UD    0.48
                         *

             51          KK   B5
             52          KM   Runoff from Basin 5
             53          BA   0.805
             54          LS       0    74.1
             55          UD    0.63
                         *

             56          KK   C2
             57          KM   Combine RC1, B4, B5
             58          HC       3
                         *

             59          KK   RC2
             60          KM   Route C2
             61          RD    2380    .039    .030           TRAP      40       2
                         *

             62          KK   B6
             63          KM   Runoff from Basin 6
             64          BA   0.150
             65          LS       0    84.3
             66          UD    0.19
                         *

             67          KK   B7
             68          KM   Runoff from Basin 7
             69          BA   0.327
             70          LS       0    75.7
             71          UD    0.46
                         *

             72          KK   C3
             73          KM   Combine RC2, B6, B7
             74          HC       3
                         *
1                                          HEC-1 INPUT                                          PAGE  3

            LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             75          KK   RC3
             76          KM   Route C3
             77          RD   11323    .023    .030           TRAP      40      20
                         *

             78          KK   B8
             79          KM   Runoff from Basin 8
             80          BA   1.012
             81          LS       0    84.0
             82          UD    0.67
                         *

             83          KK   B9
             84          KM   Runoff from Basin 9
             85          BA   0.242
             86          LS       0    85.5
             87          UD    0.26
                         *

             88          KK   B10
             89          KM   Runoff from Basin 10
             90          BA   0.129
             91          LS       0    86.7
             92          UD    0.18
                         *

             93          KK   C4
             94          KM   Combine B9, B10
             95          HC       2
                         *

             96          KK   RC4
             97          KM   Route C4
             98          RD    3380    .037    .030           TRAP      40      20
                         *
```

```
             99           KK   B11
            100           KM   Runoff from Basin 11
            101           BA   0.279
            102           LS       0    84.8
            103           UD    0.39
                          *

            104           KK   C5
            105           KM   Combine RC3, B8, RC4, B11
            106           HC       4
                          *

            107           KK   B12
            108           KM   Runoff from Basin 12
            109           BA   0.127
            110           LS       0    81.2
            111           UD    0.40
                          *
1                                              HEC-1 INPUT                                              PAGE  4

           LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

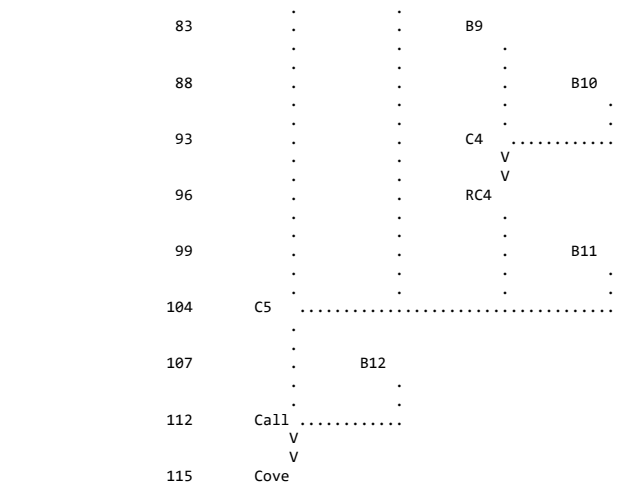

            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            115           KK   Cove Reservoir
            116           KM   Routing through Res'v
            117           RS       1    ELEV  5545.5
            118           SV       0      19      95     240     453     738    1105    1563    2217    2773
            119           SV    3542    4423    5419    6149    7347    8000
            120           SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
            121           SE    5530    5536    5542    5548    5552    5558
            122           SL  5545.5   4.909     0.6     0.5
            123           SS  5549.2      30    2.67     1.5
            124           ST  5552.0    1892     2.9     1.5
                          *
            125           ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK

 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

    NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     18       B1
                  V
                  V
     27       RB1
                  .
                  .
     30           .       B2
                  .           .
                  .           .
     35           .           .       B3
                  .           .           .
                  .           .           .
     40       C1   .......................
                  V
                  V
     43       RC1
                  .
                  .
     46           .       B4
                  .           .
                  .           .
     51           .           .       B5
                  .           .           .
                  .           .           .
     56       C2   .......................
                  V
                  V
     59       RC2
                  .
                  .
     62           .       B6
                  .           .
                  .           .
     67           .           .       B7
                  .           .           .
                  .           .           .
     72       C3   .......................
                  V
                  V
     75       RC3
                  .
                  .
     78           .       B8
                  .           .
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
 *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
 *              JUN   1998               *
 *            VERSION 4.1                *
 *                                       *
 *  RUN DATE   06AUG20  TIME  02:51:41   *
 *                                       *
 *****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

5-YR, 24-HR, AMC II

```
  16 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           0  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN          72  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ          50  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      3    0  ENDING DATE
                     NDTIME        1048  ENDING TIME
                     ICENT           19  CENTURY MARK

                   COMPUTATION INTERVAL    1.20 HOURS
                        TOTAL TIME BASE   58.80 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                       NPLAN           1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                    1.00
```

*** *** *** *

*** ***

```
           **************
           *            *
 112 KK    *     Call   *
           *            *
           **************
                        Combine C5, B12

 114 HC          HYDROGRAPH COMBINATION
                      ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***
```

****

HYDROGRAPH AT STATION Call
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = 1.00

****

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		1536	14	90.	2		0712	27	0.	2		2248	40	0.
1		0112	2	0.	1		1648	15	81.	2		0824	28	0.	3		0000	41	0.
1		0224	3	0.	1		1800	16	78.	2		0936	29	0.	3		0112	42	0.
1		0336	4	0.	1		1912	17	72.	2		1048	30	0.	3		0224	43	0.
1		0448	5	0.	1		2024	18	69.	2		1200	31	0.	3		0336	44	0.
1		0600	6	0.	1		2136	19	68.	2		1312	32	0.	3		0448	45	0.
1		0712	7	0.	1		2248	20	69.	2		1424	33	0.	3		0600	46	0.
1		0824	8	17.	2		0000	21	64.	2		1536	34	0.	3		0712	47	0.
1		0936	9	110.	2		0112	22	36.	2		1648	35	0.	3		0824	48	0.
1		1048	10	175.	2		0224	23	15.	2		1800	36	0.	3		0936	49	0.
1		1200	11	141.	2		0336	24	6.	2		1912	37	0.	3		1048	50	0.
1		1312	12	113.	2		0448	25	3.	2		2024	38	0.					
1		1424	13	99.	2		0600	26	1.	2		2136	39	0.					

****

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	58.80-HR
(CFS)	(HR)				
		(CFS)			
175.	10.80	125.	65.	27.	27.
		(INCHES) .246	.512	.512	.512
		(AC-FT) 62.	130.	130.	130.

CUMULATIVE AREA = 4.74 SQ MI

*** ***

```
           **************
           *            *
 115 KK    *     Cove   *     Reservoir
           *            *
           **************
                        Routing through Res'v

              HYDROGRAPH ROUTING DATA

 117 RS          STORAGE ROUTING
                      NSTPS           1  NUMBER OF SUBREACHES
                       ITYP        ELEV  TYPE OF INITIAL CONDITION
                     RSVRIC     5545.50  INITIAL CONDITION
                          X         .00 WORKING R AND D COEFFICIENT

 118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                 3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

 120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                               5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

 122 SL          LOW-LEVEL OUTLET
                      ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                      CAREA        4.91  CROSS-SECTIONAL AREA
                       COQL         .60  COEFFICIENT
                       EXPL         .50  EXPONENT OF HEAD

 123 SS          SPILLWAY
                       CREL     5549.20  SPILLWAY CREST ELEVATION
                      SPWID       30.00  SPILLWAY WIDTH
                       COQW        2.67  WEIR COEFFICIENT
                       EXPW        1.50  EXPONENT OF HEAD

 124 ST          TOP OF DAM
```

TOPEL	5552.00	ELEVATION AT TOP OF DAM
DAMWID	1892.00	DAM WIDTH
COQD	2.90	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1	0000		1	0.	5844.8	5545.5	1	2024		18	20.	5931.0	5546.2	2	1648		35	19.	5925.4	5546.2
1	0112		2	0.	5844.8	5545.5	1	2136		19	20.	5935.8	5546.2	2	1800		36	19.	5923.5	5546.1
1	0224		3	0.	5844.8	5545.5	1	2248		20	21.	5940.6	5546.3	2	1912		37	19.	5921.6	5546.1
1	0336		4	0.	5844.8	5545.5	2	0000		21	21.	5945.1	5546.3	2	2024		38	19.	5919.8	5546.1
1	0448		5	0.	5844.8	5545.5	2	0112		22	22.	5947.9	5546.3	2	2136		39	18.	5918.0	5546.1
1	0600		6	0.	5844.8	5545.5	2	0224		23	22.	5948.3	5546.4	2	2248		40	18.	5916.2	5546.1
1	0712		7	0.	5844.8	5545.5	2	0336		24	22.	5947.1	5546.3	3	0000		41	18.	5914.4	5546.1
1	0824		8	2.	5845.6	5545.5	2	0448		25	21.	5945.4	5546.3	3	0112		42	18.	5912.6	5546.1
1	0936		9	6.	5851.5	5545.6	2	0600		26	21.	5943.4	5546.3	3	0224		43	17.	5910.9	5546.0
1	1048		10	10.	5864.9	5545.7	2	0712		27	21.	5941.4	5546.3	3	0336		44	17.	5909.2	5546.0
1	1200		11	13.	5879.5	5545.8	2	0824		28	21.	5939.4	5546.3	3	0448		45	17.	5907.4	5546.0
1	1312		12	15.	5890.8	5545.9	2	0936		29	21.	5937.3	5546.3	3	0600		46	17.	5905.8	5546.0
1	1424		13	16.	5899.8	5546.0	2	1048		30	20.	5935.3	5546.2	3	0712		47	16.	5904.1	5546.0
1	1536		14	17.	5907.5	5546.0	2	1200		31	20.	5933.2	5546.2	3	0824		48	16.	5902.5	5546.0
1	1648		15	18.	5914.3	5546.1	2	1312		32	20.	5931.3	5546.2	3	0936		49	16.	5900.9	5546.0
1	1800		16	19.	5920.4	5546.1	2	1424		33	20.	5929.3	5546.2	3	1048		50	16.	5899.3	5545.9
1	1912		17	19.	5926.0	5546.2	2	1536		34	19.	5927.4	5546.2							

PEAK OUTFLOW IS 22. AT TIME 26.40 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	58.80-HR
+ (CFS)	(HR)				
		(CFS)			
+ 22.	26.40	22.	20.	15.	15.
		(INCHES) .042	.161	.297	.297
		(AC-FT) 11.	41.	75.	75.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (AC-FT)	(HR)				
5948.	26.40	5947.	5937.	5908.	5908.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (FEET)	(HR)				
5546.35	26.40	5546.33	5546.25	5546.02	5546.02

CUMULATIVE AREA = 4.74 SQ MI

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1
					1.00
HYDROGRAPH AT					
+	B1	.50	1	FLOW	11.
				TIME	10.80
ROUTED TO					
+	RB1	.50	1	FLOW	10.
				TIME	12.00
HYDROGRAPH AT					
+	B2	.44	1	FLOW	10.
				TIME	10.80
HYDROGRAPH AT					
+	B3	.28	1	FLOW	5.
				TIME	10.80
3 COMBINED AT					
+	C1	1.22	1	FLOW	23.
				TIME	10.80
ROUTED TO					
+	RC1	1.22	1	FLOW	21.
				TIME	12.00
HYDROGRAPH AT					
+	B4	.45	1	FLOW	11.
				TIME	10.80
HYDROGRAPH AT					
+	B5	.81	1	FLOW	21.
				TIME	10.80
3 COMBINED AT					
+	C2	2.48	1	FLOW	50.
				TIME	10.80
ROUTED TO					
+	RC2	2.48	1	FLOW	48.
				TIME	10.80
HYDROGRAPH AT					
+	B6	.15	1	FLOW	11.
				TIME	10.80
HYDROGRAPH AT					
+	B7	.33	1	FLOW	11.
				TIME	10.80
3 COMBINED AT					
+	C3	2.95	1	FLOW	69.
				TIME	10.80
ROUTED TO					
+	RC3	2.95	1	FLOW	63.
				TIME	12.00
HYDROGRAPH AT					
+	B8	1.01	1	FLOW	70.
				TIME	10.80
HYDROGRAPH AT					
+	B9	.24	1	FLOW	19.
				TIME	10.80
HYDROGRAPH AT					
+	B10	.13	1	FLOW	11.
				TIME	10.80
2 COMBINED AT					
+	C4	.37	1	FLOW	30.
				TIME	10.80
ROUTED TO					
+	RC4	.37	1	FLOW	29.
				TIME	10.80
HYDROGRAPH AT					
+	B11	.28	1	FLOW	21.
				TIME	10.80
4 COMBINED AT					
+	C5	4.61	1	FLOW	168.
				TIME	10.80

```
 HYDROGRAPH AT
+                  B12          .13     1   FLOW           7.
                                            TIME        10.80

  2 COMBINED AT
+                  Call        4.74     1   FLOW         175.
                                            TIME        10.80

 ROUTED TO
+                  Cove        4.74     1   FLOW          22.
                                            TIME        26.40

                                        ** PEAK STAGES IN FEET **
                                        1   STAGE     5546.35
                                            TIME        26.40
1
                                            SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                                (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                    INTERPOLATED TO
                                                                                 COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

           FOR PLAN = 1  RATIO=  .00
              RB1    MANE         7.20     11.31    676.80       .32     72.00      9.54    720.00         .32


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .8557E+01 EXCESS= .0000E+00 OUTFLOW= .8560E+01 BASIN STORAGE= .3508E-02 PERCENT ERROR=   -.1


           FOR PLAN = 1  RATIO=  .00
              RC1    MANE         7.20     23.21    676.80       .30     72.00     21.22    720.00         .31


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1977E+02 EXCESS= .0000E+00 OUTFLOW= .1977E+02 BASIN STORAGE= .3640E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC2    MANE         7.20     50.33    655.20       .33     72.00     47.70    648.00         .33


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .4326E+02 EXCESS= .0000E+00 OUTFLOW= .4326E+02 BASIN STORAGE= .2914E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC3    MANE        10.80     69.04    691.20       .36     72.00     63.27    720.00         .36


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5668E+02 EXCESS= .0000E+00 OUTFLOW= .5670E+02 BASIN STORAGE= .9084E-02 PERCENT ERROR=   -.1


           FOR PLAN = 1  RATIO=  .00
              RC4    MANE        14.08     29.35    633.76       .85     72.00     29.23    648.00         .86


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1687E+02 EXCESS= .0000E+00 OUTFLOW= .1688E+02 BASIN STORAGE= .2335E-02 PERCENT ERROR=    .0


1                               SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                              (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


      PLAN  1 .............                    INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                 ELEVATION        5545.50           5549.20          5552.00
                                 STORAGE             5845.             6508.            7347.
                                 OUTFLOW                0.               45.              435.


                       RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                         OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                        PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                       1.00      5546.35         .00       5948.        22.       .00        26.40         .00


 *** NORMAL END OF HEC-1 ***
```

Storm Event 3. 10-year, 24-hour

```
1****************************************                                  ****************************************
 *                                      *                                  *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                  *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                  *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1               *                                  *         609 SECOND STREET            *
 *                                      *                                  *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   06AUG20  TIME  02:52:08  *                                  *           (916) 756-1104             *
 *                                      *                                  *                                      *
 ****************************************                                  ****************************************

                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X        X     X        XX
                                                X     X  X        X              X
                                                XXXXXXX  XXXX     X        XXXXX  X
                                                X     X  X        X              X
                                                X     X  X        X     X        X
                                                X     X  XXXXXXX   XXXXX         XXX


            THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

            THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
            THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
            NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
            DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
            KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                HEC-1 INPUT                                                PAGE  1

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

              1          ID   HYDROLOGY STUDY for COVE RESERVOIR
              2          ID   Located in KANE COUNTY, UTAH
              3          ID
              4          ID   AUG 2020
              5          ID
              6          ID   PREPARED BY ALPHA ENGINEERING
              7          ID   43 SOUTH 100 EAST, SUITE 100
              8          ID   ST. GEORGE, UTAH  84770
              9          ID   TEL: (435) 628-6500
             10          ID   FAX: (435) 628-6553
             11          ID
             12          ID   10-YR, 24-HR, AMC II
             13          ID
                         *Diagram
             14          JR    PREC     1.0
             15          IT      72       0       0      50
             16          IO       0
             17          IN      72
                         *

             18          KK   B1
             19          KM   Runoff from Basin 1
             20          BA   0.503
             21          PB    2.34
             22          PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
             23          PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
             24          PC   1.000
             25          LS       0    72.8
             26          UD    0.51
                         *

             27          KK   RB1
             28          KM   Route B1
             29          RD    4928    .045    .050           TRAP      20      20
                         *

             30          KK   B2
             31          KM   Runoff from Basin 2
             32          BA   0.436
             33          LS       0    72.5
             34          UD    0.52
                         *

             35          KK   B3
             36          KM   Runoff from Basin 3
             37          BA   0.279
             38          LS       0    71.0
             39          UD    0.39
                         *
1                                                HEC-1 INPUT                                                PAGE  2

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
             40          KK   C1
             41          KM   Combine RB1, B2, B3
             42          HC       3
                         *

             43          KK   RC1
             44          KM   Route RC1
             45          RD    7255    .060    .030           TRAP      20      20
                         *

             46          KK   B4
             47          KM   Runoff from Basin 4
             48          BA   0.453
             49          LS       0    73.3
             50          UD    0.48
                         *

             51          KK   B5
             52          KM   Runoff from Basin 5
             53          BA   0.805
             54          LS       0    74.1
             55          UD    0.63
                         *

             56          KK   C2
             57          KM   Combine RC1, B4, B5
             58          HC       3
                         *

             59          KK   RC2
             60          KM   Route C2
             61          RD    2380    .039    .030           TRAP      40       2
                         *

             62          KK   B6
             63          KM   Runoff from Basin 6
             64          BA   0.150
             65          LS       0    84.3
             66          UD    0.19
                         *

             67          KK   B7
             68          KM   Runoff from Basin 7
             69          BA   0.327
             70          LS       0    75.7
             71          UD    0.46
                         *

             72          KK   C3
             73          KM   Combine RC2, B6, B7
             74          HC       3
                         *
1                                          HEC-1 INPUT                                          PAGE  3

            LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             75          KK   RC3
             76          KM   Route C3
             77          RD   11323    .023    .030           TRAP      40      20
                         *

             78          KK   B8
             79          KM   Runoff from Basin 8
             80          BA   1.012
             81          LS       0    84.0
             82          UD    0.67
                         *

             83          KK   B9
             84          KM   Runoff from Basin 9
             85          BA   0.242
             86          LS       0    85.5
             87          UD    0.26
                         *

             88          KK   B10
             89          KM   Runoff from Basin 10
             90          BA   0.129
             91          LS       0    86.7
             92          UD    0.18
                         *

             93          KK   C4
             94          KM   Combine B9, B10
             95          HC       2
                         *

             96          KK   RC4
             97          KM   Route C4
             98          RD    3380    .037    .030           TRAP      40      20
                         *
```

```
             99           KK   B11
            100           KM   Runoff from Basin 11
            101           BA   0.279
            102           LS       0    84.8
            103           UD    0.39
                          *

            104           KK   C5
            105           KM   Combine RC3, B8, RC4, B11
            106           HC       4
                          *

            107           KK   B12
            108           KM   Runoff from Basin 12
            109           BA   0.127
            110           LS       0    81.2
            111           UD    0.40
                          *
1                                              HEC-1 INPUT                                              PAGE  4

           LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

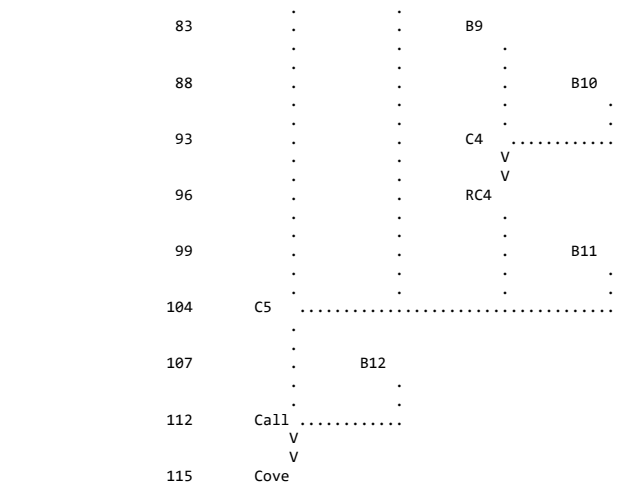

            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            115           KK   Cove Reservoir
            116           KM   Routing through Res'v
            117           RS       1    ELEV  5545.5
            118           SV       0      19      95     240     453     738    1105    1563    2217    2773
            119           SV    3542    4423    5419    6149    7347    8000
            120           SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
            121           SE    5530    5536    5542    5548    5552    5558
            122           SL  5545.5   4.909     0.6     0.5
            123           SS  5549.2      30    2.67     1.5
            124           ST  5552.0    1892     2.9     1.5
                          *
            125           ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK

 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

    NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     18       B1
                  V
                  V
     27       RB1
                  .
                  .
     30           .       B2
                  .           .
                  .           .
     35           .           .       B3
                  .           .           .
                  .           .           .
     40       C1   .......................
                  V
                  V
     43       RC1
                  .
                  .
     46           .       B4
                  .           .
                  .           .
     51           .           .       B5
                  .           .           .
                  .           .           .
     56       C2   .......................
                  V
                  V
     59       RC2
                  .
                  .
     62           .       B6
                  .           .
                  .           .
     67           .           .       B7
                  .           .           .
                  .           .           .
     72       C3   .......................
                  V
                  V
     75       RC3
                  .
                  .
     78           .       B8
                  .           .
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************                    *****************************************
 *                                       *                    *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *    U.S. ARMY CORPS OF ENGINEERS       *
 *              JUN   1998               *                    *    HYDROLOGIC ENGINEERING CENTER      *
 *            VERSION 4.1                *                    *          609 SECOND STREET            *
 *                                       *                    *       DAVIS, CALIFORNIA 95616         *
 *  RUN DATE   06AUG20  TIME  02:52:08   *                    *           (916) 756-1104              *
 *                                       *                    *                                       *
 *****************************************                    *****************************************
```

HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

10-YR, 24-HR, AMC II

```
  16 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           0  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN          72  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ          50  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      3    0  ENDING DATE
                     NDTIME        1048  ENDING TIME
                     ICENT           19  CENTURY MARK

                   COMPUTATION INTERVAL    1.20 HOURS
                        TOTAL TIME BASE   58.80 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                      NPLAN           1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                    1.00


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
```

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 112 KK    *     Call   *
           *            *
           **************
                        Combine C5, B12

 114 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

*****************************************************************************************************************************************

                                                HYDROGRAPH AT STATION    Call
                                                     SUM OF  2 HYDROGRAPHS
                                                    PLAN 1,   RATIO =  1.00

*****************************************************************************************************************************************
                                *                                *                                *
   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW
                                *                                *                                *
     1     0000    1        0.   *    1     1536   14       120.   *    2     0712   27        0.   *    2     2248   40        0.
     1     0112    2        0.   *    1     1648   15       107.   *    2     0824   28        0.   *    3     0000   41        0.
     1     0224    3        0.   *    1     1800   16       102.   *    2     0936   29        0.   *    3     0112   42        0.
     1     0336    4        0.   *    1     1912   17        94.   *    2     1048   30        0.   *    3     0224   43        0.
     1     0448    5        0.   *    1     2024   18        89.   *    2     1200   31        0.   *    3     0336   44        0.
     1     0600    6        0.   *    1     2136   19        89.   *    2     1312   32        0.   *    3     0448   45        0.
     1     0712    7        1.   *    1     2248   20        89.   *    2     1424   33        0.   *    3     0600   46        0.
     1     0824    8       32.   *    2     0000   21        82.   *    2     1536   34        0.   *    3     0712   47        0.
     1     0936    9      165.   *    2     0112   22        46.   *    2     1648   35        0.   *    3     0824   48        0.
     1     1048   10      261.   *    2     0224   23        18.   *    2     1800   36        0.   *    3     0936   49        0.
     1     1200   11      201.   *    2     0336   24         7.   *    2     1912   37        0.   *    3     1048   50        0.
     1     1312   12      155.   *    2     0448   25         2.   *    2     2024   38        0.   *
     1     1424   13      133.   *    2     0600   26         1.   *    2     2136   39        0.   *
                                *                                *                                *
*****************************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR     58.80-HR
+   (CFS)       (HR)
                        (CFS)
+     261.     10.80                  179.          90.          37.          37.
                          (INCHES)      .350         .704         .705         .705
                           (AC-FT)       89.         178.         178.         178.

                         CUMULATIVE AREA =    4.74 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 115 KK    *     Cove   *     Reservoir
           *            *
           **************
                        Routing through Res'v

              HYDROGRAPH ROUTING DATA

 117 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC     5545.50  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

 118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                  3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

 120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                               5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

 122 SL          LOW-LEVEL OUTLET
                       ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                       CAREA        4.91  CROSS-SECTIONAL AREA
                        COQL         .60  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

 123 SS          SPILLWAY
                        CREL     5549.20  SPILLWAY CREST ELEVATION
                       SPWID       30.00  SPILLWAY WIDTH
                        COQW        2.67  WEIR COEFFICIENT
                        EXPW        1.50  EXPONENT OF HEAD

 124 ST          TOP OF DAM
```

TOPEL	5552.00	ELEVATION AT TOP OF DAM
DAMWID	1892.00	DAM WIDTH
COQD	2.90	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1	0000		1	0.	5844.8	5545.5	1		2024	18	24.	5968.3	5546.5	2		1648	35	23.	5964.1	5546.5
1	0112		2	0.	5844.8	5545.5	1		2136	19	24.	5974.8	5546.6	2		1800	36	23.	5961.7	5546.5
1	0224		3	0.	5844.8	5545.5	1		2248	20	25.	5981.1	5546.6	2		1912	37	23.	5959.5	5546.4
1	0336		4	0.	5844.8	5545.5	2		0000	21	26.	5987.1	5546.7	2		2024	38	23.	5957.2	5546.4
1	0448		5	0.	5844.8	5545.5	2		0112	22	26.	5990.9	5546.7	2		2136	39	22.	5955.0	5546.4
1	0600		6	0.	5844.8	5545.5	2		0224	23	26.	5991.5	5546.7	2		2248	40	22.	5952.8	5546.4
1	0712		7	1.	5844.9	5545.5	2		0336	24	26.	5990.2	5546.7	3		0000	41	22.	5950.6	5546.4
1	0824		8	3.	5846.4	5545.5	2		0448	25	26.	5988.1	5546.7	3		0112	42	22.	5948.4	5546.4
1	0936		9	7.	5855.7	5545.6	2		0600	26	25.	5985.7	5546.7	3		0224	43	22.	5946.2	5546.3
1	1048		10	12.	5876.0	5545.8	2		0712	27	25.	5983.3	5546.6	3		0336	44	21.	5944.1	5546.3
1	1200		11	16.	5897.5	5545.9	2		0824	28	25.	5980.8	5546.6	3		0448	45	21.	5942.0	5546.3
1	1312		12	18.	5913.6	5546.1	2		0936	29	25.	5978.4	5546.6	3		0600	46	21.	5939.9	5546.3
1	1424		13	19.	5926.0	5546.2	2		1048	30	25.	5975.9	5546.6	3		0712	47	21.	5937.9	5546.3
1	1536		14	21.	5936.6	5546.3	2		1200	31	24.	5973.5	5546.6	3		0824	48	20.	5935.8	5546.2
1	1648		15	22.	5945.8	5546.3	2		1312	32	24.	5971.1	5546.5	3		0936	49	20.	5933.8	5546.2
1	1800		16	22.	5954.1	5546.4	2		1424	33	24.	5968.8	5546.5	3		1048	50	20.	5931.8	5546.2
1	1912		17	23.	5961.6	5546.5	2		1536	34	24.	5966.4	5546.5							

PEAK OUTFLOW IS 26. AT TIME 26.40 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	58.80-HR
+ (CFS)	(HR)				
		(CFS)			
+ 26.	26.40	26.	25.	19.	19.
		(INCHES) .050	.193	.362	.362
		(AC-FT) 13.	49.	91.	91.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (AC-FT)	(HR)				
5992.	26.40	5989.	5977.	5938.	5938.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (FEET)	(HR)				
5546.71	26.40	5546.69	5546.59	5546.27	5546.27

CUMULATIVE AREA = 4.74 SQ MI

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1
					1.00
HYDROGRAPH AT					
+	B1	.50	1	FLOW	19.
				TIME	10.80
ROUTED TO					
+	RB1	.50	1	FLOW	16.
				TIME	10.80
HYDROGRAPH AT					
+	B2	.44	1	FLOW	16.
				TIME	10.80
HYDROGRAPH AT					
+	B3	.28	1	FLOW	9.
				TIME	10.80
3 COMBINED AT					
+	C1	1.22	1	FLOW	41.
				TIME	10.80
ROUTED TO					
+	RC1	1.22	1	FLOW	35.
				TIME	10.80
HYDROGRAPH AT					
+	B4	.45	1	FLOW	18.
				TIME	10.80
HYDROGRAPH AT					
+	B5	.81	1	FLOW	34.
				TIME	10.80
3 COMBINED AT					
+	C2	2.48	1	FLOW	88.
				TIME	10.80
ROUTED TO					
+	RC2	2.48	1	FLOW	84.
				TIME	10.80
HYDROGRAPH AT					
+	B6	.15	1	FLOW	14.
				TIME	10.80
HYDROGRAPH AT					
+	B7	.33	1	FLOW	16.
				TIME	10.80
3 COMBINED AT					
+	C3	2.95	1	FLOW	115.
				TIME	10.80
ROUTED TO					
+	RC3	2.95	1	FLOW	99.
				TIME	12.00
HYDROGRAPH AT					
+	B8	1.01	1	FLOW	94.
				TIME	10.80
HYDROGRAPH AT					
+	B9	.24	1	FLOW	25.
				TIME	10.80
HYDROGRAPH AT					
+	B10	.13	1	FLOW	14.
				TIME	9.60
2 COMBINED AT					
+	C4	.37	1	FLOW	39.
				TIME	10.80
ROUTED TO					
+	RC4	.37	1	FLOW	39.
				TIME	10.80
HYDROGRAPH AT					
+	B11	.28	1	FLOW	27.
				TIME	10.80
4 COMBINED AT					
+	C5	4.61	1	FLOW	251.
				TIME	10.80

```
 HYDROGRAPH AT
+                  B12          .13     1   FLOW          10.
                                            TIME        10.80

  2 COMBINED AT
+                  Call        4.74     1   FLOW         261.
                                            TIME        10.80

 ROUTED TO
+                  Cove        4.74     1   FLOW          26.
                                            TIME        26.40

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     5546.71
                                            TIME        26.40
1
                                            SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                                (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                    INTERPOLATED TO
                                                                                 COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

          FOR PLAN = 1  RATIO=  .00
             RB1    MANE         7.20     18.90    676.80       .48     72.00     16.14    648.00         .48


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1277E+02 EXCESS= .0000E+00 OUTFLOW= .1278E+02 BASIN STORAGE= .3345E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
             RC1    MANE         7.20     40.76    669.60       .46     72.00     35.00    648.00         .46


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2976E+02 EXCESS= .0000E+00 OUTFLOW= .2977E+02 BASIN STORAGE= .3635E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC2    MANE         6.10     86.70    652.57       .49     72.00     84.43    648.00         .49


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .6439E+02 EXCESS= .0000E+00 OUTFLOW= .6439E+02 BASIN STORAGE= .3086E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC3    MANE        14.40    113.78    691.20       .53     72.00     99.11    720.00         .52


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .8293E+02 EXCESS= .0000E+00 OUTFLOW= .8298E+02 BASIN STORAGE= .8804E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
             RC4    MANE        13.06     39.45    600.61      1.11     72.00     38.67    648.00        1.11


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2195E+02 EXCESS= .0000E+00 OUTFLOW= .2195E+02 BASIN STORAGE= .2242E-02 PERCENT ERROR=    .0


1                              SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                             (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


       PLAN  1 .............                  INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                ELEVATION         5545.50           5549.20          5552.00
                                STORAGE             5845.             6508.            7347.
                                OUTFLOW                0.               45.              435.


                        RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                          OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                         PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                        1.00      5546.71         .00       5992.        26.       .00        26.40         .00


 *** NORMAL END OF HEC-1 ***
```

Storm Event 4. 25-year, 24-hour

```
1****************************************                                  ************************************
 *                                      *                                  *                                  *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                  *    U.S. ARMY CORPS OF ENGINEERS  *
 *              JUN   1998              *                                  *    HYDROLOGIC ENGINEERING CENTER *
 *            VERSION 4.1               *                                  *         609 SECOND STREET        *
 *                                      *                                  *       DAVIS, CALIFORNIA 95616    *
 *  RUN DATE   06AUG20  TIME  02:52:36  *                                  *           (916) 756-1104         *
 *                                      *                                  *                                  *
 ****************************************                                  ************************************

                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X        X     X        XX
                                                X     X  X        X              X
                                                XXXXXXX  XXXX     X        XXXXX  X
                                                X     X  X        X              X
                                                X     X  X        X     X        X
                                                X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


```
          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   25-YR, 24-HR, AMC II
           13           ID
                        *Diagram
           14           JR    PREC     1.0
           15           IT      72       0       0      50
           16           IO       0
           17           IN      72
                        *

           18           KK   B1
           19           KM   Runoff from Basin 1
           20           BA   0.503
           21           PB    2.79
           22           PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
           23           PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
           24           PC   1.000
           25           LS       0    72.8
           26           UD    0.51
                        *

           27           KK   RB1
           28           KM   Route B1
           29           RD    4928    .045    .050           TRAP      20      20
                        *

           30           KK   B2
           31           KM   Runoff from Basin 2
           32           BA   0.436
           33           LS       0    72.5
           34           UD    0.52
                        *

           35           KK   B3
           36           KM   Runoff from Basin 3
           37           BA   0.279
           38           LS       0    71.0
           39           UD    0.39
                        *
```



```
          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
             40          KK   C1
             41          KM   Combine RB1, B2, B3
             42          HC       3
                         *

             43          KK   RC1
             44          KM   Route RC1
             45          RD    7255    .060    .030           TRAP      20      20
                         *

             46          KK   B4
             47          KM   Runoff from Basin 4
             48          BA   0.453
             49          LS       0    73.3
             50          UD    0.48
                         *

             51          KK   B5
             52          KM   Runoff from Basin 5
             53          BA   0.805
             54          LS       0    74.1
             55          UD    0.63
                         *

             56          KK   C2
             57          KM   Combine RC1, B4, B5
             58          HC       3
                         *

             59          KK   RC2
             60          KM   Route C2
             61          RD    2380    .039    .030           TRAP      40       2
                         *

             62          KK   B6
             63          KM   Runoff from Basin 6
             64          BA   0.150
             65          LS       0    84.3
             66          UD    0.19
                         *

             67          KK   B7
             68          KM   Runoff from Basin 7
             69          BA   0.327
             70          LS       0    75.7
             71          UD    0.46
                         *

             72          KK   C3
             73          KM   Combine RC2, B6, B7
             74          HC       3
                         *
1                                          HEC-1 INPUT                                          PAGE  3

            LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             75          KK   RC3
             76          KM   Route C3
             77          RD   11323    .023    .030           TRAP      40      20
                         *

             78          KK   B8
             79          KM   Runoff from Basin 8
             80          BA   1.012
             81          LS       0    84.0
             82          UD    0.67
                         *

             83          KK   B9
             84          KM   Runoff from Basin 9
             85          BA   0.242
             86          LS       0    85.5
             87          UD    0.26
                         *

             88          KK   B10
             89          KM   Runoff from Basin 10
             90          BA   0.129
             91          LS       0    86.7
             92          UD    0.18
                         *

             93          KK   C4
             94          KM   Combine B9, B10
             95          HC       2
                         *

             96          KK   RC4
             97          KM   Route C4
             98          RD    3380    .037    .030           TRAP      40      20
                         *
```

```
             99           KK   B11
            100           KM   Runoff from Basin 11
            101           BA   0.279
            102           LS       0    84.8
            103           UD    0.39
                          *

            104           KK   C5
            105           KM   Combine RC3, B8, RC4, B11
            106           HC       4
                          *

            107           KK   B12
            108           KM   Runoff from Basin 12
            109           BA   0.127
            110           LS       0    81.2
            111           UD    0.40
                          *
1                                              HEC-1 INPUT                                              PAGE  4

           LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

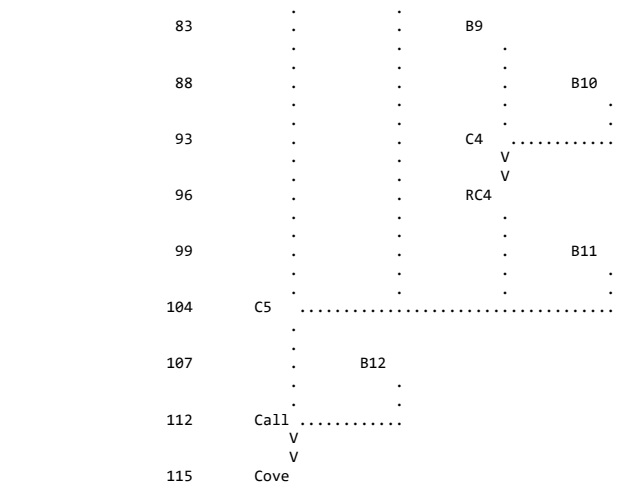

            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            115           KK   Cove Reservoir
            116           KM   Routing through Res'v
            117           RS       1    ELEV  5545.5
            118           SV       0      19      95     240     453     738    1105    1563    2217    2773
            119           SV    3542    4423    5419    6149    7347    8000
            120           SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
            121           SE    5530    5536    5542    5548    5552    5558
            122           SL  5545.5   4.909     0.6     0.5
            123           SS  5549.2      30    2.67     1.5
            124           ST  5552.0    1892     2.9     1.5
                          *
            125           ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK

 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

    NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     18       B1
                  V
                  V
     27       RB1
                  .
                  .
     30           .       B2
                  .           .
                  .           .
     35           .           .       B3
                  .           .           .
                  .           .           .
     40       C1   .......................
                  V
                  V
     43       RC1
                  .
                  .
     46           .       B4
                  .           .
                  .           .
     51           .           .       B5
                  .           .           .
                  .           .           .
     56       C2   .......................
                  V
                  V
     59       RC2
                  .
                  .
     62           .       B6
                  .           .
                  .           .
     67           .           .       B7
                  .           .           .
                  .           .           .
     72       C3   .......................
                  V
                  V
     75       RC3
                  .
                  .
     78           .       B8
                  .           .
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
 *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
 *              JUN   1998               *
 *            VERSION 4.1                *
 *                                       *
 *  RUN DATE   06AUG20  TIME  02:52:36   *
 *                                       *
 *****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

25-YR, 24-HR, AMC II

```
  16 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           0  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN          72  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ          50  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      3    0  ENDING DATE
                     NDTIME        1048  ENDING TIME
                     ICENT           19  CENTURY MARK

                   COMPUTATION INTERVAL    1.20 HOURS
                        TOTAL TIME BASE   58.80 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                       NPLAN           1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                    1.00
```

*** *** *** *

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 112 KK    *     Call   *
           *            *
           **************
                        Combine C5, B12

 114 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

*********************************************************************************************************************************************

                                                HYDROGRAPH AT STATION    Call
                                                     SUM OF  2 HYDROGRAPHS
                                                    PLAN 1,   RATIO =  1.00

*********************************************************************************************************************************************
                                *                                *                                *                                *
   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW
                                *                                *                                *
    1     0000    1        0.   *    1     1536   14       162.   *    2     0712   27        0.   *    2     2248   40        0.
    1     0112    2        0.   *    1     1648   15       144.   *    2     0824   28        0.   *    3     0000   41        0.
    1     0224    3        0.   *    1     1800   16       137.   *    2     0936   29        0.   *    3     0112   42        0.
    1     0336    4        0.   *    1     1912   17       125.   *    2     1048   30        0.   *    3     0224   43        0.
    1     0448    5        0.   *    1     2024   18       119.   *    2     1200   31        0.   *    3     0336   44        0.
    1     0600    6        0.   *    1     2136   19       117.   *    2     1312   32        0.   *    3     0448   45        0.
    1     0712    7        6.   *    1     2248   20       118.   *    2     1424   33        0.   *    3     0600   46        0.
    1     0824    8       59.   *    2     0000   21       108.   *    2     1536   34        0.   *    3     0712   47        0.
    1     0936    9      288.   *    2     0112   22        59.   *    2     1648   35        0.   *    3     0824   48        0.
    1     1048   10      396.   *    2     0224   23        23.   *    2     1800   36        0.   *    3     0936   49        0.
    1     1200   11      290.   *    2     0336   24         9.   *    2     1912   37        0.   *    3     1048   50        0.
    1     1312   12      216.   *    2     0448   25         3.   *    2     2024   38        0.   *
    1     1424   13      183.   *    2     0600   26         1.   *    2     2136   39        0.   *
                                *                                *                                *
*********************************************************************************************************************************************

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR     58.80-HR
+   (CFS)       (HR)
                      (CFS)
+     396.     10.80                262.         128.          52.          52.
                    (INCHES)       .514        1.005        1.005        1.005
                     (AC-FT)      130.         254.         254.         254.

                     CUMULATIVE AREA =    4.74 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 115 KK    *     Cove   *     Reservoir
           *            *
           **************
                        Routing through Res'v

              HYDROGRAPH ROUTING DATA

 117 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                      RSVRIC     5545.50  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

 118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                  3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

 120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                               5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

 122 SL          LOW-LEVEL OUTLET
                       ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                       CAREA        4.91  CROSS-SECTIONAL AREA
                        COQL         .60  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

 123 SS          SPILLWAY
                        CREL     5549.20  SPILLWAY CREST ELEVATION
                       SPWID       30.00  SPILLWAY WIDTH
                        COQW        2.67  WEIR COEFFICIENT
                        EXPW        1.50  EXPONENT OF HEAD

 124 ST          TOP OF DAM
```

TOPEL	5552.00	ELEVATION AT TOP OF DAM
DAMWID	1892.00	DAM WIDTH
COQD	2.90	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1	0000		1	0.	5844.8	5545.5	1		2024	18	29.	6028.3	5547.0	2		1648	35	29.	6026.4	5547.0
1	0112		2	0.	5844.8	5545.5	1		2136	19	30.	6037.1	5547.1	2		1800	36	29.	6023.5	5547.0
1	0224		3	0.	5844.8	5545.5	1		2248	20	30.	6045.7	5547.2	2		1912	37	28.	6020.7	5546.9
1	0336		4	0.	5844.8	5545.5	2		0000	21	31.	6053.9	5547.2	2		2024	38	28.	6017.9	5546.9
1	0448		5	0.	5844.8	5545.5	2		0112	22	31.	6059.1	5547.3	2		2136	39	28.	6015.1	5546.9
1	0600		6	0.	5844.8	5545.5	2		0224	23	31.	6060.1	5547.3	2		2248	40	28.	6012.4	5546.9
1	0712		7	1.	5845.1	5545.5	2		0336	24	31.	6058.5	5547.3	3		0000	41	27.	6009.6	5546.9
1	0824		8	4.	5848.0	5545.5	2		0448	25	31.	6056.0	5547.2	3		0112	42	27.	6006.9	5546.8
1	0936		9	10.	5864.6	5545.7	2		0600	26	31.	6053.1	5547.2	3		0224	43	27.	6004.2	5546.8
1	1048		10	16.	5897.3	5545.9	2		0712	27	31.	6050.0	5547.2	3		0336	44	27.	6001.6	5546.8
1	1200		11	20.	5929.6	5546.2	2		0824	28	30.	6047.0	5547.2	3		0448	45	27.	5998.9	5546.8
1	1312		12	22.	5952.7	5546.4	2		0936	29	30.	6044.0	5547.1	3		0600	46	26.	5996.3	5546.7
1	1424		13	24.	5970.2	5546.5	2		1048	30	30.	6041.0	5547.1	3		0712	47	26.	5993.6	5546.7
1	1536		14	25.	5984.9	5546.7	2		1200	31	30.	6038.0	5547.1	3		0824	48	26.	5991.1	5546.7
1	1648		15	26.	5997.5	5546.8	2		1312	32	30.	6035.1	5547.1	3		0936	49	26.	5988.5	5546.7
1	1800		16	27.	6008.8	5546.8	2		1424	33	29.	6032.1	5547.0	3		1048	50	25.	5986.0	5546.7
1	1912		17	28.	6019.0	5546.9	2		1536	34	29.	6029.2	5547.0							

PEAK OUTFLOW IS 31. AT TIME 26.40 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	58.80-HR
(CFS)	(HR)				
		(CFS)			
31.	26.40	31.	30.	23.	23.
		(INCHES) .061	.236	.447	.447
		(AC-FT) 15.	60.	113.	113.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	58.80-HR
(AC-FT)	(HR)				
6060.	26.40	6057.	6042.	5986.	5986.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	58.80-HR
(FEET)	(HR)				
5547.27	26.40	5547.25	5547.12	5546.66	5546.66

CUMULATIVE AREA = 4.74 SQ MI

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1
					1.00
HYDROGRAPH AT					
+	B1	.50	1	FLOW	31.
				TIME	10.80
ROUTED TO					
+	RB1	.50	1	FLOW	29.
				TIME	10.80
HYDROGRAPH AT					
+	B2	.44	1	FLOW	27.
				TIME	10.80
HYDROGRAPH AT					
+	B3	.28	1	FLOW	15.
				TIME	10.80
3 COMBINED AT					
+	C1	1.22	1	FLOW	70.
				TIME	10.80
ROUTED TO					
+	RC1	1.22	1	FLOW	64.
				TIME	10.80
HYDROGRAPH AT					
+	B4	.45	1	FLOW	29.
				TIME	10.80
HYDROGRAPH AT					
+	B5	.81	1	FLOW	55.
				TIME	10.80
3 COMBINED AT					
+	C2	2.48	1	FLOW	148.
				TIME	10.80
ROUTED TO					
+	RC2	2.48	1	FLOW	145.
				TIME	10.80
HYDROGRAPH AT					
+	B6	.15	1	FLOW	20.
				TIME	9.60
HYDROGRAPH AT					
+	B7	.33	1	FLOW	25.
				TIME	10.80
3 COMBINED AT					
+	C3	2.95	1	FLOW	190.
				TIME	10.80
ROUTED TO					
+	RC3	2.95	1	FLOW	166.
				TIME	10.80
HYDROGRAPH AT					
+	B8	1.01	1	FLOW	128.
				TIME	10.80
HYDROGRAPH AT					
+	B9	.24	1	FLOW	34.
				TIME	9.60
HYDROGRAPH AT					
+	B10	.13	1	FLOW	20.
				TIME	9.60
2 COMBINED AT					
+	C4	.37	1	FLOW	54.
				TIME	9.60
ROUTED TO					
+	RC4	.37	1	FLOW	52.
				TIME	10.80
HYDROGRAPH AT					
+	B11	.28	1	FLOW	38.
				TIME	9.60
4 COMBINED AT					
+	C5	4.61	1	FLOW	383.
				TIME	10.80

```
 HYDROGRAPH AT
+                   B12          .13     1   FLOW          14.
                                             TIME        10.80

  2 COMBINED AT
+                   Call        4.74     1   FLOW         396.
                                             TIME        10.80

 ROUTED TO
+                   Cove        4.74     1   FLOW          31.
                                             TIME        26.40

                                         ** PEAK STAGES IN FEET **
                                         1   STAGE     5547.27
                                             TIME        26.40
1
                                             SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                                 (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                    INTERPOLATED TO
                                                                                 COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

           FOR PLAN = 1  RATIO=  .00
              RB1    MANE        10.80     30.91    669.60       .72     72.00     28.63    648.00         .73


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1937E+02 EXCESS= .0000E+00 OUTFLOW= .1938E+02 BASIN STORAGE= .4507E-02 PERCENT ERROR=   -.1


           FOR PLAN = 1  RATIO=  .00
              RC1    MANE        10.80     69.48    669.60       .70     72.00     64.10    648.00         .71


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .4557E+02 EXCESS= .0000E+00 OUTFLOW= .4558E+02 BASIN STORAGE= .4033E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC2    MANE         5.04    146.95    655.56       .74     72.00    145.12    648.00         .74


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .9743E+02 EXCESS= .0000E+00 OUTFLOW= .9744E+02 BASIN STORAGE= .3141E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC3    MANE        14.40    187.14    676.80       .79     72.00    165.61    648.00         .78


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1237E+03 EXCESS= .0000E+00 OUTFLOW= .1237E+03 BASIN STORAGE= .1170E-01 PERCENT ERROR=   -.1


           FOR PLAN = 1  RATIO=  .00
              RC4    MANE        11.89     54.51    594.33      1.48     72.00     52.02    648.00        1.48


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2925E+02 EXCESS= .0000E+00 OUTFLOW= .2926E+02 BASIN STORAGE= .2520E-02 PERCENT ERROR=    .0


1                               SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                              (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


      PLAN  1 ..............                    INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                  ELEVATION         5545.50           5549.20          5552.00
                                  STORAGE             5845.             6508.            7347.
                                  OUTFLOW                0.               45.              435.


                       RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                         OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                        PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                       1.00      5547.27         .00       6060.        31.       .00        26.40         .00


 *** NORMAL END OF HEC-1 ***
```

Storm Event 5. 50-year, 24-hour

```
1****************************************                                  ****************************************
 *                                      *                                  *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                  *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                  *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1               *                                  *         609 SECOND STREET            *
 *                                      *                                  *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   06AUG20  TIME  02:53:04  *                                  *           (916) 756-1104             *
 *                                      *                                  *                                      *
 ****************************************                                  ****************************************

                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X        X     X        XX
                                                X     X  X        X              X
                                                XXXXXXX  XXXX     X        XXXXX  X
                                                X     X  X        X              X
                                                X     X  X        X     X        X
                                                X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   50-YR, 24-HR, AMC II
           13           ID
                        *Diagram
           14           JR    PREC     1.0
           15           IT      72       0       0      50
           16           IO       0
           17           IN      72
                        *

           18           KK   B1
           19           KM   Runoff from Basin 1
           20           BA   0.503
           21           PB    3.14
           22           PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
           23           PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
           24           PC   1.000
           25           LS       0    72.8
           26           UD    0.51
                        *

           27           KK   RB1
           28           KM   Route B1
           29           RD    4928    .045    .050           TRAP      20      20
                        *

           30           KK   B2
           31           KM   Runoff from Basin 2
           32           BA   0.436
           33           LS       0    72.5
           34           UD    0.52
                        *

           35           KK   B3
           36           KM   Runoff from Basin 3
           37           BA   0.279
           38           LS       0    71.0
           39           UD    0.39
                        *
1                                                HEC-1 INPUT                                                PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
             40          KK   C1
             41          KM   Combine RB1, B2, B3
             42          HC       3
                         *

             43          KK   RC1
             44          KM   Route RC1
             45          RD    7255    .060    .030           TRAP      20      20
                         *

             46          KK   B4
             47          KM   Runoff from Basin 4
             48          BA   0.453
             49          LS       0    73.3
             50          UD    0.48
                         *

             51          KK   B5
             52          KM   Runoff from Basin 5
             53          BA   0.805
             54          LS       0    74.1
             55          UD    0.63
                         *

             56          KK   C2
             57          KM   Combine RC1, B4, B5
             58          HC       3
                         *

             59          KK   RC2
             60          KM   Route C2
             61          RD    2380    .039    .030           TRAP      40       2
                         *

             62          KK   B6
             63          KM   Runoff from Basin 6
             64          BA   0.150
             65          LS       0    84.3
             66          UD    0.19
                         *

             67          KK   B7
             68          KM   Runoff from Basin 7
             69          BA   0.327
             70          LS       0    75.7
             71          UD    0.46
                         *

             72          KK   C3
             73          KM   Combine RC2, B6, B7
             74          HC       3
                         *
1                                          HEC-1 INPUT                                          PAGE  3

            LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             75          KK   RC3
             76          KM   Route C3
             77          RD   11323    .023    .030           TRAP      40      20
                         *

             78          KK   B8
             79          KM   Runoff from Basin 8
             80          BA   1.012
             81          LS       0    84.0
             82          UD    0.67
                         *

             83          KK   B9
             84          KM   Runoff from Basin 9
             85          BA   0.242
             86          LS       0    85.5
             87          UD    0.26
                         *

             88          KK   B10
             89          KM   Runoff from Basin 10
             90          BA   0.129
             91          LS       0    86.7
             92          UD    0.18
                         *

             93          KK   C4
             94          KM   Combine B9, B10
             95          HC       2
                         *

             96          KK   RC4
             97          KM   Route C4
             98          RD    3380    .037    .030           TRAP      40      20
                         *
```

```
             99           KK   B11
            100           KM   Runoff from Basin 11
            101           BA   0.279
            102           LS       0    84.8
            103           UD    0.39
                          *

            104           KK   C5
            105           KM   Combine RC3, B8, RC4, B11
            106           HC       4
                          *

            107           KK   B12
            108           KM   Runoff from Basin 12
            109           BA   0.127
            110           LS       0    81.2
            111           UD    0.40
                          *
1                                              HEC-1 INPUT                                              PAGE  4

           LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

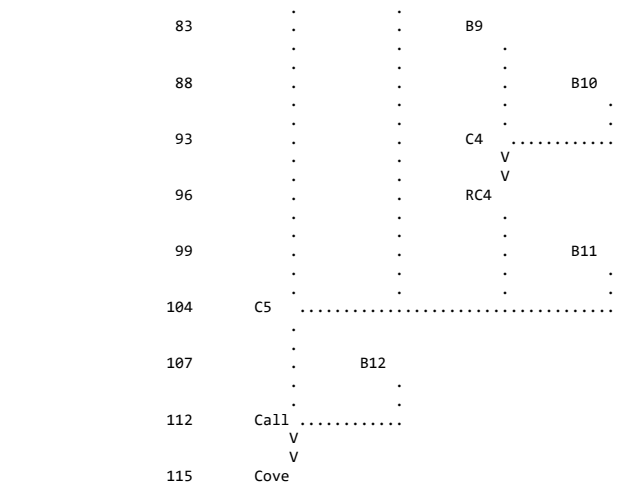

            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            115           KK   Cove Reservoir
            116           KM   Routing through Res'v
            117           RS       1    ELEV  5545.5
            118           SV       0      19      95     240     453     738    1105    1563    2217    2773
            119           SV    3542    4423    5419    6149    7347    8000
            120           SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
            121           SE    5530    5536    5542    5548    5552    5558
            122           SL  5545.5   4.909     0.6     0.5
            123           SS  5549.2      30    2.67     1.5
            124           ST  5552.0    1892     2.9     1.5
                          *
            125           ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK

 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

    NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     18       B1
                  V
                  V
     27       RB1
                  .
                  .
     30           .       B2
                  .           .
                  .           .
     35           .           .       B3
                  .           .           .
                  .           .           .
     40       C1   .......................
                  V
                  V
     43       RC1
                  .
                  .
     46           .       B4
                  .           .
                  .           .
     51           .           .       B5
                  .           .           .
                  .           .           .
     56       C2   .......................
                  V
                  V
     59       RC2
                  .
                  .
     62           .       B6
                  .           .
                  .           .
     67           .           .       B7
                  .           .           .
                  .           .           .
     72       C3   .......................
                  V
                  V
     75       RC3
                  .
                  .
     78           .       B8
                  .           .
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
 *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
 *              JUN   1998               *
 *            VERSION 4.1                *
 *                                       *
 *  RUN DATE   06AUG20  TIME  02:53:04   *
 *                                       *
 *****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

50-YR, 24-HR, AMC II

```
  16 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           0  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN          72  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ          50  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      3    0  ENDING DATE
                     NDTIME        1048  ENDING TIME
                     ICENT           19  CENTURY MARK

                   COMPUTATION INTERVAL    1.20 HOURS
                        TOTAL TIME BASE   58.80 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                       NPLAN           1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                    1.00
```

*** *** *** *

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 112 KK    *     Call   *
           *            *
           **************
                        Combine C5, B12

 114 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

*****************************************************************************************************************************************

                                                HYDROGRAPH AT STATION    Call
                                                     SUM OF  2 HYDROGRAPHS
                                                    PLAN 1,   RATIO =  1.00

*****************************************************************************************************************************************
                                *                                *                                *
   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW
                                *                                *                                *
    1     0000    1        0.   *    1     1536   14       196.   *    2     0712   27        0.   *    2     2248   40        0.
    1     0112    2        0.   *    1     1648   15       174.   *    2     0824   28        0.   *    3     0000   41        0.
    1     0224    3        0.   *    1     1800   16       165.   *    2     0936   29        0.   *    3     0112   42        0.
    1     0336    4        0.   *    1     1912   17       150.   *    2     1048   30        0.   *    3     0224   43        0.
    1     0448    5        0.   *    1     2024   18       142.   *    2     1200   31        0.   *    3     0336   44        0.
    1     0600    6        1.   *    1     2136   19       140.   *    2     1312   32        0.   *    3     0448   45        0.
    1     0712    7       12.   *    1     2248   20       141.   *    2     1424   33        0.   *    3     0600   46        0.
    1     0824    8       85.   *    2     0000   21       129.   *    2     1536   34        0.   *    3     0712   47        0.
    1     0936    9      398.   *    2     0112   22        69.   *    2     1648   35        0.   *    3     0824   48        0.
    1     1048   10      506.   *    2     0224   23        28.   *    2     1800   36        0.   *    3     0936   49        0.
    1     1200   11      362.   *    2     0336   24         9.   *    2     1912   37        0.   *    3     1048   50        0.
    1     1312   12      268.   *    2     0448   25         3.   *    2     2024   38        0.   *
    1     1424   13      223.   *    2     0600   26         1.   *    2     2136   39        0.   *
                                *                                *                                *
*****************************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR     58.80-HR
+   (CFS)       (HR)
                      (CFS)
+     506.     10.80                338.         160.          65.          65.
                    (INCHES)      .662        1.254        1.255        1.255
                     (AC-FT)      167.         317.         317.         317.

                     CUMULATIVE AREA =    4.74 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 115 KK    *     Cove   *     Reservoir
           *            *
           **************
                        Routing through Res'v

              HYDROGRAPH ROUTING DATA

 117 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC     5545.50  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

 118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                  3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

 120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                               5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

 122 SL          LOW-LEVEL OUTLET
                       ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                       CAREA        4.91  CROSS-SECTIONAL AREA
                        COQL         .60  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

 123 SS          SPILLWAY
                        CREL     5549.20  SPILLWAY CREST ELEVATION
                       SPWID       30.00  SPILLWAY WIDTH
                        COQW        2.67  WEIR COEFFICIENT
                        EXPW        1.50  EXPONENT OF HEAD

 124 ST          TOP OF DAM
```

TOPEL	5552.00	ELEVATION AT TOP OF DAM
DAMWID	1892.00	DAM WIDTH
COQD	2.90	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	5844.8	5545.5	1		2024	18	33.	6079.1	5547.4	2		1648	35	33.	6079.8	5547.4
1		0112	2	0.	5844.8	5545.5	1		2136	19	34.	6089.8	5547.5	2		1800	36	33.	6076.5	5547.4
1		0224	3	0.	5844.8	5545.5	1		2248	20	34.	6100.3	5547.6	2		1912	37	32.	6073.3	5547.4
1		0336	4	0.	5844.8	5545.5	2		0000	21	35.	6110.3	5547.7	2		2024	38	32.	6070.1	5547.4
1		0448	5	0.	5844.8	5545.5	2		0112	22	35.	6116.6	5547.7	2		2136	39	32.	6067.0	5547.3
1		0600	6	0.	5844.8	5545.5	2		0224	23	35.	6117.8	5547.7	2		2248	40	32.	6063.8	5547.3
1		0712	7	2.	5845.4	5545.5	2		0336	24	35.	6116.1	5547.7	3		0000	41	31.	6060.7	5547.3
1		0824	8	5.	5849.9	5545.5	2		0448	25	35.	6113.2	5547.7	3		0112	42	31.	6057.6	5547.2
1		0936	9	11.	5873.1	5545.7	2		0600	26	35.	6109.9	5547.7	3		0224	43	31.	6054.5	5547.2
1		1048	10	18.	5916.5	5546.1	2		0712	27	35.	6106.5	5547.7	3		0336	44	31.	6051.4	5547.2
1		1200	11	23.	5957.5	5546.4	2		0824	28	34.	6103.1	5547.6	3		0448	45	31.	6048.4	5547.2
1		1312	12	25.	5986.4	5546.7	2		0936	29	34.	6099.8	5547.6	3		0600	46	30.	6045.3	5547.1
1		1424	13	27.	6008.1	5546.8	2		1048	30	34.	6096.4	5547.6	3		0712	47	30.	6042.4	5547.1
1		1536	14	29.	6026.1	5547.0	2		1200	31	34.	6093.0	5547.5	3		0824	48	30.	6039.4	5547.1
1		1648	15	30.	6041.5	5547.1	2		1312	32	34.	6089.7	5547.5	3		0936	49	30.	6036.4	5547.1
1		1800	16	31.	6055.3	5547.2	2		1424	33	33.	6086.3	5547.5	3		1048	50	29.	6033.5	5547.1
1		1912	17	32.	6067.8	5547.3	2		1536	34	33.	6083.1	5547.5							

PEAK OUTFLOW IS 35. AT TIME 26.40 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	58.80-HR
+ (CFS)	(HR)				
		(CFS)			
+ 35.	26.40	35.	34.	27.	27.
		(INCHES) .069	.267	.509	.509
		(AC-FT) 17.	67.	129.	129.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (AC-FT)	(HR)				
6118.	26.40	6115.	6097.	6028.	6028.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (FEET)	(HR)				
5547.74	26.40	5547.72	5547.57	5547.00	5547.00

CUMULATIVE AREA = 4.74 SQ MI

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1
					1.00
HYDROGRAPH AT					
+	B1	.50	1	FLOW	42.
				TIME	10.80
ROUTED TO					
+	RB1	.50	1	FLOW	39.
				TIME	10.80
HYDROGRAPH AT					
+	B2	.44	1	FLOW	36.
				TIME	10.80
HYDROGRAPH AT					
+	B3	.28	1	FLOW	20.
				TIME	10.80
3 COMBINED AT					
+	C1	1.22	1	FLOW	95.
				TIME	10.80
ROUTED TO					
+	RC1	1.22	1	FLOW	89.
				TIME	10.80
HYDROGRAPH AT					
+	B4	.45	1	FLOW	39.
				TIME	10.80
HYDROGRAPH AT					
+	B5	.81	1	FLOW	73.
				TIME	10.80
3 COMBINED AT					
+	C2	2.48	1	FLOW	201.
				TIME	10.80
ROUTED TO					
+	RC2	2.48	1	FLOW	198.
				TIME	10.80
HYDROGRAPH AT					
+	B6	.15	1	FLOW	24.
				TIME	9.60
HYDROGRAPH AT					
+	B7	.33	1	FLOW	33.
				TIME	10.80
3 COMBINED AT					
+	C3	2.95	1	FLOW	254.
				TIME	10.80
ROUTED TO					
+	RC3	2.95	1	FLOW	226.
				TIME	10.80
HYDROGRAPH AT					
+	B8	1.01	1	FLOW	156.
				TIME	10.80
HYDROGRAPH AT					
+	B9	.24	1	FLOW	43.
				TIME	9.60
HYDROGRAPH AT					
+	B10	.13	1	FLOW	24.
				TIME	9.60
2 COMBINED AT					
+	C4	.37	1	FLOW	67.
				TIME	9.60
ROUTED TO					
+	RC4	.37	1	FLOW	63.
				TIME	10.80
HYDROGRAPH AT					
+	B11	.28	1	FLOW	47.
				TIME	9.60
4 COMBINED AT					
+	C5	4.61	1	FLOW	489.
				TIME	10.80

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 HYDROGRAPH AT
+                  B12          .13     1   FLOW          17.
                                            TIME        10.80

  2 COMBINED AT
+                  Call        4.74     1   FLOW         506.
                                            TIME        10.80

 ROUTED TO
+                  Cove        4.74     1   FLOW          35.
                                            TIME        26.40

                                        ** PEAK STAGES IN FEET **
                                        1   STAGE     5547.74
                                            TIME        26.40
1
                                            SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                                (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                    INTERPOLATED TO
                                                                                 COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

           FOR PLAN = 1  RATIO=  .00
              RB1    MANE        10.80     41.28    669.60       .93     72.00     39.32    648.00         .94


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2506E+02 EXCESS= .0000E+00 OUTFLOW= .2507E+02 BASIN STORAGE= .3252E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC1    MANE        10.80     93.85    669.60       .91     72.00     89.39    648.00         .92


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5909E+02 EXCESS= .0000E+00 OUTFLOW= .5910E+02 BASIN STORAGE= .3497E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC2    MANE         4.52    199.61    651.21       .95     72.00    197.63    648.00         .95


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1257E+03 EXCESS= .0000E+00 OUTFLOW= .1257E+03 BASIN STORAGE= .3088E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC3    MANE        18.00    247.22    666.00      1.01     72.00    225.83    648.00        1.01


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1584E+03 EXCESS= .0000E+00 OUTFLOW= .1585E+03 BASIN STORAGE= .1185E-01 PERCENT ERROR=   -.1


           FOR PLAN = 1  RATIO=  .00
              RC4    MANE        11.21     66.99    594.15      1.78     72.00     62.77    648.00        1.78


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3515E+02 EXCESS= .0000E+00 OUTFLOW= .3516E+02 BASIN STORAGE= .2436E-02 PERCENT ERROR=    .0


1                               SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                              (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


       PLAN  1 .............                  INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                 ELEVATION        5545.50           5549.20          5552.00
                                 STORAGE             5845.             6508.            7347.
                                 OUTFLOW                0.               45.              435.


                        RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                          OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                         PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                        1.00      5547.74         .00       6118.        35.       .00        26.40         .00


 *** NORMAL END OF HEC-1 ***
```

Storm Event 6. 100-year, 24-hour

```
1****************************************                                  ************************************
 *                                      *                                  *                                  *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                  *    U.S. ARMY CORPS OF ENGINEERS  *
 *              JUN   1998              *                                  *    HYDROLOGIC ENGINEERING CENTER *
 *            VERSION 4.1               *                                  *         609 SECOND STREET        *
 *                                      *                                  *       DAVIS, CALIFORNIA 95616    *
 *  RUN DATE   06AUG20  TIME  02:53:31  *                                  *           (916) 756-1104         *
 *                                      *                                  *                                  *
 ****************************************                                  ************************************

                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X        X     X        XX
                                                X     X  X        X              X
                                                XXXXXXX  XXXX     X        XXXXX  X
                                                X     X  X        X              X
                                                X     X  X        X     X        X
                                                X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   100-YR, 24-HR, AMC II
           13           ID
                        *Diagram
           14           JR    PREC     1.0
           15           IT      72       0       0      50
           16           IO       0
           17           IN      72
                        *

           18           KK   B1
           19           KM   Runoff from Basin 1
           20           BA   0.503
           21           PB    3.51
           22           PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
           23           PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
           24           PC   1.000
           25           LS       0    72.8
           26           UD    0.51
                        *

           27           KK   RB1
           28           KM   Route B1
           29           RD    4928    .045    .050           TRAP      20      20
                        *

           30           KK   B2
           31           KM   Runoff from Basin 2
           32           BA   0.436
           33           LS       0    72.5
           34           UD    0.52
                        *

           35           KK   B3
           36           KM   Runoff from Basin 3
           37           BA   0.279
           38           LS       0    71.0
           39           UD    0.39
                        *
1                                                HEC-1 INPUT                                                PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
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```
             40          KK   C1
             41          KM   Combine RB1, B2, B3
             42          HC       3
                         *

             43          KK   RC1
             44          KM   Route RC1
             45          RD    7255    .060    .030           TRAP      20      20
                         *

             46          KK   B4
             47          KM   Runoff from Basin 4
             48          BA   0.453
             49          LS       0    73.3
             50          UD    0.48
                         *

             51          KK   B5
             52          KM   Runoff from Basin 5
             53          BA   0.805
             54          LS       0    74.1
             55          UD    0.63
                         *

             56          KK   C2
             57          KM   Combine RC1, B4, B5
             58          HC       3
                         *

             59          KK   RC2
             60          KM   Route C2
             61          RD    2380    .039    .030           TRAP      40       2
                         *

             62          KK   B6
             63          KM   Runoff from Basin 6
             64          BA   0.150
             65          LS       0    84.3
             66          UD    0.19
                         *

             67          KK   B7
             68          KM   Runoff from Basin 7
             69          BA   0.327
             70          LS       0    75.7
             71          UD    0.46
                         *

             72          KK   C3
             73          KM   Combine RC2, B6, B7
             74          HC       3
                         *
1                                          HEC-1 INPUT                                          PAGE  3

            LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             75          KK   RC3
             76          KM   Route C3
             77          RD   11323    .023    .030           TRAP      40      20
                         *

             78          KK   B8
             79          KM   Runoff from Basin 8
             80          BA   1.012
             81          LS       0    84.0
             82          UD    0.67
                         *

             83          KK   B9
             84          KM   Runoff from Basin 9
             85          BA   0.242
             86          LS       0    85.5
             87          UD    0.26
                         *

             88          KK   B10
             89          KM   Runoff from Basin 10
             90          BA   0.129
             91          LS       0    86.7
             92          UD    0.18
                         *

             93          KK   C4
             94          KM   Combine B9, B10
             95          HC       2
                         *

             96          KK   RC4
             97          KM   Route C4
             98          RD    3380    .037    .030           TRAP      40      20
                         *
```

```
             99           KK   B11
            100           KM   Runoff from Basin 11
            101           BA   0.279
            102           LS       0    84.8
            103           UD    0.39
                          *

            104           KK   C5
            105           KM   Combine RC3, B8, RC4, B11
            106           HC       4
                          *

            107           KK   B12
            108           KM   Runoff from Basin 12
            109           BA   0.127
            110           LS       0    81.2
            111           UD    0.40
                          *
1                                              HEC-1 INPUT                                              PAGE  4

           LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

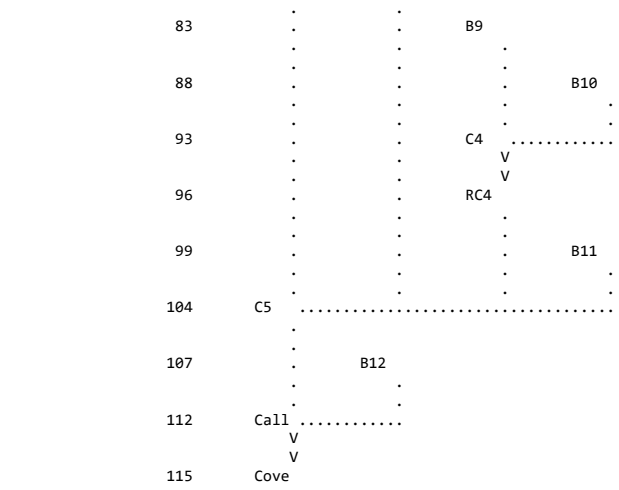

            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            115           KK   Cove Reservoir
            116           KM   Routing through Res'v
            117           RS       1    ELEV  5545.5
            118           SV       0      19      95     240     453     738    1105    1563    2217    2773
            119           SV    3542    4423    5419    6149    7347    8000
            120           SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
            121           SE    5530    5536    5542    5548    5552    5558
            122           SL  5545.5   4.909     0.6     0.5
            123           SS  5549.2      30    2.67     1.5
            124           ST  5552.0    1892     2.9     1.5
                          *
            125           ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK

 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

    NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     18       B1
                  V
                  V
     27       RB1
                  .
                  .
     30           .       B2
                  .           .
                  .           .
     35           .           .       B3
                  .           .           .
                  .           .           .
     40       C1   .......................
                  V
                  V
     43       RC1
                  .
                  .
     46           .       B4
                  .           .
                  .           .
     51           .           .       B5
                  .           .           .
                  .           .           .
     56       C2   .......................
                  V
                  V
     59       RC2
                  .
                  .
     62           .       B6
                  .           .
                  .           .
     67           .           .       B7
                  .           .           .
                  .           .           .
     72       C3   .......................
                  V
                  V
     75       RC3
                  .
                  .
     78           .       B8
                  .           .
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************                    *****************************************
 *                                       *                    *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *    U.S. ARMY CORPS OF ENGINEERS       *
 *              JUN   1998               *                    *    HYDROLOGIC ENGINEERING CENTER      *
 *            VERSION 4.1                *                    *          609 SECOND STREET            *
 *                                       *                    *       DAVIS, CALIFORNIA 95616         *
 *  RUN DATE   06AUG20  TIME  02:53:31   *                    *          (916) 756-1104               *
 *                                       *                    *                                       *
 *****************************************                    *****************************************
```

HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

100-YR, 24-HR, AMC II

```
  16 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           0  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN          72  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ          50  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      3    0  ENDING DATE
                     NDTIME        1048  ENDING TIME
                     ICENT           19  CENTURY MARK

                   COMPUTATION INTERVAL    1.20 HOURS
                        TOTAL TIME BASE   58.80 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                       NPLAN           1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                    1.00


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
```

*** ***

```
           **************
           *            *
 112 KK    *     Call   *
           *            *
           **************
                        Combine C5, B12

 114 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***
```

****

HYDROGRAPH AT STATION Call
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = 1.00

****

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		1536	14	233.	2		0712	27	0.	2		2248	40	0.
1		0112	2	0.	1		1648	15	206.	2		0824	28	0.	3		0000	41	0.
1		0224	3	0.	1		1800	16	194.	2		0936	29	0.	3		0112	42	0.
1		0336	4	0.	1		1912	17	177.	2		1048	30	0.	3		0224	43	0.
1		0448	5	0.	1		2024	18	167.	2		1200	31	0.	3		0336	44	0.
1		0600	6	3.	1		2136	19	165.	2		1312	32	0.	3		0448	45	0.
1		0712	7	20.	1		2248	20	165.	2		1424	33	0.	3		0600	46	0.
1		0824	8	116.	2		0000	21	150.	2		1536	34	0.	3		0712	47	0.
1		0936	9	519.	2		0112	22	79.	2		1648	35	0.	3		0824	48	0.
1		1048	10	632.	2		0224	23	32.	2		1800	36	0.	3		0936	49	0.
1		1200	11	442.	2		0336	24	11.	2		1912	37	0.	3		1048	50	0.
1		1312	12	321.	2		0448	25	3.	2		2024	38	0.					
1		1424	13	265.	2		0600	26	1.	2		2136	39	0.					

****

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	58.80-HR
(CFS)	(HR)				
		(CFS)			
632.	10.80	421.	195.	80.	80.
	(INCHES)	.826	1.529	1.530	1.530
	(AC-FT)	209.	387.	387.	387.

CUMULATIVE AREA = 4.74 SQ MI

*** ***

```
           **************
           *            *
 115 KK    *     Cove   *     Reservoir
           *            *
           **************
                        Routing through Res'v

              HYDROGRAPH ROUTING DATA

 117 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC     5545.50  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

 118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                 3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

 120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                               5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

 122 SL          LOW-LEVEL OUTLET
                       ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                       CAREA        4.91  CROSS-SECTIONAL AREA
                        COQL         .60  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

 123 SS          SPILLWAY
                        CREL     5549.20  SPILLWAY CREST ELEVATION
                       SPWID       30.00  SPILLWAY WIDTH
                        COQW        2.67  WEIR COEFFICIENT
                        EXPW        1.50  EXPONENT OF HEAD

 124 ST          TOP OF DAM
```

TOPEL	5552.00	ELEVATION AT TOP OF DAM
DAMWID	1892.00	DAM WIDTH
COQD	2.90	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1	0000		1	0.	5844.8	5545.5	1	2024		18	36.	6135.3	5547.9	2	1648		35	37.	6140.0	5547.9
1	0112		2	0.	5844.8	5545.5	1	2136		19	37.	6148.0	5548.0	2	1800		36	37.	6136.3	5547.9
1	0224		3	0.	5844.8	5545.5	1	2248		20	38.	6160.7	5548.0	2	1912		37	36.	6132.7	5547.9
1	0336		4	0.	5844.8	5545.5	2	0000		21	38.	6172.5	5548.1	2	2024		38	36.	6129.2	5547.8
1	0448		5	0.	5844.8	5545.5	2	0112		22	38.	6180.1	5548.1	2	2136		39	36.	6125.6	5547.8
1	0600		6	1.	5845.0	5545.5	2	0224		23	38.	6181.9	5548.1	2	2248		40	36.	6122.0	5547.8
1	0712		7	2.	5846.0	5545.5	2	0336		24	38.	6180.1	5548.1	3	0000		41	35.	6118.5	5547.7
1	0824		8	6.	5852.3	5545.6	2	0448		25	38.	6177.1	5548.1	3	0112		42	35.	6115.0	5547.7
1	0936		9	13.	5882.9	5545.8	2	0600		26	38.	6173.4	5548.1	3	0224		43	35.	6111.5	5547.7
1	1048		10	21.	5938.3	5546.3	2	0712		27	38.	6169.8	5548.1	3	0336		44	35.	6108.1	5547.7
1	1200		11	26.	5989.3	5546.7	2	0824		28	38.	6166.0	5548.1	3	0448		45	35.	6104.6	5547.6
1	1312		12	29.	6024.4	5547.0	2	0936		29	38.	6162.2	5548.0	3	0600		46	34.	6101.2	5547.6
1	1424		13	31.	6050.6	5547.2	2	1048		30	38.	6158.4	5548.0	3	0712		47	34.	6097.9	5547.6
1	1536		14	32.	6072.1	5547.4	2	1200		31	37.	6154.7	5548.0	3	0824		48	34.	6094.5	5547.6
1	1648		15	34.	6090.6	5547.5	2	1312		32	37.	6151.0	5548.0	3	0936		49	34.	6091.1	5547.5
1	1800		16	35.	6107.0	5547.7	2	1424		33	37.	6147.3	5548.0	3	1048		50	33.	6087.8	5547.5
1	1912		17	36.	6121.9	5547.8	2	1536		34	37.	6143.7	5548.0							

PEAK OUTFLOW IS 38. AT TIME 26.40 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	58.80-HR
+ (CFS)	(HR)				
		(CFS)			
+ 38.	26.40	38.	37.	30.	30.
		(INCHES) .075	.294	.568	.568
		(AC-FT) 19.	74.	144.	144.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (AC-FT)	(HR)				
6182.	26.40	6178.	6158.	6075.	6075.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (FEET)	(HR)				
5548.11	26.40	5548.10	5548.02	5547.36	5547.36

CUMULATIVE AREA = 4.74 SQ MI

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1
					1.00
HYDROGRAPH AT					
+	B1	.50	1	FLOW	54.
				TIME	10.80
ROUTED TO					
+	RB1	.50	1	FLOW	51.
				TIME	10.80
HYDROGRAPH AT					
+	B2	.44	1	FLOW	46.
				TIME	10.80
HYDROGRAPH AT					
+	B3	.28	1	FLOW	27.
				TIME	10.80
3 COMBINED AT					
+	C1	1.22	1	FLOW	124.
				TIME	10.80
ROUTED TO					
+	RC1	1.22	1	FLOW	118.
				TIME	10.80
HYDROGRAPH AT					
+	B4	.45	1	FLOW	50.
				TIME	10.80
HYDROGRAPH AT					
+	B5	.81	1	FLOW	92.
				TIME	10.80
3 COMBINED AT					
+	C2	2.48	1	FLOW	260.
				TIME	10.80
ROUTED TO					
+	RC2	2.48	1	FLOW	257.
				TIME	10.80
HYDROGRAPH AT					
+	B6	.15	1	FLOW	30.
				TIME	9.60
HYDROGRAPH AT					
+	B7	.33	1	FLOW	41.
				TIME	10.80
3 COMBINED AT					
+	C3	2.95	1	FLOW	326.
				TIME	10.80
ROUTED TO					
+	RC3	2.95	1	FLOW	298.
				TIME	10.80
HYDROGRAPH AT					
+	B8	1.01	1	FLOW	190.
				TIME	9.60
HYDROGRAPH AT					
+	B9	.24	1	FLOW	51.
				TIME	9.60
HYDROGRAPH AT					
+	B10	.13	1	FLOW	29.
				TIME	9.60
2 COMBINED AT					
+	C4	.37	1	FLOW	81.
				TIME	9.60
ROUTED TO					
+	RC4	.37	1	FLOW	74.
				TIME	10.80
HYDROGRAPH AT					
+	B11	.28	1	FLOW	57.
				TIME	9.60
4 COMBINED AT					
+	C5	4.61	1	FLOW	611.
				TIME	10.80

```
 HYDROGRAPH AT
+                   B12          .13     1   FLOW          21.
                                             TIME         9.60

  2 COMBINED AT
+                   Call        4.74     1   FLOW         632.
                                             TIME        10.80

 ROUTED TO
+                   Cove        4.74     1   FLOW          38.
                                             TIME        26.40

                                         ** PEAK STAGES IN FEET **
                                         1   STAGE     5548.11
                                             TIME        26.40
1
                                             SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                                 (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                    INTERPOLATED TO
                                                                                 COMPUTATION INTERVAL
             ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                       PEAK                                    PEAK

                                   (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

            FOR PLAN = 1  RATIO=  .00
               RB1    MANE        10.80     52.87    669.60      1.17     72.00     51.47    648.00        1.18


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3151E+02 EXCESS= .0000E+00 OUTFLOW= .3152E+02 BASIN STORAGE= .3618E-02 PERCENT ERROR=    .0


            FOR PLAN = 1  RATIO=  .00
               RC1    MANE        10.80    122.15    658.80      1.15     72.00    118.32    648.00        1.15


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .7446E+02 EXCESS= .0000E+00 OUTFLOW= .7448E+02 BASIN STORAGE= .3965E-02 PERCENT ERROR=    .0


            FOR PLAN = 1  RATIO=  .00
               RC2    MANE         4.12    258.94    650.80      1.19     72.00    257.20    648.00        1.20


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1578E+03 EXCESS= .0000E+00 OUTFLOW= .1578E+03 BASIN STORAGE= .3030E-02 PERCENT ERROR=    .0


            FOR PLAN = 1  RATIO=  .00
               RC3    MANE        18.00    321.28    666.00      1.25     72.00    298.28    648.00        1.26


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1975E+03 EXCESS= .0000E+00 OUTFLOW= .1976E+03 BASIN STORAGE= .8525E-02 PERCENT ERROR=   -.1


            FOR PLAN = 1  RATIO=  .00
               RC4    MANE        10.64     80.58    595.79      2.10     72.00     74.24    648.00        2.11


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .4157E+02 EXCESS= .0000E+00 OUTFLOW= .4158E+02 BASIN STORAGE= .3047E-02 PERCENT ERROR=    .0


1                                SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                               (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


       PLAN  1 ..............                    INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                  ELEVATION         5545.50           5549.20          5552.00
                                  STORAGE              5845.             6508.            7347.
                                  OUTFLOW                 0.               45.              435.


                        RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                          OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                         PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                        1.00      5548.11         .00       6182.        38.       .00        26.40         .00


 *** NORMAL END OF HEC-1 ***
```

Storm Event 7. 500-year, 24-hour

```
1****************************************                                  ************************************
 *                                      *                                  *                                  *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                  *    U.S. ARMY CORPS OF ENGINEERS  *
 *              JUN   1998              *                                  *    HYDROLOGIC ENGINEERING CENTER *
 *            VERSION 4.1               *                                  *         609 SECOND STREET        *
 *                                      *                                  *       DAVIS, CALIFORNIA 95616    *
 *  RUN DATE   06AUG20  TIME  02:53:56  *                                  *           (916) 756-1104         *
 *                                      *                                  *                                  *
 ****************************************                                  ************************************

                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X        X     X        XX
                                                X     X  X        X              X
                                                XXXXXXX  XXXX     X        XXXXX  X
                                                X     X  X        X              X
                                                X     X  X        X     X        X
                                                X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   500-YR, 24-HR, AMC II
           13           ID
                        *Diagram
           14           JR    PREC     1.0
           15           IT      72       0       0      50
           16           IO       0
           17           IN      72
                        *

           18           KK   B1
           19           KM   Runoff from Basin 1
           20           BA   0.503
           21           PB    4.69
           22           PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
           23           PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
           24           PC   1.000
           25           LS       0    72.8
           26           UD    0.51
                        *

           27           KK   RB1
           28           KM   Route B1
           29           RD    4928    .045    .050           TRAP      20      20
                        *

           30           KK   B2
           31           KM   Runoff from Basin 2
           32           BA   0.436
           33           LS       0    72.5
           34           UD    0.52
                        *

           35           KK   B3
           36           KM   Runoff from Basin 3
           37           BA   0.279
           38           LS       0    71.0
           39           UD    0.39
                        *
1                                                HEC-1 INPUT                                                PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
             40          KK   C1
             41          KM   Combine RB1, B2, B3
             42          HC       3
                         *

             43          KK   RC1
             44          KM   Route RC1
             45          RD    7255    .060    .030           TRAP      20      20
                         *

             46          KK   B4
             47          KM   Runoff from Basin 4
             48          BA   0.453
             49          LS       0    73.3
             50          UD    0.48
                         *

             51          KK   B5
             52          KM   Runoff from Basin 5
             53          BA   0.805
             54          LS       0    74.1
             55          UD    0.63
                         *

             56          KK   C2
             57          KM   Combine RC1, B4, B5
             58          HC       3
                         *

             59          KK   RC2
             60          KM   Route C2
             61          RD    2380    .039    .030           TRAP      40       2
                         *

             62          KK   B6
             63          KM   Runoff from Basin 6
             64          BA   0.150
             65          LS       0    84.3
             66          UD    0.19
                         *

             67          KK   B7
             68          KM   Runoff from Basin 7
             69          BA   0.327
             70          LS       0    75.7
             71          UD    0.46
                         *

             72          KK   C3
             73          KM   Combine RC2, B6, B7
             74          HC       3
                         *
1                                          HEC-1 INPUT                                          PAGE  3

            LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             75          KK   RC3
             76          KM   Route C3
             77          RD   11323    .023    .030           TRAP      40      20
                         *

             78          KK   B8
             79          KM   Runoff from Basin 8
             80          BA   1.012
             81          LS       0    84.0
             82          UD    0.67
                         *

             83          KK   B9
             84          KM   Runoff from Basin 9
             85          BA   0.242
             86          LS       0    85.5
             87          UD    0.26
                         *

             88          KK   B10
             89          KM   Runoff from Basin 10
             90          BA   0.129
             91          LS       0    86.7
             92          UD    0.18
                         *

             93          KK   C4
             94          KM   Combine B9, B10
             95          HC       2
                         *

             96          KK   RC4
             97          KM   Route C4
             98          RD    3380    .037    .030           TRAP      40      20
                         *
```

```
             99           KK   B11
            100           KM   Runoff from Basin 11
            101           BA   0.279
            102           LS       0    84.8
            103           UD    0.39
                          *

            104           KK   C5
            105           KM   Combine RC3, B8, RC4, B11
            106           HC       4
                          *

            107           KK   B12
            108           KM   Runoff from Basin 12
            109           BA   0.127
            110           LS       0    81.2
            111           UD    0.40
                          *
1                                              HEC-1 INPUT                                              PAGE  4

           LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

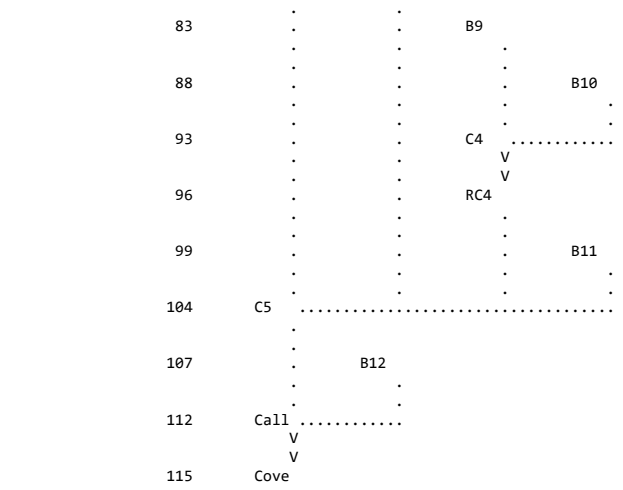

            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            115           KK   Cove Reservoir
            116           KM   Routing through Res'v
            117           RS       1    ELEV  5545.5
            118           SV       0      19      95     240     453     738    1105    1563    2217    2773
            119           SV    3542    4423    5419    6149    7347    8000
            120           SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
            121           SE    5530    5536    5542    5548    5552    5558
            122           SL  5545.5   4.909     0.6     0.5
            123           SS  5549.2      30    2.67     1.5
            124           ST  5552.0    1892     2.9     1.5
                          *
            125           ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK

 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

    NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     18       B1
                  V
                  V
     27       RB1
                  .
                  .
     30           .       B2
                  .           .
                  .           .
     35           .           .       B3
                  .           .           .
                  .           .           .
     40       C1   .......................
                  V
                  V
     43       RC1
                  .
                  .
     46           .       B4
                  .           .
                  .           .
     51           .           .       B5
                  .           .           .
                  .           .           .
     56       C2   .......................
                  V
                  V
     59       RC2
                  .
                  .
     62           .       B6
                  .           .
                  .           .
     67           .           .       B7
                  .           .           .
                  .           .           .
     72       C3   .......................
                  V
                  V
     75       RC3
                  .
                  .
     78           .       B8
                  .           .
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
 *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
 *              JUN   1998               *
 *            VERSION 4.1                *
 *                                       *
 *  RUN DATE   06AUG20  TIME  02:53:56   *
 *                                       *
 *****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

500-YR, 24-HR, AMC II

```
  16 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           0  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN          72  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ          50  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      3    0  ENDING DATE
                     NDTIME        1048  ENDING TIME
                     ICENT           19  CENTURY MARK

                   COMPUTATION INTERVAL    1.20 HOURS
                        TOTAL TIME BASE   58.80 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                       NPLAN           1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                    1.00
```

*** *** *** *

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 112 KK    *     Call   *
           *            *
           **************
                        Combine C5, B12

 114 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

*****************************************************************************************************************************************

                                                HYDROGRAPH AT STATION    Call
                                                     SUM OF  2 HYDROGRAPHS
                                                    PLAN 1,   RATIO =  1.00

*****************************************************************************************************************************************
                                *                                *                                *
   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW
                                *                                *                                *
    1     0000    1        0.   *    1     1536   14       352.   *    2     0712   27        0.   *    2     2248   40        0.
    1     0112    2        0.   *    1     1648   15       309.   *    2     0824   28        0.   *    3     0000   41        0.
    1     0224    3        0.   *    1     1800   16       291.   *    2     0936   29        0.   *    3     0112   42        0.
    1     0336    4        0.   *    1     1912   17       263.   *    2     1048   30        0.   *    3     0224   43        0.
    1     0448    5        2.   *    1     2024   18       247.   *    2     1200   31        0.   *    3     0336   44        0.
    1     0600    6       17.   *    1     2136   19       244.   *    2     1312   32        0.   *    3     0448   45        0.
    1     0712    7       55.   *    1     2248   20       244.   *    2     1424   33        0.   *    3     0600   46        0.
    1     0824    8      257.   *    2     0000   21       221.   *    2     1536   34        0.   *    3     0712   47        0.
    1     0936    9      937.   *    2     0112   22       114.   *    2     1648   35        0.   *    3     0824   48        0.
    1     1048   10     1064.   *    2     0224   23        43.   *    2     1800   36        0.   *    3     0936   49        0.
    1     1200   11      711.   *    2     0336   24        13.   *    2     1912   37        0.   *    3     1048   50        0.
    1     1312   12      497.   *    2     0448   25         3.   *    2     2024   38        0.   *
    1     1424   13      404.   *    2     0600   26         1.   *    2     2136   39        0.   *
                                *                                *                                *
*****************************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR     58.80-HR
+   (CFS)       (HR)
                        (CFS)
+    1064.     10.80                  708.         314.         128.         128.
                       (INCHES)     1.388        2.465        2.466        2.466
                        (AC-FT)      351.         623.         624.         624.

                        CUMULATIVE AREA =    4.74 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 115 KK    *     Cove   *     Reservoir
           *            *
           **************
                        Routing through Res'v

              HYDROGRAPH ROUTING DATA

 117 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                      RSVRIC     5545.50  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

 118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                 3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

 120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                               5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

 122 SL          LOW-LEVEL OUTLET
                       ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                       CAREA        4.91  CROSS-SECTIONAL AREA
                        COQL         .60  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

 123 SS          SPILLWAY
                        CREL     5549.20  SPILLWAY CREST ELEVATION
                       SPWID       30.00  SPILLWAY WIDTH
                        COQW        2.67  WEIR COEFFICIENT
                        EXPW        1.50  EXPONENT OF HEAD

 124 ST          TOP OF DAM
```

TOPEL	5552.00	ELEVATION AT TOP OF DAM
DAMWID	1892.00	DAM WIDTH
COQD	2.90	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1	0000		1	0.	5844.8	5545.5	1	2024		18	42.	6333.4	5548.6	2	1648		35	42.	6361.0	5548.7
1	0112		2	0.	5844.8	5545.5	1	2136		19	42.	6353.6	5548.7	2	1800		36	42.	6356.8	5548.7
1	0224		3	0.	5844.8	5545.5	1	2248		20	43.	6373.6	5548.8	2	1912		37	42.	6352.6	5548.7
1	0336		4	0.	5844.8	5545.5	2	0000		21	43.	6392.5	5548.8	2	2024		38	42.	6348.3	5548.7
1	0448		5	1.	5845.0	5545.5	2	0112		22	43.	6404.8	5548.9	2	2136		39	42.	6344.2	5548.7
1	0600		6	2.	5845.8	5545.5	2	0224		23	43.	6408.3	5548.9	2	2248		40	42.	6340.1	5548.6
1	0712		7	4.	5849.1	5545.5	2	0336		24	43.	6406.8	5548.9	3	0000		41	42.	6336.0	5548.6
1	0824		8	9.	5863.8	5545.7	2	0448		25	43.	6403.3	5548.8	3	0112		42	42.	6331.9	5548.6
1	0936		9	19.	5921.6	5546.1	2	0600		26	43.	6399.2	5548.8	3	0224		43	42.	6327.9	5548.6
1	1048		10	28.	6018.5	5546.9	2	0712		27	43.	6395.0	5548.8	3	0336		44	41.	6323.8	5548.6
1	1200		11	34.	6103.4	5547.6	2	0824		28	43.	6390.7	5548.8	3	0448		45	41.	6319.7	5548.6
1	1312		12	38.	6159.7	5548.0	2	0936		29	43.	6386.5	5548.8	3	0600		46	41.	6315.6	5548.6
1	1424		13	39.	6200.6	5548.2	2	1048		30	43.	6382.3	5548.8	3	0712		47	41.	6311.5	5548.5
1	1536		14	39.	6234.3	5548.3	2	1200		31	43.	6378.0	5548.8	3	0824		48	41.	6307.4	5548.5
1	1648		15	40.	6263.1	5548.4	2	1312		32	43.	6373.8	5548.8	3	0936		49	41.	6303.3	5548.5
1	1800		16	41.	6288.8	5548.5	2	1424		33	42.	6369.5	5548.7	3	1048		50	41.	6299.2	5548.5
1	1912		17	41.	6312.2	5548.5	2	1536		34	42.	6365.3	5548.7							

PEAK OUTFLOW IS 43. AT TIME 26.40 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	58.80-HR
(CFS)	(HR)				
		(CFS)			
43.	26.40	43.	43.	35.	35.
		(INCHES) .085	.335	.670	.670
		(AC-FT) 21.	85.	169.	169.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	58.80-HR
(AC-FT)	(HR)				
6408.	26.40	6404.	6380.	6245.	6245.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	58.80-HR
(FEET)	(HR)				
5548.87	26.40	5548.85	5548.77	5548.06	5548.06

CUMULATIVE AREA = 4.74 SQ MI

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1
					1.00
HYDROGRAPH AT					
+	B1	.50	1	FLOW	95.
				TIME	10.80
ROUTED TO					
+	RB1	.50	1	FLOW	96.
				TIME	10.80
HYDROGRAPH AT					
+	B2	.44	1	FLOW	82.
				TIME	10.80
HYDROGRAPH AT					
+	B3	.28	1	FLOW	49.
				TIME	10.80
3 COMBINED AT					
+	C1	1.22	1	FLOW	227.
				TIME	10.80
ROUTED TO					
+	RC1	1.22	1	FLOW	221.
				TIME	10.80
HYDROGRAPH AT					
+	B4	.45	1	FLOW	88.
				TIME	10.80
HYDROGRAPH AT					
+	B5	.81	1	FLOW	161.
				TIME	10.80
3 COMBINED AT					
+	C2	2.48	1	FLOW	469.
				TIME	10.80
ROUTED TO					
+	RC2	2.48	1	FLOW	467.
				TIME	10.80
HYDROGRAPH AT					
+	B6	.15	1	FLOW	48.
				TIME	9.60
HYDROGRAPH AT					
+	B7	.33	1	FLOW	70.
				TIME	9.60
3 COMBINED AT					
+	C3	2.95	1	FLOW	579.
				TIME	10.80
ROUTED TO					
+	RC3	2.95	1	FLOW	555.
				TIME	10.80
HYDROGRAPH AT					
+	B8	1.01	1	FLOW	307.
				TIME	9.60
HYDROGRAPH AT					
+	B9	.24	1	FLOW	81.
				TIME	9.60
HYDROGRAPH AT					
+	B10	.13	1	FLOW	45.
				TIME	9.60
2 COMBINED AT					
+	C4	.37	1	FLOW	126.
				TIME	9.60
ROUTED TO					
+	RC4	.37	1	FLOW	117.
				TIME	9.60
HYDROGRAPH AT					
+	B11	.28	1	FLOW	91.
				TIME	9.60
4 COMBINED AT					
+	C5	4.61	1	FLOW	1031.
				TIME	10.80

```
 HYDROGRAPH AT
+                  B12          .13     1   FLOW          36.
                                            TIME         9.60

  2 COMBINED AT
+                  Call        4.74     1   FLOW        1064.
                                            TIME        10.80

 ROUTED TO
+                  Cove        4.74     1   FLOW          43.
                                            TIME        26.40

                                        ** PEAK STAGES IN FEET **
                                        1   STAGE     5548.87
                                            TIME        26.40
1
                                            SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                                (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                    INTERPOLATED TO
                                                                                 COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

           FOR PLAN = 1  RATIO=  .00
              RB1    MANE        14.40     95.90    648.00      2.02     72.00     95.90    648.00        2.04


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5431E+02 EXCESS= .0000E+00 OUTFLOW= .5432E+02 BASIN STORAGE= .4285E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC1    MANE        13.43    223.85    658.04      1.99     72.00    220.85    648.00        2.00


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1292E+03 EXCESS= .0000E+00 OUTFLOW= .1293E+03 BASIN STORAGE= .3778E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC2    MANE         3.33    467.63    649.64      2.05     72.00    466.77    648.00        2.06


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2710E+03 EXCESS= .0000E+00 OUTFLOW= .2710E+03 BASIN STORAGE= .3014E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC3    MANE        21.60    572.39    669.60      2.13     72.00    554.87    648.00        2.13


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3352E+03 EXCESS= .0000E+00 OUTFLOW= .3354E+03 BASIN STORAGE= .1060E-01 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC4    MANE         9.39    125.40    591.38      3.17     72.00    117.08    576.00        3.18


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .6274E+02 EXCESS= .0000E+00 OUTFLOW= .6274E+02 BASIN STORAGE= .2980E-02 PERCENT ERROR=    .0


1                               SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                              (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


      PLAN  1 .............                    INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                  ELEVATION        5545.50           5549.20          5552.00
                                  STORAGE             5845.             6508.            7347.
                                  OUTFLOW                0.               45.              435.


                        RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                          OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                         PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                        1.00      5548.87         .00       6408.        43.       .00        26.40         .00


 *** NORMAL END OF HEC-1 ***
```

Storm Event 8. 100-year, 6-hour AMC III

```
1****************************************                                  ************************************
 *                                      *                                  *                                  *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                  *    U.S. ARMY CORPS OF ENGINEERS  *
 *              JUN   1998              *                                  *    HYDROLOGIC ENGINEERING CENTER *
 *            VERSION 4.1               *                                  *         609 SECOND STREET        *
 *                                      *                                  *       DAVIS, CALIFORNIA 95616    *
 *  RUN DATE   06AUG20  TIME  02:54:27  *                                  *           (916) 756-1104         *
 *                                      *                                  *                                  *
 ****************************************                                  ************************************

                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X        X     X        XX
                                                X     X  X        X              X
                                                XXXXXXX  XXXX     X        XXXXX  X
                                                X     X  X        X              X
                                                X     X  X        X     X        X
                                                X     X  XXXXXXX   XXXXX         XXX


            THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

            THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
            THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
            NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
            DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
            KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                HEC-1 INPUT                                                PAGE  1

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

              1          ID   HYDROLOGY STUDY for COVE RESERVOIR
              2          ID   Located in KANE COUNTY, UTAH
              3          ID
              4          ID   AUG 2020
              5          ID
              6          ID   PREPARED BY ALPHA ENGINEERING
              7          ID   43 SOUTH 100 EAST, SUITE 100
              8          ID   ST. GEORGE, UTAH  84770
              9          ID   TEL: (435) 628-6500
             10          ID   FAX: (435) 628-6553
             11          ID
             12          ID   100-YR, 6-HR, AMC III
             13          ID
                         *Diagram
             14          JR    PREC     1.0
             15          IT      18       0       0      50
             16          IO       0
             17          IN      18
                         *

             18          KK   B1
             19          KM   Runoff from Basin 1
             20          BA   0.503
             21          PB    2.75
             22          PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
             23          PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
             24          PC   1.000
             25          LS       0    86.0
             26          UD    0.34
                         *

             27          KK   RB1
             28          KM   Route B1
             29          RD    4928    .045    .050           TRAP      20      20
                         *

             30          KK   B2
             31          KM   Runoff from Basin 2
             32          BA   0.436
             33          LS       0    85.8
             34          UD    0.34
                         *

             35          KK   B3
             36          KM   Runoff from Basin 3
             37          BA   0.279
             38          LS       0    84.9
             39          UD    0.25
                         *
1                                                HEC-1 INPUT                                                PAGE  2

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
             40          KK   C1
             41          KM   Combine RB1, B2, B3
             42          HC       3
                         *

             43          KK   RC1
             44          KM   Route RC1
             45          RD    7255    .060    .030           TRAP      20      20
                         *

             46          KK   B4
             47          KM   Runoff from Basin 4
             48          BA   0.453
             49          LS       0    86.3
             50          UD    0.32
                         *

             51          KK   B5
             52          KM   Runoff from Basin 5
             53          BA   0.805
             54          LS       0    86.8
             55          UD    0.42
                         *

             56          KK   C2
             57          KM   Combine RC1, B4, B5
             58          HC       3
                         *

             59          KK   RC2
             60          KM   Route C2
             61          RD    2380    .039    .030           TRAP      40       2
                         *

             62          KK   B6
             63          KM   Runoff from Basin 6
             64          BA   0.150
             65          LS       0    92.5
             66          UD    0.14
                         *

             67          KK   B7
             68          KM   Runoff from Basin 7
             69          BA   0.327
             70          LS       0    87.8
             71          UD    0.31
                         *

             72          KK   C3
             73          KM   Combine RC2, B6, B7
             74          HC       3
                         *
1                                          HEC-1 INPUT                                          PAGE  3

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             75          KK   RC3
             76          KM   Route C3
             77          RD   11323    .023    .030           TRAP      40      20
                         *

             78          KK   B8
             79          KM   Runoff from Basin 8
             80          BA   1.012
             81          LS       0    92.4
             82          UD    0.48
                         *

             83          KK   B9
             84          KM   Runoff from Basin 9
             85          BA   0.242
             86          LS       0    93.1
             87          UD    0.19
                         *

             88          KK   B10
             89          KM   Runoff from Basin 10
             90          BA   0.129
             91          LS       0    93.7
             92          UD    0.14
                         *

             93          KK   C4
             94          KM   Combine B9, B10
             95          HC       2
                         *

             96          KK   RC4
             97          KM   Route C4
             98          RD    3380    .037    .030           TRAP      40      20
                         *
```

```
             99           KK   B11
            100           KM   Runoff from Basin 11
            101           BA   0.279
            102           LS       0    92.8
            103           UD    0.28
                          *

            104           KK   C5
            105           KM   Combine RC3, B8, RC4, B11
            106           HC       4
                          *

            107           KK   B12
            108           KM   Runoff from Basin 12
            109           BA   0.127
            110           LS       0    90.9
            111           UD    0.28
                          *
1                                              HEC-1 INPUT                                                PAGE  4

           LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

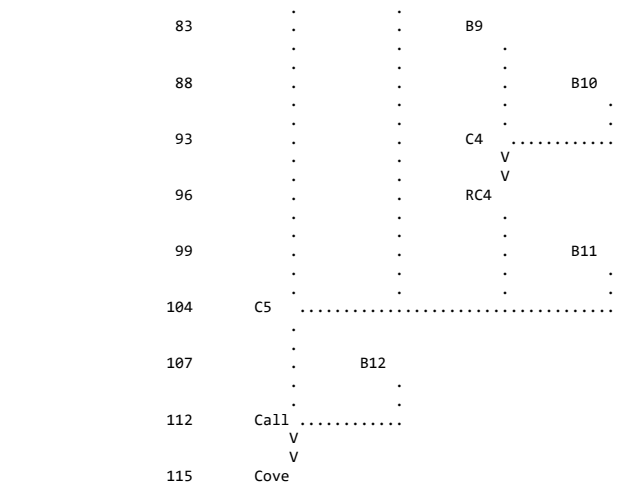

            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            115           KK   Cove Reservoir
            116           KM   Routing through Res'v
            117           RS       1    ELEV  5545.5
            118           SV       0      19      95     240     453     738    1105    1563    2217    2773
            119           SV    3542    4423    5419    6149    7347    8000
            120           SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
            121           SE    5530    5536    5542    5548    5552    5558
            122           SL  5545.5   4.909     0.6     0.5
            123           SS  5549.2      30    2.67     1.5
            124           ST  5552.0    1892     2.9     1.5
                          *
            125           ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK

 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

    NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     18       B1
                  V
                  V
     27       RB1
                  .
                  .
     30           .       B2
                  .           .
                  .           .
     35           .           .       B3
                  .           .           .
                  .           .           .
     40       C1   .......................
                  V
                  V
     43       RC1
                  .
                  .
     46           .       B4
                  .           .
                  .           .
     51           .           .       B5
                  .           .           .
                  .           .           .
     56       C2   .......................
                  V
                  V
     59       RC2
                  .
                  .
     62           .       B6
                  .           .
                  .           .
     67           .           .       B7
                  .           .           .
                  .           .           .
     72       C3   .......................
                  V
                  V
     75       RC3
                  .
                  .
     78           .       B8
                  .           .
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************                    *****************************************
 *                                       *                    *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *    U.S. ARMY CORPS OF ENGINEERS       *
 *              JUN   1998               *                    *    HYDROLOGIC ENGINEERING CENTER      *
 *            VERSION 4.1                *                    *          609 SECOND STREET            *
 *                                       *                    *       DAVIS, CALIFORNIA 95616         *
 *  RUN DATE   06AUG20  TIME  02:54:27   *                    *           (916) 756-1104              *
 *                                       *                    *                                       *
 *****************************************                    *****************************************
```

HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

100-YR, 6-HR, AMC III

```
  16 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           0  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN          18  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ          50  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      1    0  ENDING DATE
                     NDTIME        1442  ENDING TIME
                     ICENT           19  CENTURY MARK

                   COMPUTATION INTERVAL     .30 HOURS
                        TOTAL TIME BASE   14.70 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                       NPLAN           1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                    1.00
```

*** *** *** *

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 112 KK    *     Call   *
           *            *
           **************
                        Combine C5, B12

 114 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

*****************************************************************************************************************************************

                                                HYDROGRAPH AT STATION    Call
                                                     SUM OF  2 HYDROGRAPHS
                                                    PLAN 1,   RATIO =  1.00

*****************************************************************************************************************************************
                                *                                *                                *                                *
   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW
                                *                                *                                *
    1     0000    1        0.   *    1     0354   14     1248.   *    1     0748   27        53.   *    1     1142   40        0.
    1     0018    2        0.   *    1     0412   15     1032.   *    1     0806   28        30.   *    1     1200   41        0.
    1     0036    3        0.   *    1     0430   16      892.   *    1     0824   29        15.   *    1     1218   42        0.
    1     0054    4        1.   *    1     0448   17      796.   *    1     0842   30         8.   *    1     1236   43        0.
    1     0112    5       10.   *    1     0506   18      719.   *    1     0900   31         4.   *    1     1254   44        0.
    1     0130    6       39.   *    1     0524   19      668.   *    1     0918   32         2.   *    1     1312   45        0.
    1     0148    7      106.   *    1     0542   20      638.   *    1     0936   33         1.   *    1     1330   46        0.
    1     0206    8      321.   *    1     0600   21      611.   *    1     0954   34         0.   *    1     1348   47        0.
    1     0224    9      883.   *    1     0618   22      529.   *    1     1012   35         0.   *    1     1406   48        0.
    1     0242   10     1826.   *    1     0636   23      386.   *    1     1030   36         0.   *    1     1424   49        0.
    1     0300   11     2280.   *    1     0654   24      254.   *    1     1048   37         0.   *    1     1442   50        0.
    1     0318   12     1978.   *    1     0712   25      156.   *    1     1106   38         0.   *
    1     0336   13     1550.   *    1     0730   26       95.   *    1     1124   39         0.   *
                                *                                *                                *
*****************************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR     14.70-HR
+   (CFS)       (HR)
                        (CFS)
+    2280.      3.00                  847.         350.         350.         350.
                          (INCHES)    1.661        1.679        1.679        1.679
                           (AC-FT)     420.         425.         425.         425.

                           CUMULATIVE AREA =    4.74 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 115 KK    *     Cove   *     Reservoir
           *            *
           **************
                        Routing through Res'v

              HYDROGRAPH ROUTING DATA

 117 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC     5545.50  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

 118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                  3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

 120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                               5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

 122 SL          LOW-LEVEL OUTLET
                       ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                       CAREA        4.91  CROSS-SECTIONAL AREA
                        COQL         .60  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

 123 SS          SPILLWAY
                        CREL     5549.20  SPILLWAY CREST ELEVATION
                       SPWID       30.00  SPILLWAY WIDTH
                        COQW        2.67  WEIR COEFFICIENT
                        EXPW        1.50  EXPONENT OF HEAD

 124 ST          TOP OF DAM
```

TOPEL	5552.00	ELEVATION AT TOP OF DAM
DAMWID	1892.00	DAM WIDTH
COQD	2.90	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	5844.8	5545.5	1		0506	18	38.	6168.2	5548.1	1		1012	35	40.	6245.8	5548.3
1		0018	2	0.	5844.8	5545.5	1		0524	19	38.	6184.4	5548.1	1		1030	36	40.	6244.8	5548.3
1		0036	3	0.	5844.8	5545.5	1		0542	20	39.	6199.6	5548.2	1		1048	37	40.	6243.8	5548.3
1		0054	4	0.	5844.8	5545.5	1		0600	21	39.	6214.1	5548.2	1		1106	38	40.	6242.7	5548.3
1		0112	5	1.	5845.0	5545.5	1		0618	22	39.	6227.2	5548.3	1		1124	39	40.	6241.7	5548.3
1		0130	6	2.	5845.5	5545.5	1		0636	23	39.	6237.6	5548.3	1		1142	40	40.	6240.7	5548.3
1		0148	7	3.	5847.3	5545.5	1		0654	24	40.	6244.6	5548.3	1		1200	41	40.	6239.7	5548.3
1		0206	8	6.	5852.4	5545.6	1		0712	25	40.	6248.7	5548.3	1		1218	42	40.	6238.6	5548.3
1		0224	9	10.	5867.2	5545.7	1		0730	26	40.	6250.9	5548.3	1		1236	43	39.	6237.6	5548.3
1		0242	10	16.	5900.4	5546.0	1		0748	27	40.	6251.8	5548.3	1		1254	44	39.	6236.6	5548.3
1		0300	11	22.	5950.9	5546.4	1		0806	28	40.	6251.8	5548.3	1		1312	45	39.	6235.6	5548.3
1		0318	12	27.	6003.0	5546.8	1		0824	29	40.	6251.4	5548.3	1		1330	46	39.	6234.6	5548.3
1		0336	13	30.	6046.0	5547.2	1		0842	30	40.	6250.6	5548.3	1		1348	47	39.	6233.5	5548.3
1		0354	14	33.	6080.0	5547.4	1		0900	31	40.	6249.8	5548.3	1		1406	48	39.	6232.5	5548.3
1		0412	15	35.	6107.4	5547.7	1		0918	32	40.	6248.9	5548.3	1		1424	49	39.	6231.5	5548.3
1		0430	16	36.	6130.3	5547.8	1		0936	33	40.	6247.9	5548.3	1		1442	50	39.	6230.5	5548.3
1		0448	17	37.	6150.3	5548.0	1		0954	34	40.	6246.8	5548.3							

PEAK OUTFLOW IS 40. AT TIME 7.80 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	14.70-HR
+ (CFS)	(HR)				
		(CFS)			
+ 40.	7.80	40.	31.	31.	31.
		(INCHES) .078	.151	.151	.151
		(AC-FT) 20.	38.	38.	38.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	14.70-HR
+ (AC-FT)	(HR)				
6252.	7.80	6246.	6138.	6138.	6138.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	14.70-HR
+ (FEET)	(HR)				
5548.34	7.80	5548.32	5547.63	5547.63	5547.63

CUMULATIVE AREA = 4.74 SQ MI

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1
					1.00
HYDROGRAPH AT					
+	B1	.50	1	FLOW	252.
				TIME	2.70
ROUTED TO					
+	RB1	.50	1	FLOW	245.
				TIME	3.00
HYDROGRAPH AT					
+	B2	.44	1	FLOW	216.
				TIME	2.70
HYDROGRAPH AT					
+	B3	.28	1	FLOW	142.
				TIME	2.70
3 COMBINED AT					
+	C1	1.22	1	FLOW	542.
				TIME	2.70
ROUTED TO					
+	RC1	1.22	1	FLOW	538.
				TIME	3.00
HYDROGRAPH AT					
+	B4	.45	1	FLOW	237.
				TIME	2.70
HYDROGRAPH AT					
+	B5	.81	1	FLOW	376.
				TIME	2.70
3 COMBINED AT					
+	C2	2.48	1	FLOW	1100.
				TIME	3.00
ROUTED TO					
+	RC2	2.48	1	FLOW	1090.
				TIME	3.00
HYDROGRAPH AT					
+	B6	.15	1	FLOW	128.
				TIME	2.40
HYDROGRAPH AT					
+	B7	.33	1	FLOW	188.
				TIME	2.70
3 COMBINED AT					
+	C3	2.95	1	FLOW	1294.
				TIME	3.00
ROUTED TO					
+	RC3	2.95	1	FLOW	1250.
				TIME	3.30
HYDROGRAPH AT					
+	B8	1.01	1	FLOW	620.
				TIME	3.00
HYDROGRAPH AT					
+	B9	.24	1	FLOW	196.
				TIME	2.40
HYDROGRAPH AT					
+	B10	.13	1	FLOW	118.
				TIME	2.40
2 COMBINED AT					
+	C4	.37	1	FLOW	314.
				TIME	2.40
ROUTED TO					
+	RC4	.37	1	FLOW	290.
				TIME	2.70
HYDROGRAPH AT					
+	B11	.28	1	FLOW	212.
				TIME	2.70
4 COMBINED AT					
+	C5	4.61	1	FLOW	2218.
				TIME	3.00

```
 HYDROGRAPH AT
+                  B12          .13     1   FLOW          88.
                                            TIME         2.70

  2 COMBINED AT
+                  Call        4.74     1   FLOW        2280.
                                            TIME         3.00

 ROUTED TO
+                  Cove        4.74     1   FLOW          40.
                                            TIME         7.80

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     5548.34
                                            TIME         7.80
1
                                            SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                                (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                    INTERPOLATED TO
                                                                                  COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

          FOR PLAN = 1  RATIO=  .00
             RB1    MANE         4.50    251.41    175.50      1.45     18.00    245.28    180.00        1.45


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3891E+02 EXCESS= .0000E+00 OUTFLOW= .3894E+02 BASIN STORAGE= .4659E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
             RC1    MANE         4.50    551.33    175.50      1.43     18.00    538.17    180.00        1.42


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .9271E+02 EXCESS= .0000E+00 OUTFLOW= .9275E+02 BASIN STORAGE= .3503E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC2    MANE         2.45   1093.25    181.44      1.46     18.00   1089.58    180.00        1.46


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1924E+03 EXCESS= .0000E+00 OUTFLOW= .1925E+03 BASIN STORAGE= .2883E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC3    MANE         7.20   1313.52    187.20      1.50     18.00   1250.30    198.00        1.50


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2363E+03 EXCESS= .0000E+00 OUTFLOW= .2366E+03 BASIN STORAGE= .1038E-01 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
             RC4    MANE         5.40    310.06    156.60      2.04     18.00    289.52    162.00        2.04


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .4045E+02 EXCESS= .0000E+00 OUTFLOW= .4046E+02 BASIN STORAGE= .2901E-02 PERCENT ERROR=    .0


1                              SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                             (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


      PLAN  1 .....................                INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                     ELEVATION        5545.50           5549.20          5552.00
                                     STORAGE             5845.             6508.            7347.
                                     OUTFLOW                0.               45.              435.


                        RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                          OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                         PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                        1.00      5548.34         .00       6252.        40.       .00         7.80         .00


 *** NORMAL END OF HEC-1 ***
```

Storm Event 9. 100-year, 24-hour AMC III

```
1****************************************                                  ************************************
 *                                      *                                  *                                  *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                  *    U.S. ARMY CORPS OF ENGINEERS  *
 *              JUN   1998              *                                  *    HYDROLOGIC ENGINEERING CENTER *
 *            VERSION 4.1               *                                  *         609 SECOND STREET        *
 *                                      *                                  *       DAVIS, CALIFORNIA 95616    *
 *  RUN DATE   06AUG20  TIME  02:55:10  *                                  *           (916) 756-1104         *
 *                                      *                                  *                                  *
 ****************************************                                  ************************************

                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X        X     X        XX
                                                X     X  X        X              X
                                                XXXXXXX  XXXX     X        XXXXX  X
                                                X     X  X        X              X
                                                X     X  X        X     X        X
                                                X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   100-YR, 24-HR, AMC III
           13           ID
                        *Diagram
           14           JR    PREC     1.0
           15           IT      72       0       0      50
           16           IO       0
           17           IN      72
                        *

           18           KK   B1
           19           KM   Runoff from Basin 1
           20           BA   0.503
           21           PB    3.51
           22           PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
           23           PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
           24           PC   1.000
           25           LS       0    86.0
           26           UD    0.34
                        *

           27           KK   RB1
           28           KM   Route B1
           29           RD    4928    .045    .050           TRAP      20      20
                        *

           30           KK   B2
           31           KM   Runoff from Basin 2
           32           BA   0.436
           33           LS       0    85.8
           34           UD    0.34
                        *

           35           KK   B3
           36           KM   Runoff from Basin 3
           37           BA   0.279
           38           LS       0    84.9
           39           UD    0.25
                        *
1                                                HEC-1 INPUT                                                PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
             40          KK   C1
             41          KM   Combine RB1, B2, B3
             42          HC       3
                         *

             43          KK   RC1
             44          KM   Route RC1
             45          RD    7255    .060    .030           TRAP      20      20
                         *

             46          KK   B4
             47          KM   Runoff from Basin 4
             48          BA   0.453
             49          LS       0    86.3
             50          UD    0.32
                         *

             51          KK   B5
             52          KM   Runoff from Basin 5
             53          BA   0.805
             54          LS       0    86.8
             55          UD    0.42
                         *

             56          KK   C2
             57          KM   Combine RC1, B4, B5
             58          HC       3
                         *

             59          KK   RC2
             60          KM   Route C2
             61          RD    2380    .039    .030           TRAP      40       2
                         *

             62          KK   B6
             63          KM   Runoff from Basin 6
             64          BA   0.150
             65          LS       0    92.5
             66          UD    0.14
                         *

             67          KK   B7
             68          KM   Runoff from Basin 7
             69          BA   0.327
             70          LS       0    87.8
             71          UD    0.31
                         *

             72          KK   C3
             73          KM   Combine RC2, B6, B7
             74          HC       3
                         *
1                                          HEC-1 INPUT                                          PAGE  3

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             75          KK   RC3
             76          KM   Route C3
             77          RD   11323    .023    .030           TRAP      40      20
                         *

             78          KK   B8
             79          KM   Runoff from Basin 8
             80          BA   1.012
             81          LS       0    92.4
             82          UD    0.48
                         *

             83          KK   B9
             84          KM   Runoff from Basin 9
             85          BA   0.242
             86          LS       0    93.1
             87          UD    0.19
                         *

             88          KK   B10
             89          KM   Runoff from Basin 10
             90          BA   0.129
             91          LS       0    93.7
             92          UD    0.14
                         *

             93          KK   C4
             94          KM   Combine B9, B10
             95          HC       2
                         *

             96          KK   RC4
             97          KM   Route C4
             98          RD    3380    .037    .030           TRAP      40      20
                         *
```

```
             99           KK   B11
            100           KM   Runoff from Basin 11
            101           BA   0.279
            102           LS       0    92.8
            103           UD    0.28
                          *

            104           KK   C5
            105           KM   Combine RC3, B8, RC4, B11
            106           HC       4
                          *

            107           KK   B12
            108           KM   Runoff from Basin 12
            109           BA   0.127
            110           LS       0    90.9
            111           UD    0.28
                          *
1                                              HEC-1 INPUT                                                PAGE  4

           LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

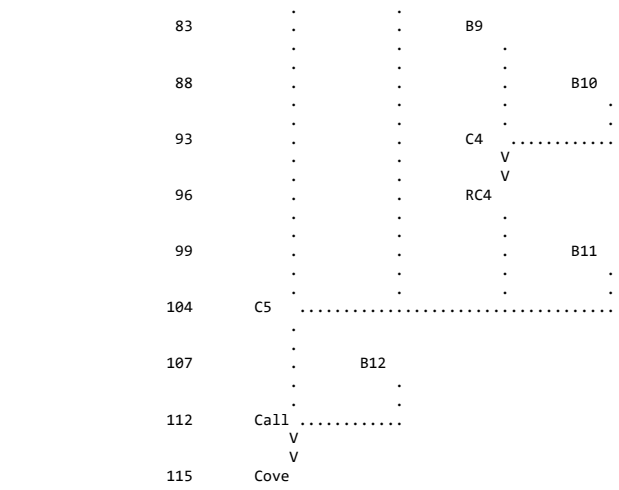

            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            115           KK   Cove Reservoir
            116           KM   Routing through Res'v
            117           RS       1    ELEV  5545.5
            118           SV       0      19      95     240     453     738    1105    1563    2217    2773
            119           SV    3542    4423    5419    6149    7347    8000
            120           SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
            121           SE    5530    5536    5542    5548    5552    5558
            122           SL  5545.5   4.909     0.6     0.5
            123           SS  5549.2      30    2.67     1.5
            124           ST  5552.0    1892     2.9     1.5
                          *
            125           ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK

 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

    NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     18       B1
                  V
                  V
     27       RB1
                  .
                  .
     30           .       B2
                  .           .
                  .           .
     35           .           .       B3
                  .           .           .
                  .           .           .
     40       C1   .......................
                  V
                  V
     43       RC1
                  .
                  .
     46           .       B4
                  .           .
                  .           .
     51           .           .       B5
                  .           .           .
                  .           .           .
     56       C2   .......................
                  V
                  V
     59       RC2
                  .
                  .
     62           .       B6
                  .           .
                  .           .
     67           .           .       B7
                  .           .           .
                  .           .           .
     72       C3   .......................
                  V
                  V
     75       RC3
                  .
                  .
     78           .       B8
                  .           .
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
 *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
 *              JUN   1998               *
 *            VERSION 4.1                *
 *                                       *
 *  RUN DATE   06AUG20  TIME  02:55:10   *
 *                                       *
 *****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

100-YR, 24-HR, AMC III

```
  16 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           0  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN          72  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ          50  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      3    0  ENDING DATE
                     NDTIME        1048  ENDING TIME
                     ICENT           19  CENTURY MARK

                   COMPUTATION INTERVAL    1.20 HOURS
                        TOTAL TIME BASE   58.80 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                       NPLAN           1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                    1.00
```

*** *** *** *

*** ***

```
          **************
          *            *
112 KK    *     Call   *
          *            *
          **************
                       Combine C5, B12

114 HC          HYDROGRAPH COMBINATION
                     ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***
```

****

HYDROGRAPH AT STATION Call
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = 1.00

****

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1	0000	1	0.	1	1	1536	14	305.	2	2	0712	27	0.	2	2	2248	40	0.
1	0112	2	0.	1	1	1648	15	266.	2	2	0824	28	0.	3	3	0000	41	0.
1	0224	3	0.	1	1	1800	16	248.	2	2	0936	29	0.	3	3	0112	42	0.
1	0336	4	6.	1	1	1912	17	223.	2	2	1048	30	0.	3	3	0224	43	0.
1	0448	5	18.	1	1	2024	18	209.	2	2	1200	31	0.	3	3	0336	44	0.
1	0600	6	44.	1	1	2136	19	205.	2	2	1312	32	0.	3	3	0448	45	0.
1	0712	7	101.	1	1	2248	20	204.	2	2	1424	33	0.	3	3	0600	46	0.
1	0824	8	371.	2	2	0000	21	185.	2	2	1536	34	0.	3	3	0712	47	0.
1	0936	9	1026.	2	2	0112	22	96.	2	2	1648	35	0.	3	3	0824	48	0.
1	1048	10	1031.	2	2	0224	23	37.	2	2	1800	36	0.	3	3	0936	49	0.
1	1200	11	662.	2	2	0336	24	12.	2	2	1912	37	0.	3	3	1048	50	0.
1	1312	12	453.	2	2	0448	25	3.	2	2	2024	38	0.					
1	1424	13	356.	2	2	0600	26	1.	2	2	2136	39	0.					

****

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	58.80-HR
(CFS)	(HR)				
		(CFS)			
1031.	10.80	707.	302.	124.	124.
		(INCHES) 1.386	2.372	2.377	2.377
		(AC-FT) 351.	600.	601.	601.

CUMULATIVE AREA = 4.74 SQ MI

*** ***

```
          **************
          *            *
115 KK    *     Cove   *     Reservoir
          *            *
          **************
                       Routing through Res'v

             HYDROGRAPH ROUTING DATA

117 RS          STORAGE ROUTING
                     NSTPS           1  NUMBER OF SUBREACHES
                      ITYP        ELEV  TYPE OF INITIAL CONDITION
                     RSVRIC     5545.50  INITIAL CONDITION
                          X         .00 WORKING R AND D COEFFICIENT

118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                              5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

122 SL          LOW-LEVEL OUTLET
                     ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                     CAREA        4.91  CROSS-SECTIONAL AREA
                      COQL         .60  COEFFICIENT
                      EXPL         .50  EXPONENT OF HEAD

123 SS          SPILLWAY
                      CREL     5549.20  SPILLWAY CREST ELEVATION
                     SPWID       30.00  SPILLWAY WIDTH
                      COQW        2.67  WEIR COEFFICIENT
                      EXPW        1.50  EXPONENT OF HEAD

124 ST          TOP OF DAM
```

TOPEL	5552.00	ELEVATION AT TOP OF DAM
DAMWID	1892.00	DAM WIDTH
COQD	2.90	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1	0000		1	0.	5844.8	5545.5	1		2024	18	42.	6325.1	5548.6	2		1648	35	42.	6337.5	5548.6
1	0112		2	0.	5844.8	5545.5	1		2136	19	42.	6341.5	5548.6	2		1800	36	42.	6333.4	5548.6
1	0224		3	0.	5844.8	5545.5	1		2248	20	42.	6357.5	5548.7	2		1912	37	42.	6329.3	5548.6
1	0336		4	1.	5845.1	5545.5	2		0000	21	43.	6372.6	5548.7	2		2024	38	42.	6325.2	5548.6
1	0448		5	2.	5846.1	5545.5	2		0112	22	43.	6382.3	5548.8	2		2136	39	41.	6321.1	5548.6
1	0600		6	4.	5848.8	5545.5	2		0224	23	43.	6384.6	5548.8	2		2248	40	41.	6317.0	5548.6
1	0712		7	7.	5855.4	5545.6	2		0336	24	43.	6382.8	5548.8	3		0000	41	41.	6312.9	5548.5
1	0824		8	12.	5877.9	5545.8	2		0448	25	43.	6379.3	5548.8	3		0112	42	41.	6308.8	5548.5
1	0936		9	21.	5945.5	5546.3	2		0600	26	43.	6375.2	5548.8	3		0224	43	41.	6304.7	5548.5
1	1048		10	30.	6044.9	5547.1	2		0712	27	43.	6371.0	5548.7	3		0336	44	41.	6300.7	5548.5
1	1200		11	36.	6125.6	5547.8	2		0824	28	42.	6366.8	5548.7	3		0448	45	41.	6296.6	5548.5
1	1312		12	38.	6177.2	5548.1	2		0936	29	42.	6362.5	5548.7	3		0600	46	41.	6292.5	5548.5
1	1424		13	39.	6213.5	5548.2	2		1048	30	42.	6358.3	5548.7	3		0712	47	41.	6288.4	5548.5
1	1536		14	40.	6242.4	5548.3	2		1200	31	42.	6354.0	5548.7	3		0824	48	41.	6284.3	5548.5
1	1648		15	40.	6266.9	5548.4	2		1312	32	42.	6349.8	5548.7	3		0936	49	40.	6280.3	5548.4
1	1800		16	41.	6288.4	5548.5	2		1424	33	42.	6345.7	5548.7	3		1048	50	40.	6276.4	5548.4
1	1912		17	41.	6307.7	5548.5	2		1536	34	42.	6341.6	5548.6							

PEAK OUTFLOW IS 43. AT TIME 26.40 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	58.80-HR
+ (CFS)	(HR)				
		(CFS)			
+ 43.	26.40	43.	42.	35.	35.
		(INCHES) .084	.331	.671	.671
		(AC-FT) 21.	84.	170.	170.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (AC-FT)	(HR)				
6385.	26.40	6381.	6358.	6233.	6233.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (FEET)	(HR)				
5548.79	26.40	5548.77	5548.70	5548.03	5548.03

CUMULATIVE AREA = 4.74 SQ MI

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1
					1.00
HYDROGRAPH AT					
+	B1	.50	1	FLOW	110.
				TIME	9.60
ROUTED TO					
+	RB1	.50	1	FLOW	102.
				TIME	10.80
HYDROGRAPH AT					
+	B2	.44	1	FLOW	94.
				TIME	9.60
HYDROGRAPH AT					
+	B3	.28	1	FLOW	57.
				TIME	9.60
3 COMBINED AT					
+	C1	1.22	1	FLOW	245.
				TIME	9.60
ROUTED TO					
+	RC1	1.22	1	FLOW	241.
				TIME	10.80
HYDROGRAPH AT					
+	B4	.45	1	FLOW	100.
				TIME	9.60
HYDROGRAPH AT					
+	B5	.81	1	FLOW	183.
				TIME	9.60
3 COMBINED AT					
+	C2	2.48	1	FLOW	502.
				TIME	9.60
ROUTED TO					
+	RC2	2.48	1	FLOW	496.
				TIME	10.80
HYDROGRAPH AT					
+	B6	.15	1	FLOW	44.
				TIME	9.60
HYDROGRAPH AT					
+	B7	.33	1	FLOW	78.
				TIME	9.60
3 COMBINED AT					
+	C3	2.95	1	FLOW	612.
				TIME	9.60
ROUTED TO					
+	RC3	2.95	1	FLOW	589.
				TIME	10.80
HYDROGRAPH AT					
+	B8	1.01	1	FLOW	298.
				TIME	9.60
HYDROGRAPH AT					
+	B9	.24	1	FLOW	73.
				TIME	9.60
HYDROGRAPH AT					
+	B10	.13	1	FLOW	40.
				TIME	9.60
2 COMBINED AT					
+	C4	.37	1	FLOW	113.
				TIME	9.60
ROUTED TO					
+	RC4	.37	1	FLOW	106.
				TIME	9.60
HYDROGRAPH AT					
+	B11	.28	1	FLOW	83.
				TIME	9.60
4 COMBINED AT					
+	C5	4.61	1	FLOW	1001.
				TIME	10.80

```
 HYDROGRAPH AT
+                  B12          .13     1   FLOW          35.
                                            TIME         9.60

  2 COMBINED AT
+                  Call        4.74     1   FLOW        1031.
                                            TIME        10.80

 ROUTED TO
+                  Cove        4.74     1   FLOW          43.
                                            TIME        26.40

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     5548.79
                                            TIME        26.40
1
                                            SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                                (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                    INTERPOLATED TO
                                                                                  COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

          FOR PLAN = 1  RATIO=  .00
             RB1    MANE        17.89    109.66    608.15      2.11     72.00    102.14    648.00        2.12


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5653E+02 EXCESS= .0000E+00 OUTFLOW= .5654E+02 BASIN STORAGE= .5474E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC1    MANE        13.16    246.58    605.26      2.08     72.00    240.71    648.00        2.09


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1354E+03 EXCESS= .0000E+00 OUTFLOW= .1354E+03 BASIN STORAGE= .3020E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC2    MANE         3.25    503.11    582.29      2.13     72.00    496.18    648.00        2.13


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2808E+03 EXCESS= .0000E+00 OUTFLOW= .2808E+03 BASIN STORAGE= .2726E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC3    MANE        23.97    630.14    623.12      2.17     72.00    588.94    648.00        2.18


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3423E+03 EXCESS= .0000E+00 OUTFLOW= .3424E+03 BASIN STORAGE= .1070E-01 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC4    MANE         9.67    112.23    590.06      2.78     72.00    105.70    576.00        2.78


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5492E+02 EXCESS= .0000E+00 OUTFLOW= .5492E+02 BASIN STORAGE= .2119E-02 PERCENT ERROR=    .0


1                              SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                             (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


       PLAN  1 ..............                  INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                ELEVATION         5545.50           5549.20          5552.00
                                STORAGE             5845.             6508.            7347.
                                OUTFLOW                0.               45.              435.


                        RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                          OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                         PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                        1.00      5548.79         .00       6385.        43.       .00        26.40         .00


 *** NORMAL END OF HEC-1 ***
```

Storm Event 10. Local SEP Hydrograph

```
1****************************************                                  ************************************
 *                                      *                                  *                                  *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                  *    U.S. ARMY CORPS OF ENGINEERS  *
 *              JUN   1998              *                                  *    HYDROLOGIC ENGINEERING CENTER *
 *            VERSION 4.1               *                                  *         609 SECOND STREET        *
 *                                      *                                  *       DAVIS, CALIFORNIA 95616    *
 *  RUN DATE   06AUG20  TIME  02:56:10  *                                  *           (916) 756-1104         *
 *                                      *                                  *                                  *
 ****************************************                                  ************************************

                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X        X     X        XX
                                                X     X  X        X              X
                                                XXXXXXX  XXXX     X        XXXXX  X
                                                X     X  X        X              X
                                                X     X  X        X     X        X
                                                X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


```
          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   Local SEP
           13           ID
                        *Diagram
           14           JR    PREC     1.0
           15           IT      18       0       0      50
           16           IO       0
           17           IN      18
                        *

           18           KK   B1
           19           KM   Runoff from Basin 1
           20           BA   0.503
           21           PB    7.67
           22           PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
           23           PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
           24           PC   1.000
           25           LS       0    72.8
           26           UD    0.51
                        *

           27           KK   RB1
           28           KM   Route B1
           29           RD    4928    .045    .050           TRAP      20      20
                        *

           30           KK   B2
           31           KM   Runoff from Basin 2
           32           BA   0.436
           33           LS       0    72.5
           34           UD    0.52
                        *

           35           KK   B3
           36           KM   Runoff from Basin 3
           37           BA   0.279
           38           LS       0    71.0
           39           UD    0.39
                        *
```



```
          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
             40          KK   C1
             41          KM   Combine RB1, B2, B3
             42          HC       3
                         *

             43          KK   RC1
             44          KM   Route RC1
             45          RD    7255    .060    .030           TRAP      20      20
                         *

             46          KK   B4
             47          KM   Runoff from Basin 4
             48          BA   0.453
             49          LS       0    73.3
             50          UD    0.48
                         *

             51          KK   B5
             52          KM   Runoff from Basin 5
             53          BA   0.805
             54          LS       0    74.1
             55          UD    0.63
                         *

             56          KK   C2
             57          KM   Combine RC1, B4, B5
             58          HC       3
                         *

             59          KK   RC2
             60          KM   Route C2
             61          RD    2380    .039    .030           TRAP      40       2
                         *

             62          KK   B6
             63          KM   Runoff from Basin 6
             64          BA   0.150
             65          LS       0    84.3
             66          UD    0.19
                         *

             67          KK   B7
             68          KM   Runoff from Basin 7
             69          BA   0.327
             70          LS       0    75.7
             71          UD    0.46
                         *

             72          KK   C3
             73          KM   Combine RC2, B6, B7
             74          HC       3
                         *
1                                          HEC-1 INPUT                                          PAGE  3

            LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             75          KK   RC3
             76          KM   Route C3
             77          RD   11323    .023    .030           TRAP      40      20
                         *

             78          KK   B8
             79          KM   Runoff from Basin 8
             80          BA   1.012
             81          LS       0    84.0
             82          UD    0.67
                         *

             83          KK   B9
             84          KM   Runoff from Basin 9
             85          BA   0.242
             86          LS       0    85.5
             87          UD    0.26
                         *

             88          KK   B10
             89          KM   Runoff from Basin 10
             90          BA   0.129
             91          LS       0    86.7
             92          UD    0.18
                         *

             93          KK   C4
             94          KM   Combine B9, B10
             95          HC       2
                         *

             96          KK   RC4
             97          KM   Route C4
             98          RD    3380    .037    .030           TRAP      40      20
                         *
```

```
             99           KK   B11
            100           KM   Runoff from Basin 11
            101           BA   0.279
            102           LS       0    84.8
            103           UD    0.39
                          *

            104           KK   C5
            105           KM   Combine RC3, B8, RC4, B11
            106           HC       4
                          *

            107           KK   B12
            108           KM   Runoff from Basin 12
            109           BA   0.127
            110           LS       0    81.2
            111           UD    0.40
                          *
1                                              HEC-1 INPUT                                              PAGE  4

           LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

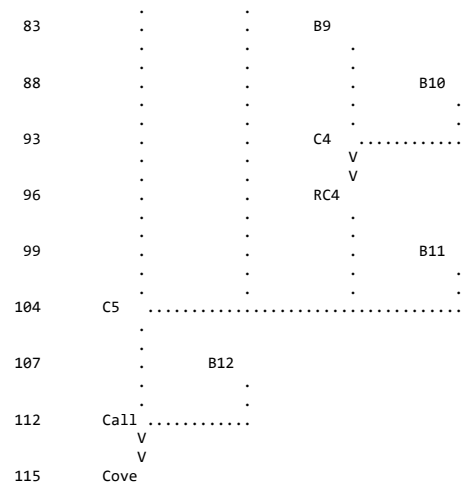

            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            115           KK   Cove Reservoir
            116           KM   Routing through Res'v
            117           RS       1    ELEV  5545.5
            118           SV       0      19      95     240     453     738    1105    1563    2217    2773
            119           SV    3542    4423    5419    6149    7347    8000
            120           SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
            121           SE    5530    5536    5542    5548    5552    5558
            122           SL  5545.5   4.909     0.6     0.5
            123           SS  5549.2      30    2.67     1.5
            124           ST  5552.0    1892     2.9     1.5
                          *
            125           ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK

 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

    NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     18       B1
                  V
                  V
     27       RB1
                  .
                  .
     30           .       B2
                  .           .
                  .           .
     35           .           .       B3
                  .           .           .
                  .           .           .
     40       C1   .......................
                  V
                  V
     43       RC1
                  .
                  .
     46           .       B4
                  .           .
                  .           .
     51           .           .       B5
                  .           .           .
                  .           .           .
     56       C2   .......................
                  V
                  V
     59       RC2
                  .
                  .
     62           .       B6
                  .           .
                  .           .
     67           .           .       B7
                  .           .           .
                  .           .           .
     72       C3   .......................
                  V
                  V
     75       RC3
                  .
                  .
     78           .       B8
                  .           .
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
 *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
 *              JUN   1998               *
 *            VERSION 4.1                *
 *                                       *
 *  RUN DATE   06AUG20  TIME  02:56:10   *
 *                                       *
 *****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

Local SEP

```
  16 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           0  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN          18  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ          50  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      1    0  ENDING DATE
                     NDTIME        1442  ENDING TIME
                     ICENT           19  CENTURY MARK

                  COMPUTATION INTERVAL     .30 HOURS
                       TOTAL TIME BASE   14.70 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                       NPLAN           1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                    1.00
```

*** *** *** *

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 112 KK    *     Call   *
           *            *
           **************
                        Combine C5, B12

 114 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

*****************************************************************************************************************************************************

                                                HYDROGRAPH AT STATION    Call
                                                     SUM OF  2 HYDROGRAPHS
                                                    PLAN 1,   RATIO =  1.00

*****************************************************************************************************************************************************
                                *                                       *                                       *
   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW
                                *                                       *                                       *
    1     0000    1        0.   *    1     0354   14     4063.   *    1     0748   27      201.   *    1     1142   40        0.
    1     0018    2        0.   *    1     0412   15     3364.   *    1     0806   28      113.   *    1     1200   41        0.
    1     0036    3        0.   *    1     0430   16     2855.   *    1     0824   29       62.   *    1     1218   42        0.
    1     0054    4        8.   *    1     0448   17     2500.   *    1     0842   30       34.   *    1     1236   43        0.
    1     0112    5       43.   *    1     0506   18     2228.   *    1     0900   31       18.   *    1     1254   44        0.
    1     0130    6      129.   *    1     0524   19     2039.   *    1     0918   32        9.   *    1     1312   45        0.
    1     0148    7      306.   *    1     0542   20     1913.   *    1     0936   33        5.   *    1     1330   46        0.
    1     0206    8      824.   *    1     0600   21     1819.   *    1     0954   34        2.   *    1     1348   47        0.
    1     0224    9     2325.   *    1     0618   22     1614.   *    1     1012   35        1.   *    1     1406   48        0.
    1     0242   10     4867.   *    1     0636   23     1240.   *    1     1030   36        0.   *    1     1424   49        0.
    1     0300   11     6395.   *    1     0654   24      851.   *    1     1048   37        0.   *    1     1442   50        0.
    1     0318   12     6123.   *    1     0712   25      540.   *    1     1106   38        0.   *
    1     0336   13     5053.   *    1     0730   26      332.   *    1     1124   39        0.   *
                                *                                       *                                       *
*****************************************************************************************************************************************************

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR     14.70-HR
+   (CFS)       (HR)
                      (CFS)
+    6395.      3.00                2560.        1059.        1059.         1059.
                     (INCHES)      5.019        5.085        5.085         5.085
                      (AC-FT)      1269.        1286.        1286.         1286.

                      CUMULATIVE AREA =    4.74 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 115 KK    *     Cove   *     Reservoir
           *            *
           **************
                        Routing through Res'v

              HYDROGRAPH ROUTING DATA

 117 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC     5545.50  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

 118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                  3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

 120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                               5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

 122 SL          LOW-LEVEL OUTLET
                       ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                       CAREA        4.91  CROSS-SECTIONAL AREA
                        COQL         .60  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

 123 SS          SPILLWAY
                        CREL     5549.20  SPILLWAY CREST ELEVATION
                       SPWID       30.00  SPILLWAY WIDTH
                        COQW        2.67  WEIR COEFFICIENT
                        EXPW        1.50  EXPONENT OF HEAD

 124 ST          TOP OF DAM
```

TOPEL	5552.00	ELEVATION AT TOP OF DAM
DAMWID	1892.00	DAM WIDTH
COQD	2.90	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1	0000		1	0.	5844.8	5545.5	1		0506	18	137.	6821.4	5550.2	1		1012	35	233.	7019.3	5550.9
1	0018		2	0.	5844.8	5545.5	1		0524	19	159.	6870.7	5550.4	1		1030	36	230.	7013.6	5550.9
1	0036		3	0.	5844.8	5545.5	1		0542	20	180.	6915.4	5550.6	1		1048	37	227.	7007.9	5550.9
1	0054		4	1.	5845.0	5545.5	1		0600	21	201.	6957.0	5550.7	1		1106	38	224.	7002.3	5550.8
1	0112		5	2.	5845.5	5545.5	1		0618	22	220.	6994.3	5550.8	1		1124	39	221.	6996.8	5550.8
1	0130		6	4.	5847.6	5545.5	1		0636	23	236.	7024.0	5550.9	1		1142	40	218.	6991.3	5550.8
1	0148		7	6.	5852.9	5545.6	1		0654	24	247.	7043.8	5551.0	1		1200	41	216.	6985.9	5550.8
1	0206		8	10.	5866.8	5545.7	1		0712	25	253.	7054.8	5551.0	1		1218	42	213.	6980.7	5550.8
1	0224		9	17.	5905.5	5546.0	1		0730	26	255.	7059.3	5551.0	1		1236	43	210.	6975.4	5550.8
1	0242		10	26.	5994.1	5546.7	1		0748	27	256.	7059.6	5551.0	1		1254	44	207.	6970.3	5550.7
1	0300		11	36.	6133.0	5547.9	1		0806	28	254.	7057.2	5551.0	1		1312	45	205.	6965.2	5550.7
1	0318		12	41.	6287.2	5548.5	1		0824	29	252.	7053.1	5551.0	1		1330	46	202.	6960.0	5550.7
1	0336		13	44.	6424.7	5548.9	1		0842	30	249.	7048.1	5551.0	1		1348	47	200.	6955.1	5550.7
1	0354		14	48.	6536.5	5549.3	1		0900	31	246.	7042.5	5551.0	1		1406	48	197.	6950.1	5550.7
1	0412		15	68.	6627.1	5549.6	1		0918	32	243.	7036.8	5551.0	1		1424	49	195.	6945.3	5550.7
1	0430		16	91.	6702.2	5549.8	1		0936	33	240.	7031.0	5550.9	1		1442	50	192.	6940.5	5550.6
1	0448		17	114.	6766.0	5550.1	1		0954	34	237.	7025.1	5550.9							

PEAK OUTFLOW IS 256. AT TIME 7.80 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	14.70-HR
+ (CFS)	(HR)				
	(CFS)				
+ 256.	7.80	238.	156.	156.	156.
	(INCHES)	.466	.752	.752	.752
	(AC-FT)	118.	190.	190.	190.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	14.70-HR
+ (AC-FT)	(HR)				
7060.	7.80	7027.	6705.	6705.	6705.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	14.70-HR
+ (FEET)	(HR)				
5551.04	7.80	5550.93	5549.59	5549.59	5549.59

CUMULATIVE AREA = 4.74 SQ MI

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1
					1.00
HYDROGRAPH AT					
+	B1	.50	1	FLOW	689.
				TIME	3.00
ROUTED TO					
+	RB1	.50	1	FLOW	657.
				TIME	3.00
HYDROGRAPH AT					
+	B2	.44	1	FLOW	589.
				TIME	3.00
HYDROGRAPH AT					
+	B3	.28	1	FLOW	393.
				TIME	2.70
3 COMBINED AT					
+	C1	1.22	1	FLOW	1608.
				TIME	3.00
ROUTED TO					
+	RC1	1.22	1	FLOW	1507.
				TIME	3.00
HYDROGRAPH AT					
+	B4	.45	1	FLOW	636.
				TIME	3.00
HYDROGRAPH AT					
+	B5	.81	1	FLOW	1050.
				TIME	3.00
3 COMBINED AT					
+	C2	2.48	1	FLOW	3194.
				TIME	3.00
ROUTED TO					
+	RC2	2.48	1	FLOW	3137.
				TIME	3.00
HYDROGRAPH AT					
+	B6	.15	1	FLOW	351.
				TIME	2.40
HYDROGRAPH AT					
+	B7	.33	1	FLOW	490.
				TIME	3.00
3 COMBINED AT					
+	C3	2.95	1	FLOW	3813.
				TIME	3.00
ROUTED TO					
+	RC3	2.95	1	FLOW	3723.
				TIME	3.30
HYDROGRAPH AT					
+	B8	1.01	1	FLOW	1656.
				TIME	3.00
HYDROGRAPH AT					
+	B9	.24	1	FLOW	547.
				TIME	2.70
HYDROGRAPH AT					
+	B10	.13	1	FLOW	326.
				TIME	2.40
2 COMBINED AT					
+	C4	.37	1	FLOW	835.
				TIME	2.70
ROUTED TO					
+	RC4	.37	1	FLOW	819.
				TIME	2.70
HYDROGRAPH AT					
+	B11	.28	1	FLOW	575.
				TIME	2.70
4 COMBINED AT					
+	C5	4.61	1	FLOW	6184.
				TIME	3.00

```
 HYDROGRAPH AT
+                  B12          .13     1   FLOW         238.
                                            TIME         2.70

  2 COMBINED AT
+                  Call        4.74     1   FLOW        6395.
                                            TIME         3.00

 ROUTED TO
+                  Cove        4.74     1   FLOW         256.
                                            TIME         7.80

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     5551.04
                                            TIME         7.80
1
                                            SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                                (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                    INTERPOLATED TO
                                                                                  COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

           FOR PLAN = 1  RATIO=  .00
              RB1    MANE         5.40    673.41    189.00      4.50     18.00    657.41    180.00        4.48


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1206E+03 EXCESS= .0000E+00 OUTFLOW= .1207E+03 BASIN STORAGE= .3686E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC1    MANE         5.40   1594.30    189.00      4.43     18.00   1507.33    180.00        4.43


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2880E+03 EXCESS= .0000E+00 OUTFLOW= .2881E+03 BASIN STORAGE= .3547E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC2    MANE         1.67   3186.21    182.05      4.52     18.00   3137.38    180.00        4.53


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5970E+03 EXCESS= .0000E+00 OUTFLOW= .5970E+03 BASIN STORAGE= .3099E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC3    MANE         7.20   3778.09    194.40      4.63     18.00   3723.23    198.00        4.64


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .7287E+03 EXCESS= .0000E+00 OUTFLOW= .7291E+03 BASIN STORAGE= .1048E-01 PERCENT ERROR=   -.1


           FOR PLAN = 1  RATIO=  .00
              RC4    MANE         5.53    841.55    154.72      6.01     18.00    818.78    162.00        6.02


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1188E+03 EXCESS= .0000E+00 OUTFLOW= .1189E+03 BASIN STORAGE= .2808E-02 PERCENT ERROR=    .0


1                              SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                             (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


       PLAN  1 ..............                  INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                ELEVATION         5545.50           5549.20          5552.00
                                STORAGE             5845.             6508.            7347.
                                OUTFLOW                0.               45.              435.


                        RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                          OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                         PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                        1.00      5551.04         .00       7060.       256.       .00         7.80         .00


 *** NORMAL END OF HEC-1 ***
```

Storm Event 11. General SEP Hydrograph

```
1****************************************                                  ************************************
 *                                      *                                  *                                  *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                  *    U.S. ARMY CORPS OF ENGINEERS  *
 *              JUN   1998              *                                  *    HYDROLOGIC ENGINEERING CENTER *
 *            VERSION 4.1               *                                  *         609 SECOND STREET        *
 *                                      *                                  *       DAVIS, CALIFORNIA 95616    *
 *  RUN DATE   06AUG20  TIME  02:56:37  *                                  *           (916) 756-1104         *
 *                                      *                                  *                                  *
 ****************************************                                  ************************************

                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X        X     X        XX
                                                X     X  X        X              X
                                                XXXXXXX  XXXX     X        XXXXX  X
                                                X     X  X        X              X
                                                X     X  X        X     X        X
                                                X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   SEP General
           13           ID
                        *Diagram
           14           JR    PREC     1.0
           15           IT     216       0       0      50
           16           IO       0
           17           IN     216
                        *

           18           KK   B1
           19           KM   Runoff from Basin 1
           20           BA   0.503
           21           PB   12.50
           22           PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
           23           PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
           24           PC   1.000
           25           LS       0    72.8
           26           UD    0.51
                        *

           27           KK   RB1
           28           KM   Route B1
           29           RD    4928    .045    .050           TRAP      20      20
                        *

           30           KK   B2
           31           KM   Runoff from Basin 2
           32           BA   0.436
           33           LS       0    72.5
           34           UD    0.52
                        *

           35           KK   B3
           36           KM   Runoff from Basin 3
           37           BA   0.279
           38           LS       0    71.0
           39           UD    0.39
                        *
1                                                HEC-1 INPUT                                                PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
             40          KK   C1
             41          KM   Combine RB1, B2, B3
             42          HC       3
                         *

             43          KK   RC1
             44          KM   Route RC1
             45          RD    7255    .060    .030           TRAP      20      20
                         *

             46          KK   B4
             47          KM   Runoff from Basin 4
             48          BA   0.453
             49          LS       0    73.3
             50          UD    0.48
                         *

             51          KK   B5
             52          KM   Runoff from Basin 5
             53          BA   0.805
             54          LS       0    74.1
             55          UD    0.63
                         *

             56          KK   C2
             57          KM   Combine RC1, B4, B5
             58          HC       3
                         *

             59          KK   RC2
             60          KM   Route C2
             61          RD    2380    .039    .030           TRAP      40       2
                         *

             62          KK   B6
             63          KM   Runoff from Basin 6
             64          BA   0.150
             65          LS       0    84.3
             66          UD    0.19
                         *

             67          KK   B7
             68          KM   Runoff from Basin 7
             69          BA   0.327
             70          LS       0    75.7
             71          UD    0.46
                         *

             72          KK   C3
             73          KM   Combine RC2, B6, B7
             74          HC       3
                         *
1                                          HEC-1 INPUT                                          PAGE  3

            LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             75          KK   RC3
             76          KM   Route C3
             77          RD   11323    .023    .030           TRAP      40      20
                         *

             78          KK   B8
             79          KM   Runoff from Basin 8
             80          BA   1.012
             81          LS       0    84.0
             82          UD    0.67
                         *

             83          KK   B9
             84          KM   Runoff from Basin 9
             85          BA   0.242
             86          LS       0    85.5
             87          UD    0.26
                         *

             88          KK   B10
             89          KM   Runoff from Basin 10
             90          BA   0.129
             91          LS       0    86.7
             92          UD    0.18
                         *

             93          KK   C4
             94          KM   Combine B9, B10
             95          HC       2
                         *

             96          KK   RC4
             97          KM   Route C4
             98          RD    3380    .037    .030           TRAP      40      20
                         *
```

```
             99           KK   B11
            100           KM   Runoff from Basin 11
            101           BA   0.279
            102           LS       0    84.8
            103           UD    0.39
                          *

            104           KK   C5
            105           KM   Combine RC3, B8, RC4, B11
            106           HC       4
                          *

            107           KK   B12
            108           KM   Runoff from Basin 12
            109           BA   0.127
            110           LS       0    81.2
            111           UD    0.40
                          *
1                                              HEC-1 INPUT                                              PAGE  4

           LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

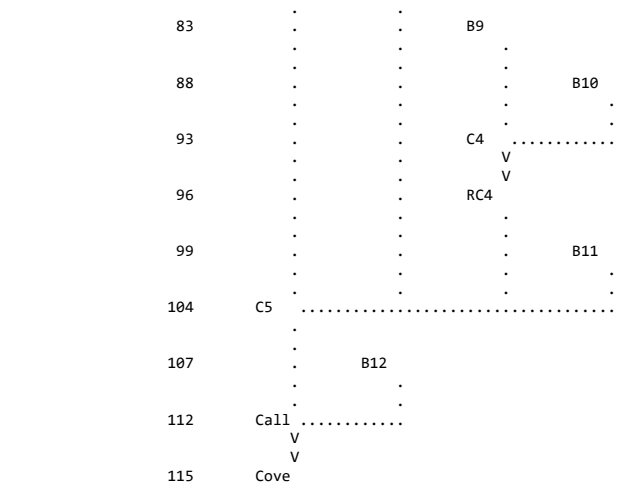

            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            115           KK   Cove Reservoir
            116           KM   Routing through Res'v
            117           RS       1    ELEV  5545.5
            118           SV       0      19      95     240     453     738    1105    1563    2217    2773
            119           SV    3542    4423    5419    6149    7347    8000
            120           SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
            121           SE    5530    5536    5542    5548    5552    5558
            122           SL  5545.5   4.909     0.6     0.5
            123           SS  5549.2      30    2.67     1.5
            124           ST  5552.0    1892     2.9     1.5
                          *
            125           ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK

 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

    NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     18       B1
                  V
                  V
     27       RB1
                  .
                  .
     30           .       B2
                  .           .
                  .           .
     35           .           .       B3
                  .           .           .
                  .           .           .
     40       C1   .......................
                  V
                  V
     43       RC1
                  .
                  .
     46           .       B4
                  .           .
                  .           .
     51           .           .       B5
                  .           .           .
                  .           .           .
     56       C2   .......................
                  V
                  V
     59       RC2
                  .
                  .
     62           .       B6
                  .           .
                  .           .
     67           .           .       B7
                  .           .           .
                  .           .           .
     72       C3   .......................
                  V
                  V
     75       RC3
                  .
                  .
     78           .       B8
                  .           .
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************                    *****************************************
 *                                       *                    *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *    U.S. ARMY CORPS OF ENGINEERS       *
 *              JUN   1998               *                    *    HYDROLOGIC ENGINEERING CENTER      *
 *            VERSION 4.1                *                    *          609 SECOND STREET            *
 *                                       *                    *       DAVIS, CALIFORNIA 95616         *
 *  RUN DATE   06AUG20  TIME  02:56:37   *                    *           (916) 756-1104              *
 *                                       *                    *                                       *
 *****************************************                    *****************************************
```

HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

SEP General

```
  16 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           0  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN         216  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ          50  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      8    0  ENDING DATE
                     NDTIME        0824  ENDING TIME
                     ICENT           19  CENTURY MARK

                  COMPUTATION INTERVAL    3.60 HOURS
                       TOTAL TIME BASE  176.40 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                       NPLAN           1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                    1.00


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
```

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 112 KK    *     Call   *
           *            *
           **************
                        Combine C5, B12

 114 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

*********************************************************************************************************************************************

                                                HYDROGRAPH AT STATION    Call
                                                     SUM OF  2 HYDROGRAPHS
                                                    PLAN 1,   RATIO =  1.00

*********************************************************************************************************************************************
                                *                                       *                                       *
   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW
                                *                                       *                                       *
    1     0000    1        0.   *    2     2248   14       372.   *    4     2136   27        0.   *    6     2024   40        0.
    1     0336    2        0.   *    3     0224   15       323.   *    5     0112   28        0.   *    7     0000   41        0.
    1     0712    3        5.   *    3     0600   16       307.   *    5     0448   29        0.   *    7     0336   42        0.
    1     1048    4       25.   *    3     0936   17       271.   *    5     0824   30        0.   *    7     0712   43        0.
    1     1424    5       56.   *    3     1312   18       257.   *    5     1200   31        0.   *    7     1048   44        0.
    1     1800    6      120.   *    3     1648   19       254.   *    5     1536   32        0.   *    7     1424   45        0.
    1     2136    7      235.   *    3     2024   20       254.   *    5     1912   33        0.   *    7     1800   46        0.
    2     0112    8      688.   *    4     0000   21       221.   *    5     2248   34        0.   *    7     2136   47        0.
    2     0448    9     1587.   *    4     0336   22        81.   *    6     0224   35        0.   *    8     0112   48        0.
    2     0824   10     1393.   *    4     0712   23        21.   *    6     0600   36        0.   *    8     0448   49        0.
    2     1200   11      771.   *    4     1048   24         4.   *    6     0936   37        0.   *    8     0824   50        0.
    2     1536   12      523.   *    4     1424   25         1.   *    6     1312   38        0.   *
    2     1912   13      428.   *    4     1800   26         0.   *    6     1648   39        0.   *
                                *                                       *                                       *
*********************************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR     176.40-HR
+   (CFS)       (HR)
                        (CFS)
+    1587.     28.80                1490.         882.         409.          167.
                          (INCHES)    1.753        6.228        9.622         9.643
                           (AC-FT)     443.        1575.        2433.         2439.

                         CUMULATIVE AREA =    4.74 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 115 KK    *     Cove   *     Reservoir
           *            *
           **************
                        Routing through Res'v

              HYDROGRAPH ROUTING DATA

 117 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                      RSVRIC     5545.50  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

 118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                  3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

 120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                               5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

 122 SL          LOW-LEVEL OUTLET
                       ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                       CAREA        4.91  CROSS-SECTIONAL AREA
                        COQL         .60  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

 123 SS          SPILLWAY
                        CREL     5549.20  SPILLWAY CREST ELEVATION
                       SPWID       30.00  SPILLWAY WIDTH
                        COQW        2.67  WEIR COEFFICIENT
                        EXPW        1.50  EXPONENT OF HEAD

 124 ST          TOP OF DAM
```

TOPEL	5552.00	ELEVATION AT TOP OF DAM
DAMWID	1892.00	DAM WIDTH
COQD	2.90	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	5844.8	5545.5	3		1312	18	326.	7179.3	5551.4	6		0224	35	61.	6601.8	5549.5
1		0336	2	0.	5844.8	5545.5	3		1648	19	314.	7160.1	5551.4	6		0600	36	57.	6584.2	5549.5
1		0712	3	2.	5845.4	5545.5	3		2024	20	304.	7143.7	5551.3	6		0936	37	54.	6567.7	5549.4
1		1048	4	4.	5849.0	5545.5	4		0000	21	294.	7125.6	5551.3	6		1312	38	51.	6552.2	5549.3
1		1424	5	8.	5859.3	5545.6	4		0336	22	271.	7086.7	5551.1	6		1648	39	48.	6537.4	5549.3
1		1800	6	13.	5882.4	5545.8	4		0712	23	237.	7026.1	5550.9	6		2024	40	47.	6523.2	5549.2
1		2136	7	20.	5930.4	5546.2	4		1048	24	204.	6964.1	5550.7	7		0000	41	45.	6509.5	5549.2
2		0112	8	31.	6060.0	5547.3	4		1424	25	177.	6908.3	5550.5	7		0336	42	45.	6496.0	5549.2
2		0448	9	43.	6386.9	5548.8	4		1800	26	154.	6859.3	5550.4	7		0712	43	45.	6482.6	5549.1
2		0824	10	130.	6804.4	5550.2	4		2136	27	135.	6816.4	5550.2	7		1048	44	45.	6469.3	5549.1
2		1200	11	261.	7069.4	5551.1	5		0112	28	119.	6778.6	5550.1	7		1424	45	44.	6456.0	5549.0
2		1536	12	323.	7174.9	5551.4	5		0448	29	106.	6745.1	5550.0	7		1800	46	44.	6442.9	5549.0
2		1912	13	349.	7216.3	5551.6	5		0824	30	95.	6715.1	5549.9	7		2136	47	44.	6429.9	5548.9
2		2248	14	358.	7230.0	5551.6	5		1200	31	86.	6688.0	5549.8	8		0112	48	44.	6417.1	5548.9
3		0224	15	356.	7227.2	5551.6	5		1536	32	78.	6663.6	5549.7	8		0448	49	43.	6404.2	5548.9
3		0600	16	349.	7216.0	5551.6	5		1912	33	72.	6641.2	5549.6	8		0824	50	43.	6391.5	5548.8
3		0936	17	339.	7199.7	5551.5	5		2248	34	66.	6620.8	5549.6							

PEAK OUTFLOW IS 358. AT TIME 46.80 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	176.40-HR
+ (CFS)	(HR)				
	(CFS)				
+ 358.	46.80	357.	346.	254.	130.
	(INCHES)	.420	2.442	5.987	7.487
	(AC-FT)	106.	618.	1514.	1894.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	176.40-HR
+ (AC-FT)	(HR)				
7230.	46.80	7229.	7211.	7044.	6643.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	176.40-HR
+ (FEET)	(HR)				
5551.61	46.80	5551.60	5551.55	5550.99	5549.46

CUMULATIVE AREA = 4.74 SQ MI

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1
					1.00
HYDROGRAPH AT					
+	B1	.50	1	FLOW	162.
				TIME	28.80
ROUTED TO					
+	RB1	.50	1	FLOW	156.
				TIME	28.80
HYDROGRAPH AT					
+	B2	.44	1	FLOW	140.
				TIME	28.80
HYDROGRAPH AT					
+	B3	.28	1	FLOW	87.
				TIME	28.80
3 COMBINED AT					
+	C1	1.22	1	FLOW	382.
				TIME	28.80
ROUTED TO					
+	RC1	1.22	1	FLOW	371.
				TIME	28.80
HYDROGRAPH AT					
+	B4	.45	1	FLOW	147.
				TIME	28.80
HYDROGRAPH AT					
+	B5	.81	1	FLOW	266.
				TIME	28.80
3 COMBINED AT					
+	C2	2.48	1	FLOW	785.
				TIME	28.80
ROUTED TO					
+	RC2	2.48	1	FLOW	780.
				TIME	28.80
HYDROGRAPH AT					
+	B6	.15	1	FLOW	58.
				TIME	28.80
HYDROGRAPH AT					
+	B7	.33	1	FLOW	111.
				TIME	28.80
3 COMBINED AT					
+	C3	2.95	1	FLOW	949.
				TIME	28.80
ROUTED TO					
+	RC3	2.95	1	FLOW	900.
				TIME	28.80
HYDROGRAPH AT					
+	B8	1.01	1	FLOW	389.
				TIME	28.80
HYDROGRAPH AT					
+	B9	.24	1	FLOW	95.
				TIME	28.80
HYDROGRAPH AT					
+	B10	.13	1	FLOW	51.
				TIME	28.80
2 COMBINED AT					
+	C4	.37	1	FLOW	146.
				TIME	28.80
ROUTED TO					
+	RC4	.37	1	FLOW	143.
				TIME	28.80
HYDROGRAPH AT					
+	B11	.28	1	FLOW	108.
				TIME	28.80
4 COMBINED AT					
+	C5	4.61	1	FLOW	1540.
				TIME	28.80

```
 HYDROGRAPH AT
+                  B12          .13     1   FLOW          47.
                                            TIME        28.80

  2 COMBINED AT
+                  Call        4.74     1   FLOW        1587.
                                            TIME        28.80

 ROUTED TO
+                  Cove        4.74     1   FLOW         358.
                                            TIME        46.80

                                        ** PEAK STAGES IN FEET **
                                        1   STAGE     5551.61
                                            TIME        46.80
1
                                            SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                                (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                    INTERPOLATED TO
                                                                                  COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

           FOR PLAN = 1  RATIO=  .00
              RB1    MANE        16.14    161.33   1758.92      8.92    216.00    155.93   1728.00        8.94


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2392E+03 EXCESS= .0000E+00 OUTFLOW= .2392E+03 BASIN STORAGE= .3928E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC1    MANE        11.70    381.73   1743.12      8.85    216.00    371.42   1728.00        8.87


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5750E+03 EXCESS= .0000E+00 OUTFLOW= .5750E+03 BASIN STORAGE= .2955E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC2    MANE         2.77    784.17   1730.55      8.97    216.00    779.86   1728.00        8.97


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1184E+04 EXCESS= .0000E+00 OUTFLOW= .1184E+04 BASIN STORAGE= .2978E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC3    MANE        21.20    945.64   1759.24      9.09    216.00    900.19   1728.00        9.11


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1431E+04 EXCESS= .0000E+00 OUTFLOW= .1431E+04 BASIN STORAGE= .1049E-01 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC4    MANE         9.01    145.33   1739.46     10.73    216.00    142.95   1728.00       10.74


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2123E+03 EXCESS= .0000E+00 OUTFLOW= .2123E+03 BASIN STORAGE= .2832E-02 PERCENT ERROR=    .0


1                              SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                             (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


      PLAN  1 .............                  INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                               ELEVATION        5545.50           5549.20          5552.00
                               STORAGE             5845.             6508.            7347.
                               OUTFLOW                0.               45.              435.


                      RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                        OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                       PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                      1.00      5551.61         .00       7230.       358.       .00        46.80         .00


 *** NORMAL END OF HEC-1 ***
```

Storm Event 12. Principal Spillway Hydrograph

```
1****************************************                                    ****************************************
 *                                      *                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                    *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1               *                                    *         609 SECOND STREET            *
 *                                      *                                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   06AUG20  TIME  03:15:56  *                                    *           (916) 756-1104             *
 *                                      *                                    *                                      *
 ****************************************                                    ****************************************

                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X        X     X        XX
                                                X     X  X        X              X
                                                XXXXXXX  XXXX     X        XXXXX  X
                                                X     X  X        X              X
                                                X     X  X        X     X        X
                                                X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM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          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   PSH (NEH)
           13           ID
                        *Diagram
           14           JR    PREC     1.0
           15           IT      60       0       0     350
           16           IO       0
           17           IN      60
                        *
           18           QI       0      11      14      15      15      15      15      15      15      15
           19           QI      15      16      16      16      16      16      16      16      16      16
           20           QI      16      17      17      17      17      17      17      17      17      17
           21           QI      17      18      18      18      18      18      18      18      18      19
           22           QI      19      19      19      19      19      20      20      20      20      20
           23           QI      20      21      21      21      21      21      21      22      22      22
           24           QI      22      23      23      23      23      24      24      24      24      25
           25           QI      25      25      26      26      26      27      27      27      28      28
           26           QI      29      29      29      30      30      31      31      32      33      33
           27           QI      34      35      35      36      37      38      39      40      41      42
           28           QI      43      45      46      48      49      51      53      56      58      61
           29           QI      65      69      74      80      87      96     109     127     157     219
           30           QI     850     479     259     172     132     111      98      88      81      75
           31           QI      70      65      62      59      56      54      51      50      48      46
           32           QI      45      43      42      41      40      39      38      37      36      35
           33           QI      35      34      33      33      32      32      31      30      30      29
           34           QI      29      29      28      28      27      27      27      26      26      26
           35           QI      25      25      25      24      24      24      24      23      23      23
           36           QI      23      22      22      22      22      22      21      21      21      21
           37           QI      21      20      20      20      20      20      20      19      19      19
           38           QI      19      19      19      19      18      18      18      18      18      18
           39           QI      18      17      17      17      17      17      17      17      17      17
           40           QI      17      16      16      16      16      16      16      16      16      16
           41           QI      16      15      15      15      15      15      15      15      15      15
           42           QI      15       4       1
                        *

           43           KK   Cove Reservoir
           44           KM   Routing through Res'v
           45           RS       1    ELEV  5545.5
           46           SV       0      19      95     240     453     738    1105    1563    2217    2773
           47           SV    3542    4423    5419    6149    7347    8000
           48           SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
           49           SE    5530    5536    5542    5548    5552    5558
           50           SL  5545.5   4.909     0.6     0.5
```

```
            51          SS  5549.2      30    2.67     1.5
1                                          HEC-1 INPUT                                          PAGE  2

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            52          ST  5552.0    1892     2.9     1.5
                        *
            53          ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

    NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

 *** HEC1 ERROR 4 *** NO HYDROGRAPHS AVAILABLE TO ROUTE
                 V
                 V
    43       Cove

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION

         1 ERRORS IN STREAM SYSTEM
1****************************************                                  ****************************************
 *                                      *                                 *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                 *    U.S. ARMY CORPS OF ENGINEERS      *
 *               JUN   1998             *                                 *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1               *                                 *          609 SECOND STREET           *
 *                                      *                                 *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   06AUG20  TIME  03:15:56  *                                 *           (916) 756-1104             *
 *                                      *                                 *                                      *
 ****************************************                                  ****************************************



                          HYDROLOGY STUDY for COVE RESERVOIR
                          Located in KANE COUNTY, UTAH

                          AUG 2020

                          PREPARED BY ALPHA ENGINEERING
                          43 SOUTH 100 EAST, SUITE 100
                          ST. GEORGE, UTAH  84770
                          TEL: (435) 628-6500
                          FAX: (435) 628-6553

                          PSH (NEH)


   16 IO          OUTPUT CONTROL VARIABLES
                        IPRNT           0  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE

      IT          HYDROGRAPH TIME DATA
                         NMIN          60  MINUTES IN COMPUTATION INTERVAL
                        IDATE      1    0  STARTING DATE
                        ITIME        0000  STARTING TIME
                           NQ         350  NUMBER OF HYDROGRAPH ORDINATES
                       NDDATE     15    0  ENDING DATE
                       NDTIME       1300  ENDING TIME
                       ICENT          19  CENTURY MARK

                    COMPUTATION INTERVAL    1.00 HOURS
                         TOTAL TIME BASE  349.00 HOURS

            ENGLISH UNITS
                 DRAINAGE AREA         SQUARE MILES
                 PRECIPITATION DEPTH   INCHES
                 LENGTH, ELEVATION     FEET
                 FLOW                  CUBIC FEET PER SECOND
                 STORAGE VOLUME        ACRE-FEET
                 SURFACE AREA          ACRES
                 TEMPERATURE           DEGREES FAHRENHEIT

      JP          MULTI-PLAN OPTION
                        NPLAN           1  NUMBER OF PLANS

      JR          MULTI-RATIO OPTION
                      RATIOS OF PRECIPITATION
                     1.00

   17 IN          TIME DATA FOR INPUT TIME SERIES
                         JXMIN          60  TIME INTERVAL IN MINUTES
                        JXDATE      1    0  STARTING DATE
                        JXTIME           0  STARTING TIME

                SUBBASIN RUNOFF DATA

    0 BA          SUBBASIN CHARACTERISTICS
```

TAREA .00 SUBBASIN AREA

***

HYDROGRAPH AT STATION Cove

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	4		1600	89	33.	8		0800	177	24.	12		0000	265	1.
1		0100	2	11.	4		1700	90	33.	8		0900	178	23.	12		0100	266	1.
1		0200	3	14.	4		1800	91	34.	8		1000	179	23.	12		0200	267	1.
1		0300	4	15.	4		1900	92	35.	8		1100	180	23.	12		0300	268	1.
1		0400	5	15.	4		2000	93	35.	8		1200	181	23.	12		0400	269	1.
1		0500	6	15.	4		2100	94	36.	8		1300	182	22.	12		0500	270	1.
1		0600	7	15.	4		2200	95	37.	8		1400	183	22.	12		0600	271	1.
1		0700	8	15.	4		2300	96	38.	8		1500	184	22.	12		0700	272	1.
1		0800	9	15.	5		0000	97	39.	8		1600	185	22.	12		0800	273	1.
1		0900	10	15.	5		0100	98	40.	8		1700	186	22.	12		0900	274	1.
1		1000	11	15.	5		0200	99	41.	8		1800	187	21.	12		1000	275	1.
1		1100	12	16.	5		0300	100	42.	8		1900	188	21.	12		1100	276	1.
1		1200	13	16.	5		0400	101	43.	8		2000	189	21.	12		1200	277	1.
1		1300	14	16.	5		0500	102	45.	8		2100	190	21.	12		1300	278	1.
1		1400	15	16.	5		0600	103	46.	8		2200	191	21.	12		1400	279	1.
1		1500	16	16.	5		0700	104	48.	8		2300	192	20.	12		1500	280	1.
1		1600	17	16.	5		0800	105	49.	9		0000	193	20.	12		1600	281	1.
1		1700	18	16.	5		0900	106	51.	9		0100	194	20.	12		1700	282	1.
1		1800	19	16.	5		1000	107	53.	9		0200	195	20.	12		1800	283	1.
1		1900	20	16.	5		1100	108	56.	9		0300	196	20.	12		1900	284	1.
1		2000	21	16.	5		1200	109	58.	9		0400	197	20.	12		2000	285	1.
1		2100	22	17.	5		1300	110	61.	9		0500	198	19.	12		2100	286	1.
1		2200	23	17.	5		1400	111	65.	9		0600	199	19.	12		2200	287	1.
1		2300	24	17.	5		1500	112	69.	9		0700	200	19.	12		2300	288	1.
2		0000	25	17.	5		1600	113	74.	9		0800	201	19.	13		0000	289	1.
2		0100	26	17.	5		1700	114	80.	9		0900	202	19.	13		0100	290	1.
2		0200	27	17.	5		1800	115	87.	9		1000	203	19.	13		0200	291	1.
2		0300	28	17.	5		1900	116	96.	9		1100	204	19.	13		0300	292	1.
2		0400	29	17.	5		2000	117	109.	9		1200	205	18.	13		0400	293	1.
2		0500	30	17.	5		2100	118	127.	9		1300	206	18.	13		0500	294	1.
2		0600	31	17.	5		2200	119	157.	9		1400	207	18.	13		0600	295	1.
2		0700	32	18.	5		2300	120	219.	9		1500	208	18.	13		0700	296	1.
2		0800	33	18.	6		0000	121	850.	9		1600	209	18.	13		0800	297	1.
2		0900	34	18.	6		0100	122	479.	9		1700	210	18.	13		0900	298	1.
2		1000	35	18.	6		0200	123	259.	9		1800	211	18.	13		1000	299	1.
2		1100	36	18.	6		0300	124	172.	9		1900	212	17.	13		1100	300	1.
2		1200	37	18.	6		0400	125	132.	9		2000	213	17.	13		1200	301	1.
2		1300	38	18.	6		0500	126	111.	9		2100	214	17.	13		1300	302	1.
2		1400	39	18.	6		0600	127	98.	9		2200	215	17.	13		1400	303	1.
2		1500	40	19.	6		0700	128	88.	9		2300	216	17.	13		1500	304	1.
2		1600	41	19.	6		0800	129	81.	10		0000	217	17.	13		1600	305	1.
2		1700	42	19.	6		0900	130	75.	10		0100	218	17.	13		1700	306	1.
2		1800	43	19.	6		1000	131	70.	10		0200	219	17.	13		1800	307	1.
2		1900	44	19.	6		1100	132	65.	10		0300	220	17.	13		1900	308	1.
2		2000	45	19.	6		1200	133	62.	10		0400	221	17.	13		2000	309	1.
2		2100	46	20.	6		1300	134	59.	10		0500	222	16.	13		2100	310	1.
2		2200	47	20.	6		1400	135	56.	10		0600	223	16.	13		2200	311	1.
2		2300	48	20.	6		1500	136	54.	10		0700	224	16.	13		2300	312	1.
3		0000	49	20.	6		1600	137	51.	10		0800	225	16.	14		0000	313	1.
3		0100	50	20.	6		1700	138	50.	10		0900	226	16.	14		0100	314	1.
3		0200	51	20.	6		1800	139	48.	10		1000	227	16.	14		0200	315	1.
3		0300	52	21.	6		1900	140	46.	10		1100	228	16.	14		0300	316	1.
3		0400	53	21.	6		2000	141	45.	10		1200	229	16.	14		0400	317	1.
3		0500	54	21.	6		2100	142	43.	10		1300	230	16.	14		0500	318	1.
3		0600	55	21.	6		2200	143	42.	10		1400	231	16.	14		0600	319	1.
3		0700	56	21.	6		2300	144	41.	10		1500	232	15.	14		0700	320	1.
3		0800	57	21.	7		0000	145	40.	10		1600	233	15.	14		0800	321	1.
3		0900	58	22.	7		0100	146	39.	10		1700	234	15.	14		0900	322	1.
3		1000	59	22.	7		0200	147	38.	10		1800	235	15.	14		1000	323	1.
3		1100	60	22.	7		0300	148	37.	10		1900	236	15.	14		1100	324	1.
3		1200	61	22.	7		0400	149	36.	10		2000	237	15.	14		1200	325	1.
3		1300	62	23.	7		0500	150	35.	10		2100	238	15.	14		1300	326	1.
3		1400	63	23.	7		0600	151	35.	10		2200	239	15.	14		1400	327	1.
3		1500	64	23.	7		0700	152	34.	10		2300	240	15.	14		1500	328	1.
3		1600	65	23.	7		0800	153	33.	11		0000	241	15.	14		1600	329	1.
3		1700	66	24.	7		0900	154	33.	11		0100	242	4.	14		1700	330	1.
3		1800	67	24.	7		1000	155	32.	11		0200	243	1.	14		1800	331	1.
3		1900	68	24.	7		1100	156	32.	11		0300	244	1.	14		1900	332	1.
3		2000	69	24.	7		1200	157	31.	11		0400	245	1.	14		2000	333	1.
3		2100	70	25.	7		1300	158	30.	11		0500	246	1.	14		2100	334	1.
3		2200	71	25.	7		1400	159	30.	11		0600	247	1.	14		2200	335	1.
3		2300	72	25.	7		1500	160	29.	11		0700	248	1.	14		2300	336	1.
4		0000	73	26.	7		1600	161	29.	11		0800	249	1.	15		0000	337	1.
4		0100	74	26.	7		1700	162	29.	11		0900	250	1.	15		0100	338	1.
4		0200	75	26.	7		1800	163	28.	11		1000	251	1.	15		0200	339	1.
4		0300	76	27.	7		1900	164	28.	11		1100	252	1.	15		0300	340	1.
4		0400	77	27.	7		2000	165	27.	11		1200	253	1.	15		0400	341	1.
4		0500	78	27.	7		2100	166	27.	11		1300	254	1.	15		0500	342	1.
4		0600	79	28.	7		2200	167	27.	11		1400	255	1.	15		0600	343	1.
4		0700	80	28.	7		2300	168	26.	11		1500	256	1.	15		0700	344	1.

4	0800	81	29.	*	8	0000	169	26.	*	11	1600	257	1.	*	15	0800	345	1.
4	0900	82	29.	*	8	0100	170	26.	*	11	1700	258	1.	*	15	0900	346	1.
4	1000	83	29.	*	8	0200	171	25.	*	11	1800	259	1.	*	15	1000	347	1.
4	1100	84	30.	*	8	0300	172	25.	*	11	1900	260	1.	*	15	1100	348	1.
4	1200	85	30.	*	8	0400	173	25.	*	11	2000	261	1.	*	15	1200	349	1.
4	1300	86	31.	*	8	0500	174	24.	*	11	2100	262	1.	*	15	1300	350	1.
4	1400	87	31.	*	8	0600	175	24.	*	11	2200	263	1.	*				
4	1500	88	32.	*	8	0700	176	24.	*	11	2300	264	1.	*				
				*					*					*				

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PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	349.00-HR
(CFS)	(HR)				
		(CFS)			
850.	120.00	354.	154.	79.	26.
		(INCHES) .000	.000	.000	.000
		(AC-FT) 175.	305.	468.	757.

CUMULATIVE AREA = .00 SQ MI

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HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

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DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	4		1600	89	33.	8		0800	177	24.	12		0000	265	1.
1		0100	2	11.	4		1700	90	33.	8		0900	178	23.	12		0100	266	1.
1		0200	3	14.	4		1800	91	34.	8		1000	179	23.	12		0200	267	1.
1		0300	4	15.	4		1900	92	35.	8		1100	180	23.	12		0300	268	1.
1		0400	5	15.	4		2000	93	35.	8		1200	181	23.	12		0400	269	1.
1		0500	6	15.	4		2100	94	36.	8		1300	182	22.	12		0500	270	1.
1		0600	7	15.	4		2200	95	37.	8		1400	183	22.	12		0600	271	1.
1		0700	8	15.	4		2300	96	38.	8		1500	184	22.	12		0700	272	1.
1		0800	9	15.	5		0000	97	39.	8		1600	185	22.	12		0800	273	1.
1		0900	10	15.	5		0100	98	40.	8		1700	186	22.	12		0900	274	1.
1		1000	11	15.	5		0200	99	41.	8		1800	187	21.	12		1000	275	1.
1		1100	12	16.	5		0300	100	42.	8		1900	188	21.	12		1100	276	1.
1		1200	13	16.	5		0400	101	43.	8		2000	189	21.	12		1200	277	1.
1		1300	14	16.	5		0500	102	45.	8		2100	190	21.	12		1300	278	1.
1		1400	15	16.	5		0600	103	46.	8		2200	191	21.	12		1400	279	1.
1		1500	16	16.	5		0700	104	48.	8		2300	192	20.	12		1500	280	1.
1		1600	17	16.	5		0800	105	49.	9		0000	193	20.	12		1600	281	1.
1		1700	18	16.	5		0900	106	51.	9		0100	194	20.	12		1700	282	1.
1		1800	19	16.	5		1000	107	53.	9		0200	195	20.	12		1800	283	1.
1		1900	20	16.	5		1100	108	56.	9		0300	196	20.	12		1900	284	1.
1		2000	21	16.	5		1200	109	58.	9		0400	197	20.	12		2000	285	1.
1		2100	22	17.	5		1300	110	61.	9		0500	198	19.	12		2100	286	1.
1		2200	23	17.	5		1400	111	65.	9		0600	199	19.	12		2200	287	1.
1		2300	24	17.	5		1500	112	69.	9		0700	200	19.	12		2300	288	1.
2		0000	25	17.	5		1600	113	74.	9		0800	201	19.	13		0000	289	1.
2		0100	26	17.	5		1700	114	80.	9		0900	202	19.	13		0100	290	1.
2		0200	27	17.	5		1800	115	87.	9		1000	203	19.	13		0200	291	1.
2		0300	28	17.	5		1900	116	96.	9		1100	204	19.	13		0300	292	1.
2		0400	29	17.	5		2000	117	109.	9		1200	205	18.	13		0400	293	1.
2		0500	30	17.	5		2100	118	127.	9		1300	206	18.	13		0500	294	1.
2		0600	31	17.	5		2200	119	157.	9		1400	207	18.	13		0600	295	1.
2		0700	32	18.	5		2300	120	219.	9		1500	208	18.	13		0700	296	1.
2		0800	33	18.	6		0000	121	850.	9		1600	209	18.	13		0800	297	1.
2		0900	34	18.	6		0100	122	479.	9		1700	210	18.	13		0900	298	1.
2		1000	35	18.	6		0200	123	259.	9		1800	211	18.	13		1000	299	1.
2		1100	36	18.	6		0300	124	172.	9		1900	212	17.	13		1100	300	1.
2		1200	37	18.	6		0400	125	132.	9		2000	213	17.	13		1200	301	1.
2		1300	38	18.	6		0500	126	111.	9		2100	214	17.	13		1300	302	1.
2		1400	39	18.	6		0600	127	98.	9		2200	215	17.	13		1400	303	1.
2		1500	40	19.	6		0700	128	88.	9		2300	216	17.	13		1500	304	1.
2		1600	41	19.	6		0800	129	81.	10		0000	217	17.	13		1600	305	1.
2		1700	42	19.	6		0900	130	75.	10		0100	218	17.	13		1700	306	1.
2		1800	43	19.	6		1000	131	70.	10		0200	219	17.	13		1800	307	1.
2		1900	44	19.	6		1100	132	65.	10		0300	220	17.	13		1900	308	1.
2		2000	45	19.	6		1200	133	62.	10		0400	221	17.	13		2000	309	1.
2		2100	46	20.	6		1300	134	59.	10		0500	222	16.	13		2100	310	1.
2		2200	47	20.	6		1400	135	56.	10		0600	223	16.	13		2200	311	1.
2		2300	48	20.	6		1500	136	54.	10		0700	224	16.	13		2300	312	1.
3		0000	49	20.	6		1600	137	51.	10		0800	225	16.	14		0000	313	1.
3		0100	50	20.	6		1700	138	50.	10		0900	226	16.	14		0100	314	1.
3		0200	51	20.	6		1800	139	48.	10		1000	227	16.	14		0200	315	1.
3		0300	52	21.	6		1900	140	46.	10		1100	228	16.	14		0300	316	1.
3		0400	53	21.	6		2000	141	45.	10		1200	229	16.	14		0400	317	1.
3		0500	54	21.	6		2100	142	43.	10		1300	230	16.	14		0500	318	1.
3		0600	55	21.	6		2200	143	42.	10		1400	231	16.	14		0600	319	1.
3		0700	56	21.	6		2300	144	41.	10		1500	232	15.	14		0700	320	1.
3		0800	57	21.	7		0000	145	40.	10		1600	233	15.	14		0800	321	1.
3		0900	58	22.	7		0100	146	39.	10		1700	234	15.	14		0900	322	1.
3		1000	59	22.	7		0200	147	38.	10		1800	235	15.	14		1000	323	1.
3		1100	60	22.	7		0300	148	37.	10		1900	236	15.	14		1100	324	1.
3		1200	61	22.	7		0400	149	36.	10		2000	237	15.	14		1200	325	1.

3	1300	62	23.	*	7	0500	150	35.	*	10	2100	238	15.	*	14	1300	326	1.
3	1400	63	23.	*	7	0600	151	35.	*	10	2200	239	15.	*	14	1400	327	1.
3	1500	64	23.	*	7	0700	152	34.	*	10	2300	240	15.	*	14	1500	328	1.
3	1600	65	23.	*	7	0800	153	33.	*	11	0000	241	15.	*	14	1600	329	1.
3	1700	66	24.	*	7	0900	154	33.	*	11	0100	242	4.	*	14	1700	330	1.
3	1800	67	24.	*	7	1000	155	32.	*	11	0200	243	1.	*	14	1800	331	1.
3	1900	68	24.	*	7	1100	156	32.	*	11	0300	244	1.	*	14	1900	332	1.
3	2000	69	24.	*	7	1200	157	31.	*	11	0400	245	1.	*	14	2000	333	1.
3	2100	70	25.	*	7	1300	158	30.	*	11	0500	246	1.	*	14	2100	334	1.
3	2200	71	25.	*	7	1400	159	30.	*	11	0600	247	1.	*	14	2200	335	1.
3	2300	72	25.	*	7	1500	160	29.	*	11	0700	248	1.	*	14	2300	336	1.
4	0000	73	26.	*	7	1600	161	29.	*	11	0800	249	1.	*	15	0000	337	1.
4	0100	74	26.	*	7	1700	162	29.	*	11	0900	250	1.	*	15	0100	338	1.
4	0200	75	26.	*	7	1800	163	28.	*	11	1000	251	1.	*	15	0200	339	1.
4	0300	76	27.	*	7	1900	164	28.	*	11	1100	252	1.	*	15	0300	340	1.
4	0400	77	27.	*	7	2000	165	27.	*	11	1200	253	1.	*	15	0400	341	1.
4	0500	78	27.	*	7	2100	166	27.	*	11	1300	254	1.	*	15	0500	342	1.
4	0600	79	28.	*	7	2200	167	27.	*	11	1400	255	1.	*	15	0600	343	1.
4	0700	80	28.	*	7	2300	168	26.	*	11	1500	256	1.	*	15	0700	344	1.
4	0800	81	29.	*	8	0000	169	26.	*	11	1600	257	1.	*	15	0800	345	1.
4	0900	82	29.	*	8	0100	170	26.	*	11	1700	258	1.	*	15	0900	346	1.
4	1000	83	29.	*	8	0200	171	25.	*	11	1800	259	1.	*	15	1000	347	1.
4	1100	84	30.	*	8	0300	172	25.	*	11	1900	260	1.	*	15	1100	348	1.
4	1200	85	30.	*	8	0400	173	25.	*	11	2000	261	1.	*	15	1200	349	1.
4	1300	86	31.	*	8	0500	174	24.	*	11	2100	262	1.	*	15	1300	350	1.
4	1400	87	31.	*	8	0600	175	24.	*	11	2200	263	1.	*				
4	1500	88	32.	*	8	0700	176	24.	*	11	2300	264	1.	*				
				*					*					*				

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PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	349.00-HR
+ (CFS)	(HR)				
		(CFS)			
+ 850.	120.00	354.	154.	79.	26.
		(INCHES) .000	.000	.000	.000
		(AC-FT) 175.	305.	468.	757.

CUMULATIVE AREA = .00 SQ MI

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          *            *
  43 KK   *     Cove   *     Reservoir
          *            *
          **************
                  Routing through Res'v

     HYDROGRAPH ROUTING DATA

  45 RS          STORAGE ROUTING
                      NSTPS           1  NUMBER OF SUBREACHES
                       ITYP        ELEV  TYPE OF INITIAL CONDITION
                     RSVRIC     5545.50  INITIAL CONDITION
                          X         .00 WORKING R AND D COEFFICIENT

  46 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                 3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

  48 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                               5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

  50 SL          LOW-LEVEL OUTLET
                      ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                      CAREA        4.91  CROSS-SECTIONAL AREA
                       COQL         .60  COEFFICIENT
                       EXPL         .50  EXPONENT OF HEAD

  51 SS          SPILLWAY
                       CREL     5549.20  SPILLWAY CREST ELEVATION
                      SPWID       30.00  SPILLWAY WIDTH
                       COQW        2.67  WEIR COEFFICIENT
                       EXPW        1.50  EXPONENT OF HEAD

  52 ST          TOP OF DAM
                      TOPEL     5552.00  ELEVATION AT TOP OF DAM
                     DAMWID     1892.00  DAM WIDTH
                       COQD        2.90  WEIR COEFFICIENT
                       EXPD        1.50  EXPONENT OF HEAD

                                                  ***

                                          COMPUTED OUTFLOW-ELEVATION DATA

                                            (EXCLUDING FLOW OVER DAM)

            OUTFLOW        .00       .00     25.78     27.48     29.42     31.65     34.25     37.31     40.98     45.44
```

ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	5844.8	5545.5	5		2100	118	26.	5992.5	5546.7	10		1800	235	34.	6094.7	5547.6
1		0100	2	1.	5845.2	5545.5	5		2200	119	27.	6002.1	5546.8	10		1900	236	34.	6093.2	5547.5
1		0200	3	2.	5846.1	5545.5	5		2300	120	28.	6015.3	5546.9	10		2000	237	34.	6091.6	5547.5
1		0300	4	3.	5847.1	5545.5	6		0000	121	31.	6057.0	5547.2	10		2100	238	34.	6090.1	5547.5
1		0400	5	4.	5848.0	5545.5	6		0100	122	35.	6109.3	5547.7	10		2200	239	33.	6088.5	5547.5
1		0500	6	4.	5848.9	5545.5	6		0200	123	37.	6136.7	5547.9	10		2300	240	33.	6087.0	5547.5
1		0600	7	5.	5849.8	5545.5	6		0300	124	37.	6151.5	5548.0	11		0000	241	33.	6085.6	5547.5
1		0700	8	5.	5850.7	5545.5	6		0400	125	38.	6161.0	5548.0	11		0100	242	33.	6083.6	5547.5
1		0800	9	6.	5851.5	5545.6	6		0500	126	38.	6167.9	5548.1	11		0200	243	33.	6081.1	5547.4
1		0900	10	6.	5852.3	5545.6	6		0600	127	38.	6173.4	5548.1	11		0300	244	33.	6078.5	5547.4
1		1000	11	6.	5853.0	5545.6	6		0700	128	38.	6178.0	5548.1	11		0400	245	33.	6075.9	5547.4
1		1100	12	6.	5853.8	5545.6	6		0800	129	38.	6181.8	5548.1	11		0500	246	32.	6073.3	5547.4
1		1200	13	7.	5854.6	5545.6	6		0900	130	38.	6185.0	5548.1	11		0600	247	32.	6070.6	5547.4
1		1300	14	7.	5855.3	5545.6	6		1000	131	38.	6187.8	5548.1	11		0700	248	32.	6068.1	5547.3
1		1400	15	7.	5856.1	5545.6	6		1100	132	38.	6190.1	5548.1	11		0800	249	32.	6065.5	5547.3
1		1500	16	7.	5856.8	5545.6	6		1200	133	38.	6192.1	5548.1	11		0900	250	32.	6063.0	5547.3
1		1600	17	8.	5857.5	5545.6	6		1300	134	38.	6193.9	5548.1	11		1000	251	31.	6060.5	5547.3
1		1700	18	8.	5858.3	5545.6	6		1400	135	38.	6195.5	5548.2	11		1100	252	31.	6058.0	5547.3
1		1800	19	8.	5858.9	5545.6	6		1500	136	39.	6196.8	5548.2	11		1200	253	31.	6055.5	5547.2
1		1900	20	8.	5859.6	5545.6	6		1600	137	39.	6198.0	5548.2	11		1300	254	31.	6053.0	5547.2
1		2000	21	8.	5860.2	5545.6	6		1700	138	39.	6199.0	5548.2	11		1400	255	31.	6050.6	5547.2
1		2100	22	9.	5860.9	5545.6	6		1800	139	39.	6199.9	5548.2	11		1500	256	31.	6048.1	5547.2
1		2200	23	9.	5861.6	5545.6	6		1900	140	39.	6200.6	5548.2	11		1600	257	30.	6045.7	5547.2
1		2300	24	9.	5862.2	5545.6	6		2000	141	39.	6201.2	5548.2	11		1700	258	30.	6043.3	5547.1
2		0000	25	9.	5862.9	5545.6	6		2100	142	39.	6201.6	5548.2	11		1800	259	30.	6040.9	5547.1
2		0100	26	9.	5863.5	5545.7	6		2200	143	39.	6201.9	5548.2	11		1900	260	30.	6038.5	5547.1
2		0200	27	9.	5864.2	5545.7	6		2300	144	39.	6202.2	5548.2	11		2000	261	30.	6036.1	5547.1
2		0300	28	10.	5864.8	5545.7	7		0000	145	39.	6202.4	5548.2	11		2100	262	29.	6033.7	5547.1
2		0400	29	10.	5865.4	5545.7	7		0100	146	39.	6202.4	5548.2	11		2200	263	29.	6031.4	5547.0
2		0500	30	10.	5866.0	5545.7	7		0200	147	39.	6202.4	5548.2	11		2300	264	29.	6029.1	5547.0
2		0600	31	10.	5866.6	5545.7	7		0300	148	39.	6202.2	5548.2	12		0000	265	29.	6026.8	5547.0
2		0700	32	10.	5867.2	5545.7	7		0400	149	39.	6202.1	5548.2	12		0100	266	29.	6024.5	5547.0
2		0800	33	10.	5867.8	5545.7	7		0500	150	39.	6201.8	5548.2	12		0200	267	29.	6022.2	5547.0
2		0900	34	10.	5868.5	5545.7	7		0600	151	39.	6201.5	5548.2	12		0300	268	28.	6020.0	5546.9
2		1000	35	11.	5869.1	5545.7	7		0700	152	39.	6201.2	5548.2	12		0400	269	28.	6017.7	5546.9
2		1100	36	11.	5869.7	5545.7	7		0800	153	39.	6200.8	5548.2	12		0500	270	28.	6015.5	5546.9
2		1200	37	11.	5870.3	5545.7	7		0900	154	39.	6200.3	5548.2	12		0600	271	28.	6013.3	5546.9
2		1300	38	11.	5870.9	5545.7	7		1000	155	39.	6199.9	5548.2	12		0700	272	28.	6011.1	5546.9
2		1400	39	11.	5871.4	5545.7	7		1100	156	39.	6199.3	5548.2	12		0800	273	27.	6008.9	5546.8
2		1500	40	11.	5872.0	5545.7	7		1200	157	39.	6198.7	5548.2	12		0900	274	27.	6006.7	5546.8
2		1600	41	11.	5872.7	5545.7	7		1300	158	39.	6198.0	5548.2	12		1000	275	27.	6004.5	5546.8
2		1700	42	11.	5873.3	5545.7	7		1400	159	39.	6197.3	5548.2	12		1100	276	27.	6002.4	5546.8
2		1800	43	12.	5873.9	5545.7	7		1500	160	39.	6196.5	5548.2	12		1200	277	27.	6000.2	5546.8
2		1900	44	12.	5874.5	5545.7	7		1600	161	38.	6195.8	5548.2	12		1300	278	27.	5998.1	5546.8
2		2000	45	12.	5875.1	5545.7	7		1700	162	38.	6195.1	5548.2	12		1400	279	26.	5996.0	5546.7
2		2100	46	12.	5875.8	5545.8	7		1800	163	38.	6194.2	5548.2	12		1500	280	26.	5993.9	5546.7
2		2200	47	12.	5876.4	5545.8	7		1900	164	38.	6193.3	5548.1	12		1600	281	26.	5991.9	5546.7
2		2300	48	12.	5877.1	5545.8	7		2000	165	38.	6192.4	5548.1	12		1700	282	26.	5989.8	5546.7
3		0000	49	12.	5877.7	5545.8	7		2100	166	38.	6191.6	5548.1	12		1800	283	26.	5987.8	5546.7
3		0100	50	12.	5878.4	5545.8	7		2200	167	38.	6190.7	5548.1	12		1900	284	25.	5985.7	5546.7
3		0200	51	13.	5879.1	5545.8	7		2300	168	38.	6189.7	5548.1	12		2000	285	25.	5983.7	5546.6
3		0300	52	13.	5879.7	5545.8	8		0000	169	38.	6188.6	5548.1	12		2100	286	25.	5981.7	5546.6
3		0400	53	13.	5880.4	5545.8	8		0100	170	38.	6187.6	5548.1	12		2200	287	25.	5979.7	5546.6
3		0500	54	13.	5881.1	5545.8	8		0200	171	38.	6186.6	5548.1	12		2300	288	25.	5977.8	5546.6
3		0600	55	13.	5881.7	5545.8	8		0300	172	38.	6185.6	5548.1	13		0000	289	25.	5975.8	5546.6
3		0700	56	13.	5882.4	5545.8	8		0400	173	38.	6184.5	5548.1	13		0100	290	24.	5973.9	5546.6
3		0800	57	13.	5883.0	5545.8	8		0500	174	38.	6183.4	5548.1	13		0200	291	24.	5972.0	5546.5

3	0900	58	13.	5883.7	5545.8	* 8	0600	175	38.	6182.2	5548.1	* 13	0300	292	24.	5970.1	5546.5
3	1000	59	13.	5884.4	5545.8	* 8	0700	176	38.	6181.0	5548.1	* 13	0400	293	24.	5968.2	5546.5
3	1100	60	14.	5885.1	5545.8	* 8	0800	177	38.	6179.9	5548.1	* 13	0500	294	24.	5966.3	5546.5
3	1200	61	14.	5885.8	5545.8	* 8	0900	178	38.	6178.7	5548.1	* 13	0600	295	23.	5964.4	5546.5
3	1300	62	14.	5886.5	5545.8	* 8	1000	179	38.	6177.4	5548.1	* 13	0700	296	23.	5962.6	5546.5
3	1400	63	14.	5887.3	5545.8	* 8	1100	180	38.	6176.2	5548.1	* 13	0800	297	23.	5960.7	5546.5
3	1500	64	14.	5888.1	5545.9	* 8	1200	181	38.	6175.0	5548.1	* 13	0900	298	23.	5958.9	5546.4
3	1600	65	14.	5888.8	5545.9	* 8	1300	182	38.	6173.7	5548.1	* 13	1000	299	23.	5957.1	5546.4
3	1700	66	14.	5889.6	5545.9	* 8	1400	183	38.	6172.4	5548.1	* 13	1100	300	23.	5955.3	5546.4
3	1800	67	14.	5890.3	5545.9	* 8	1500	184	38.	6171.1	5548.1	* 13	1200	301	22.	5953.5	5546.4
3	1900	68	15.	5891.1	5545.9	* 8	1600	185	38.	6169.8	5548.1	* 13	1300	302	22.	5951.8	5546.4
3	2000	69	15.	5891.9	5545.9	* 8	1700	186	38.	6168.5	5548.1	* 13	1400	303	22.	5950.0	5546.4
3	2100	70	15.	5892.7	5545.9	* 8	1800	187	38.	6167.1	5548.1	* 13	1500	304	22.	5948.3	5546.4
3	2200	71	15.	5893.5	5545.9	* 8	1900	188	38.	6165.8	5548.1	* 13	1600	305	22.	5946.6	5546.3
3	2300	72	15.	5894.4	5545.9	* 8	2000	189	38.	6164.5	5548.1	* 13	1700	306	21.	5944.9	5546.3
4	0000	73	15.	5895.2	5545.9	* 8	2100	190	38.	6163.2	5548.0	* 13	1800	307	21.	5943.2	5546.3
4	0100	74	15.	5896.1	5545.9	* 8	2200	191	38.	6161.9	5548.0	* 13	1900	308	21.	5941.5	5546.3
4	0200	75	15.	5897.0	5545.9	* 8	2300	192	38.	6160.4	5548.0	* 13	2000	309	21.	5939.9	5546.3
4	0300	76	16.	5897.9	5545.9	* 9	0000	193	38.	6158.9	5548.0	* 13	2100	310	21.	5938.2	5546.3
4	0400	77	16.	5898.8	5545.9	* 9	0100	194	38.	6157.5	5548.0	* 13	2200	311	21.	5936.6	5546.3
4	0500	78	16.	5899.8	5546.0	* 9	0200	195	38.	6156.0	5548.0	* 13	2300	312	20.	5935.0	5546.2
4	0600	79	16.	5900.7	5546.0	* 9	0300	196	37.	6154.6	5548.0	* 14	0000	313	20.	5933.4	5546.2
4	0700	80	16.	5901.7	5546.0	* 9	0400	197	37.	6153.1	5548.0	* 14	0100	314	20.	5931.8	5546.2
4	0800	81	16.	5902.8	5546.0	* 9	0500	198	37.	6151.6	5548.0	* 14	0200	315	20.	5930.3	5546.2
4	0900	82	16.	5903.8	5546.0	* 9	0600	199	37.	6150.2	5548.0	* 14	0300	316	20.	5928.7	5546.2
4	1000	83	17.	5904.8	5546.0	* 9	0700	200	37.	6148.6	5548.0	* 14	0400	317	19.	5927.2	5546.2
4	1100	84	17.	5905.9	5546.0	* 9	0800	201	37.	6147.2	5548.0	* 14	0500	318	19.	5925.6	5546.2
4	1200	85	17.	5907.0	5546.0	* 9	0900	202	37.	6145.7	5548.0	* 14	0600	319	19.	5924.1	5546.2
4	1300	86	17.	5908.1	5546.0	* 9	1000	203	37.	6144.2	5548.0	* 14	0700	320	19.	5922.7	5546.1
4	1400	87	17.	5909.2	5546.0	* 9	1100	204	37.	6142.7	5547.9	* 14	0800	321	19.	5921.2	5546.1
4	1500	88	17.	5910.4	5546.0	* 9	1200	205	37.	6141.2	5547.9	* 14	0900	322	19.	5919.7	5546.1
4	1600	89	18.	5911.7	5546.0	* 9	1300	206	37.	6139.6	5547.9	* 14	1000	323	18.	5918.3	5546.1
4	1700	90	18.	5912.9	5546.1	* 9	1400	207	37.	6138.1	5547.9	* 14	1100	324	18.	5916.8	5546.1
4	1800	91	18.	5914.2	5546.1	* 9	1500	208	37.	6136.5	5547.9	* 14	1200	325	18.	5915.4	5546.1
4	1900	92	18.	5915.6	5546.1	* 9	1600	209	36.	6135.0	5547.9	* 14	1300	326	18.	5914.0	5546.1
4	2000	93	18.	5917.0	5546.1	* 9	1700	210	36.	6133.4	5547.9	* 14	1400	327	18.	5912.6	5546.1
4	2100	94	18.	5918.4	5546.1	* 9	1800	211	36.	6131.9	5547.9	* 14	1500	328	17.	5911.3	5546.0
4	2200	95	19.	5919.9	5546.1	* 9	1900	212	36.	6130.3	5547.8	* 14	1600	329	17.	5909.9	5546.0
4	2300	96	19.	5921.5	5546.1	* 9	2000	213	36.	6128.7	5547.8	* 14	1700	330	17.	5908.5	5546.0
5	0000	97	19.	5923.1	5546.1	* 9	2100	214	36.	6127.2	5547.8	* 14	1800	331	17.	5907.2	5546.0
5	0100	98	19.	5924.7	5546.2	* 9	2200	215	36.	6125.7	5547.8	* 14	1900	332	17.	5905.9	5546.0
5	0200	99	19.	5926.5	5546.2	* 9	2300	216	36.	6124.1	5547.8	* 14	2000	333	17.	5904.6	5546.0
5	0300	100	20.	5928.4	5546.2	* 10	0000	217	36.	6122.6	5547.8	* 14	2100	334	16.	5903.3	5546.0
5	0400	101	20.	5930.3	5546.2	* 10	0100	218	36.	6121.0	5547.8	* 14	2200	335	16.	5902.0	5546.0
5	0500	102	20.	5932.3	5546.2	* 10	0200	219	35.	6119.5	5547.8	* 14	2300	336	16.	5900.8	5546.0
5	0600	103	20.	5934.4	5546.2	* 10	0300	220	35.	6117.9	5547.7	* 15	0000	337	16.	5899.5	5545.9
5	0700	104	21.	5936.6	5546.3	* 10	0400	221	35.	6116.4	5547.7	* 15	0100	338	16.	5898.3	5545.9
5	0800	105	21.	5938.9	5546.3	* 10	0500	222	35.	6114.8	5547.7	* 15	0200	339	15.	5897.1	5545.9
5	0900	106	21.	5941.3	5546.3	* 10	0600	223	35.	6113.2	5547.7	* 15	0300	340	15.	5895.9	5545.9
5	1000	107	21.	5943.9	5546.3	* 10	0700	224	35.	6111.7	5547.7	* 15	0400	341	15.	5894.7	5545.9
5	1100	108	22.	5946.6	5546.3	* 10	0800	225	35.	6110.1	5547.7	* 15	0500	342	15.	5893.5	5545.9
5	1200	109	22.	5949.5	5546.4	* 10	0900	226	35.	6108.6	5547.7	* 15	0600	343	15.	5892.4	5545.9
5	1300	110	22.	5952.6	5546.4	* 10	1000	227	35.	6107.1	5547.7	* 15	0700	344	15.	5891.3	5545.9
5	1400	111	23.	5956.0	5546.4	* 10	1100	228	35.	6105.5	5547.6	* 15	0800	345	14.	5890.2	5545.9
5	1500	112	23.	5959.7	5546.4	* 10	1200	229	34.	6104.0	5547.6	* 15	0900	346	14.	5889.0	5545.9
5	1600	113	23.	5963.6	5546.5	* 10	1300	230	34.	6102.4	5547.6	* 15	1000	347	14.	5888.0	5545.9
5	1700	114	24.	5968.0	5546.5	* 10	1400	231	34.	6100.9	5547.6	* 15	1100	348	14.	5886.9	5545.8
5	1800	115	24.	5973.0	5546.6	* 10	1500	232	34.	6099.4	5547.6	* 15	1200	349	14.	5885.8	5545.8
5	1900	116	25.	5978.5	5546.6	* 10	1600	233	34.	6097.8	5547.6	* 15	1300	350	14.	5884.8	5545.8
5	2000	117	25.	5984.9	5546.7	* 10	1700	234	34.	6096.2	5547.6	*					
						*						*					

****

PEAK OUTFLOW IS 39. AT TIME 144.00 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	349.00-HR
+ (CFS)	(HR)				
		(CFS)			
+ 39.	144.00	39.	39.	38.	25.
		(INCHES) .000	.000	.000	.000
		(AC-FT) 19.	77.	228.	718.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	349.00-HR
+ (AC-FT)	(HR)				
6202.	144.00	6202.	6200.	6186.	6010.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	349.00-HR
+ (FEET)	(HR)				
5548.18	144.00	5548.18	5548.17	5548.13	5546.82

CUMULATIVE AREA = .00 SQ MI

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

```
                                                    RATIOS APPLIED TO PRECIPITATION
 OPERATION       STATION     AREA    PLAN            RATIO 1
                                                       1.00

 HYDROGRAPH AT
+                 Cove        .00     1   FLOW          850.
                                           TIME       120.00

 ROUTED TO
+                 Cove        .00     1   FLOW           39.
                                           TIME       144.00

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     5548.18
                                           TIME       144.00
1                                  SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                                (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


      PLAN  1 ..............                  INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                ELEVATION        5545.50            5549.20          5552.00
                                STORAGE             5845.              6508.            7347.
                                OUTFLOW                0.                45.             435.

                     RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                       OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                      PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                     1.00      5548.18         .00       6202.        39.       .00       144.00         .00


 *** NORMAL END OF HEC-1 ***
```

Storm Event 13. Local Auxiliary Spillway Hydrograph

```
1****************************************                                  ************************************
 *                                      *                                  *                                  *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                  *    U.S. ARMY CORPS OF ENGINEERS  *
 *              JUN   1998              *                                  *    HYDROLOGIC ENGINEERING CENTER *
 *            VERSION 4.1               *                                  *         609 SECOND STREET        *
 *                                      *                                  *       DAVIS, CALIFORNIA 95616    *
 *  RUN DATE   06AUG20  TIME  02:58:03  *                                  *           (916) 756-1104         *
 *                                      *                                  *                                  *
 ****************************************                                  ************************************

                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X        X     X        XX
                                                X     X  X        X              X
                                                XXXXXXX  XXXX     X        XXXXX  X
                                                X     X  X        X              X
                                                X     X  X        X     X        X
                                                X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   Local ASH
           13           ID
                        *
           14           JR    PREC     1.0
           15           IT      18       0       0     100
           16           IO       0
           17           IN      18
                        *

           18           KK   B1
           19           KM   Runoff from Basin 1
           20           BA   0.503
           21           PB    4.09
           22           PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
           23           PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
           24           PC   1.000
           25           LS       0    72.8
           26           UD    0.51
                        *

           27           KK   RB1
           28           KM   Route B1
           29           RD    4928    .045    .050           TRAP      20      20
                        *

           30           KK   B2
           31           KM   Runoff from Basin 2
           32           BA   0.436
           33           LS       0    72.5
           34           UD    0.52
                        *

           35           KK   B3
           36           KM   Runoff from Basin 3
           37           BA   0.279
           38           LS       0    71.0
           39           UD    0.39
                        *
1                                                HEC-1 INPUT                                                PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
             40          KK   C1
             41          KM   Combine RB1, B2, B3
             42          HC       3
                         *

             43          KK   RC1
             44          KM   Route RC1
             45          RD    7255    .060    .030           TRAP      20      20
                         *

             46          KK   B4
             47          KM   Runoff from Basin 4
             48          BA   0.453
             49          LS       0    73.3
             50          UD    0.48
                         *

             51          KK   B5
             52          KM   Runoff from Basin 5
             53          BA   0.805
             54          LS       0    74.1
             55          UD    0.63
                         *

             56          KK   C2
             57          KM   Combine RC1, B4, B5
             58          HC       3
                         *

             59          KK   RC2
             60          KM   Route C2
             61          RD    2380    .039    .030           TRAP      40       2
                         *

             62          KK   B6
             63          KM   Runoff from Basin 6
             64          BA   0.150
             65          LS       0    84.3
             66          UD    0.19
                         *

             67          KK   B7
             68          KM   Runoff from Basin 7
             69          BA   0.327
             70          LS       0    75.7
             71          UD    0.46
                         *

             72          KK   C3
             73          KM   Combine RC2, B6, B7
             74          HC       3
                         *
1                                          HEC-1 INPUT                                          PAGE  3

            LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             75          KK   RC3
             76          KM   Route C3
             77          RD   11323    .023    .030           TRAP      40      20
                         *

             78          KK   B8
             79          KM   Runoff from Basin 8
             80          BA   1.012
             81          LS       0    84.0
             82          UD    0.67
                         *

             83          KK   B9
             84          KM   Runoff from Basin 9
             85          BA   0.242
             86          LS       0    85.5
             87          UD    0.26
                         *

             88          KK   B10
             89          KM   Runoff from Basin 10
             90          BA   0.129
             91          LS       0    86.7
             92          UD    0.18
                         *

             93          KK   C4
             94          KM   Combine B9, B10
             95          HC       2
                         *

             96          KK   RC4
             97          KM   Route C4
             98          RD    3380    .037    .030           TRAP      40      20
                         *
```

```
             99           KK   B11
            100           KM   Runoff from Basin 11
            101           BA   0.279
            102           LS       0    84.8
            103           UD    0.39
                          *

            104           KK   C5
            105           KM   Combine RC3, B8, RC4, B11
            106           HC       4
                          *

            107           KK   B12
            108           KM   Runoff from Basin 12
            109           BA   0.127
            110           LS       0    81.2
            111           UD    0.40
                          *
1                                              HEC-1 INPUT                                              PAGE  4

          LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            115           KK   Cove Reservoir
            116           KM   Routing through Res'v
            117           RS       1    ELEV  5545.5
            118           SV       0      19      95     240     453     738    1105    1563    2217    2773
            119           SV    3542    4423    5419    6149    7347    8000
            120           SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
            121           SE    5530    5536    5542    5548    5552    5558
            122           SL  5545.5   4.909     0.6     0.5
            123           SS  5549.2      30    2.67     1.5
            124           ST  5552.0    1892     2.9     1.5
                          *
            125           ZZ
1*************************************                                    *************************************
 *                                   *                                    *                                   *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                    *    U.S. ARMY CORPS OF ENGINEERS     *
 *              JUN   1998           *                                    *    HYDROLOGIC ENGINEERING CENTER    *
 *           VERSION 4.1             *                                    *          609 SECOND STREET          *
 *                                   *                                    *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   06AUG20  TIME  02:58:03   *                                    *          (916) 756-1104           *
 *                                   *                                    *                                   *
 *************************************                                    *************************************



                         HYDROLOGY STUDY for COVE RESERVOIR
                         Located in KANE COUNTY, UTAH

                         AUG 2020

                         PREPARED BY ALPHA ENGINEERING
                         43 SOUTH 100 EAST, SUITE 100
                         ST. GEORGE, UTAH  84770
                         TEL: (435) 628-6500
                         FAX: (435) 628-6553

                         Local ASH


   16 IO          OUTPUT CONTROL VARIABLES
                       IPRNT           0  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

      IT          HYDROGRAPH TIME DATA
                        NMIN          18  MINUTES IN COMPUTATION INTERVAL
                       IDATE       1    0  STARTING DATE
                       ITIME         0000  STARTING TIME
                          NQ          100  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE       2    0  ENDING DATE
                      NDTIME         0542  ENDING TIME
                      ICENT           19  CENTURY MARK

                    COMPUTATION INTERVAL      .30 HOURS
                         TOTAL TIME BASE   29.70 HOURS

           ENGLISH UNITS
                DRAINAGE AREA         SQUARE MILES
                PRECIPITATION DEPTH   INCHES
                LENGTH, ELEVATION     FEET
                FLOW                  CUBIC FEET PER SECOND
                STORAGE VOLUME        ACRE-FEET
```

```
             SURFACE AREA          ACRES
             TEMPERATURE           DEGREES FAHRENHEIT

     JP        MULTI-PLAN OPTION
                   NPLAN           1  NUMBER OF PLANS

     JR        MULTI-RATIO OPTION
                   RATIOS OF PRECIPITATION
                  1.00


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 112 KK    *     Call   *
           *            *
           **************
                       Combine C5, B12

 114 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                      ***

**********************************************************************************************************************************

                                              HYDROGRAPH AT STATION    Call
                                                   SUM OF  2 HYDROGRAPHS
                                                  PLAN 1,   RATIO =  1.00

**********************************************************************************************************************************
                                    *                                    *                                    *
   DA MON HRMN  ORD      FLOW     *   DA MON HRMN  ORD      FLOW     *   DA MON HRMN  ORD      FLOW     *   DA MON HRMN  ORD      FLOW
                                    *                                    *                                    *
    1     0000    1        0.     *    1     0730   26       180.     *    1     1500   51        0.     *    1     2230   76        0.
    1     0018    2        0.     *    1     0748   27       112.     *    1     1518   52        0.     *    1     2248   77        0.
    1     0036    3        0.     *    1     0806   28        73.     *    1     1536   53        0.     *    1     2306   78        0.
    1     0054    4        0.     *    1     0824   29        47.     *    1     1554   54        0.     *    1     2324   79        0.
    1     0112    5        0.     *    1     0842   30        28.     *    1     1612   55        0.     *    1     2342   80        0.
    1     0130    6        6.     *    1     0900   31        16.     *    1     1630   56        0.     *    2     0000   81        0.
    1     0148    7       39.     *    1     0918   32         9.     *    1     1648   57        0.     *    2     0018   82        0.
    1     0206    8      194.     *    1     0936   33         5.     *    1     1706   58        0.     *    2     0036   83        0.
    1     0224    9      687.     *    1     0954   34         3.     *    1     1724   59        0.     *    2     0054   84        0.
    1     0242   10     1365.     *    1     1012   35         1.     *    1     1742   60        0.     *    2     0112   85        0.
    1     0300   11     2027.     *    1     1030   36         1.     *    1     1800   61        0.     *    2     0130   86        0.
    1     0318   12     2180.     *    1     1048   37         0.     *    1     1818   62        0.     *    2     0148   87        0.
    1     0336   13     1955.     *    1     1106   38         0.     *    1     1836   63        0.     *    2     0206   88        0.
    1     0354   14     1683.     *    1     1124   39         0.     *    1     1854   64        0.     *    2     0224   89        0.
    1     0412   15     1441.     *    1     1142   40         0.     *    1     1912   65        0.     *    2     0242   90        0.
    1     0430   16     1248.     *    1     1200   41         0.     *    1     1930   66        0.     *    2     0300   91        0.
    1     0448   17     1107.     *    1     1218   42         0.     *    1     1948   67        0.     *    2     0318   92        0.
    1     0506   18     1001.     *    1     1236   43         0.     *    1     2006   68        0.     *    2     0336   93        0.
    1     0524   19      924.     *    1     1254   44         0.     *    1     2024   69        0.     *    2     0354   94        0.
    1     0542   20      874.     *    1     1312   45         0.     *    1     2042   70        0.     *    2     0412   95        0.
    1     0600   21      833.     *    1     1330   46         0.     *    1     2100   71        0.     *    2     0430   96        0.
    1     0618   22      748.     *    1     1348   47         0.     *    1     2118   72        0.     *    2     0448   97        0.
    1     0636   23      589.     *    1     1406   48         0.     *    1     2136   73        0.     *    2     0506   98        0.
    1     0654   24      423.     *    1     1424   49         0.     *    1     2154   74        0.     *    2     0524   99        0.
    1     0712   25      283.     *    1     1442   50         0.     *    1     2212   75        0.     *    2     0542  100        0.
                                    *                                    *                                    *
**********************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR     29.70-HR
+   (CFS)       (HR)
                    (CFS)
+    2180.      3.30                  991.        251.        203.         203.
                (INCHES)          1.943       1.969       1.969        1.969
                 (AC-FT)           491.        498.        498.         498.

                       CUMULATIVE AREA =    4.74 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 115 KK    *     Cove   *     Reservoir
           *            *
           **************
                       Routing through Res'v

              HYDROGRAPH ROUTING DATA
```

```
117 RS          STORAGE ROUTING
                     NSTPS           1  NUMBER OF SUBREACHES
                      ITYP        ELEV  TYPE OF INITIAL CONDITION
                     RSVRIC     5545.50  INITIAL CONDITION
                         X         .00 WORKING R AND D COEFFICIENT

118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                             3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                              5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

122 SL          LOW-LEVEL OUTLET
                     ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                     CAREA        4.91  CROSS-SECTIONAL AREA
                      COQL         .60  COEFFICIENT
                      EXPL         .50  EXPONENT OF HEAD

123 SS          SPILLWAY
                     CREL     5549.20  SPILLWAY CREST ELEVATION
                    SPWID       30.00  SPILLWAY WIDTH
                     COQW        2.67  WEIR COEFFICIENT
                     EXPW        1.50  EXPONENT OF HEAD

124 ST          TOP OF DAM
                     TOPEL     5552.00  ELEVATION AT TOP OF DAM
                    DAMWID     1892.00  DAM WIDTH
                      COQD        2.90  WEIR COEFFICIENT
                      EXPD        1.50  EXPONENT OF HEAD
```

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

****

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

****

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	5844.8	5545.5	1		1012	35	41.	6318.9	5548.6	1		2024	69	41.	6284.1	5548.5
1		0018	2	0.	5844.8	5545.5	1		1030	36	41.	6317.9	5548.6	1		2042	70	41.	6283.1	5548.4
1		0036	3	0.	5844.8	5545.5	1		1048	37	41.	6316.9	5548.6	1		2100	71	41.	6282.1	5548.4
1		0054	4	0.	5844.8	5545.5	1		1106	38	41.	6315.9	5548.6	1		2118	72	41.	6281.1	5548.4
1		0112	5	0.	5844.8	5545.5	1		1124	39	41.	6314.8	5548.6	1		2136	73	40.	6280.0	5548.4
1		0130	6	1.	5844.9	5545.5	1		1142	40	41.	6313.8	5548.6	1		2154	74	40.	6279.0	5548.4
1		0148	7	2.	5845.4	5545.5	1		1200	41	41.	6312.8	5548.5	1		2212	75	40.	6278.0	5548.4
1		0206	8	4.	5848.3	5545.5	1		1218	42	41.	6311.8	5548.5	1		2230	76	40.	6277.0	5548.4
1		0224	9	8.	5859.1	5545.6	1		1236	43	41.	6310.7	5548.5	1		2248	77	40.	6275.9	5548.4
1		0242	10	13.	5884.3	5545.8	1		1254	44	41.	6309.7	5548.5	1		2306	78	40.	6274.9	5548.4
1		0300	11	19.	5925.9	5546.2	1		1312	45	41.	6308.7	5548.5	1		2324	79	40.	6273.9	5548.4
1		0318	12	25.	5977.5	5546.6	1		1330	46	41.	6307.7	5548.5	1		2342	80	40.	6272.9	5548.4
1		0336	13	29.	6028.2	5547.0	1		1348	47	41.	6306.6	5548.5	2		0000	81	40.	6271.8	5548.4
1		0354	14	32.	6072.5	5547.4	1		1406	48	41.	6305.6	5548.5	2		0018	82	40.	6270.8	5548.4
1		0412	15	35.	6110.4	5547.7	1		1424	49	41.	6304.6	5548.5	2		0036	83	40.	6269.8	5548.4
1		0430	16	37.	6142.7	5547.9	1		1442	50	41.	6303.6	5548.5	2		0054	84	40.	6268.8	5548.4
1		0448	17	38.	6170.9	5548.1	1		1500	51	41.	6302.6	5548.5	2		0112	85	40.	6267.7	5548.4
1		0506	18	39.	6196.1	5548.2	1		1518	52	41.	6301.5	5548.5	2		0130	86	40.	6266.7	5548.4
1		0524	19	39.	6219.0	5548.2	1		1536	53	41.	6300.5	5548.5	2		0148	87	40.	6265.7	5548.4
1		0542	20	40.	6240.4	5548.3	1		1554	54	41.	6299.5	5548.5	2		0206	88	40.	6264.7	5548.4

```
   1     0600  21      40.   6260.6  5548.4 *  1     1612  55      41.   6298.5  5548.5 *  2     0224  89      40.   6263.7  5548.4
   1     0618  22      40.   6279.2  5548.4 *  1     1630  56      41.   6297.4  5548.5 *  2     0242  90      40.   6262.6  5548.4
   1     0636  23      41.   6294.7  5548.5 *  1     1648  57      41.   6296.4  5548.5 *  2     0300  91      40.   6261.6  5548.4
   1     0654  24      41.   6306.2  5548.5 *  1     1706  58      41.   6295.4  5548.5 *  2     0318  92      40.   6260.6  5548.4
   1     0712  25      41.   6314.0  5548.6 *  1     1724  59      41.   6294.4  5548.5 *  2     0336  93      40.   6259.6  5548.4
   1     0730  26      41.   6318.6  5548.6 *  1     1742  60      41.   6293.3  5548.5 *  2     0354  94      40.   6258.5  5548.4
   1     0748  27      41.   6321.3  5548.6 *  1     1800  61      41.   6292.3  5548.5 *  2     0412  95      40.   6257.5  5548.4
   1     0806  28      41.   6322.6  5548.6 *  1     1818  62      41.   6291.3  5548.5 *  2     0430  96      40.   6256.5  5548.4
   1     0824  29      41.   6323.0  5548.6 *  1     1836  63      41.   6290.3  5548.5 *  2     0448  97      40.   6255.5  5548.4
   1     0842  30      41.   6322.9  5548.6 *  1     1854  64      41.   6289.2  5548.5 *  2     0506  98      40.   6254.4  5548.4
   1     0900  31      41.   6322.4  5548.6 *  1     1912  65      41.   6288.2  5548.5 *  2     0524  99      40.   6253.4  5548.3
   1     0918  32      41.   6321.7  5548.6 *  1     1930  66      41.   6287.2  5548.5 *  2     0542 100      40.   6252.4  5548.3
   1     0936  33      41.   6320.8  5548.6 *  1     1948  67      41.   6286.2  5548.5 *
   1     0954  34      41.   6320.0  5548.6 *  1     2006  68      41.   6285.1  5548.5 *
                                            *                                            *
 ********************************************************************************************************************************************

 PEAK OUTFLOW IS       41. AT TIME   8.40 HOURS


  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                  6-HR       24-HR       72-HR     29.70-HR
+   (CFS)       (HR)
                     (CFS)
+      41.      8.40                41.         41.         36.          36.
                        (INCHES)     .081        .319        .353         .353
                         (AC-FT)      20.         81.         89.          89.

 PEAK STORAGE   TIME                       MAXIMUM AVERAGE STORAGE
                                  6-HR       24-HR       72-HR     29.70-HR
+  (AC-FT)      (HR)
     6323.      8.40               6317.       6290.       6230.        6230.

  PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                  6-HR       24-HR       72-HR     29.70-HR
+   (FEET)      (HR)
   5548.58      8.40             5548.56     5548.47     5548.10      5548.10

                         CUMULATIVE AREA =    4.74 SQ MI

1

               PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
                                   FLOWS IN CUBIC FEET PER SECOND,  AREA IN SQUARE MILES
                                                TIME TO PEAK IN HOURS


                                                                          RATIOS APPLIED TO PRECIPITATION
 OPERATION       STATION     AREA    PLAN            RATIO 1
                                                        1.00

 HYDROGRAPH AT
+                B1          .50     1   FLOW         221.
                                         TIME         3.00

 ROUTED TO
+                RB1         .50     1   FLOW         215.
                                         TIME         3.30

 HYDROGRAPH AT
+                B2          .44     1   FLOW         187.
                                         TIME         3.00

 HYDROGRAPH AT
+                B3          .28     1   FLOW         116.
                                         TIME         3.00

  3 COMBINED AT
+                C1         1.22     1   FLOW         493.
                                         TIME         3.00

 ROUTED TO
+                RC1        1.22     1   FLOW         478.
                                         TIME         3.30

 HYDROGRAPH AT
+                B4          .45     1   FLOW         209.
                                         TIME         3.00

 HYDROGRAPH AT
+                B5          .81     1   FLOW         334.
                                         TIME         3.00

  3 COMBINED AT
+                C2         2.48     1   FLOW         983.
                                         TIME         3.30

 ROUTED TO
+                RC2        2.48     1   FLOW         977.
                                         TIME         3.30

 HYDROGRAPH AT
```

```
+                 B6          .15     1   FLOW         141.
                                          TIME         2.70

 HYDROGRAPH AT
+                 B7          .33     1   FLOW         172.
                                          TIME         3.00

  3 COMBINED AT
+                 C3         2.95     1   FLOW        1173.
                                          TIME         3.30

 ROUTED TO
+                 RC3        2.95     1   FLOW        1135.
                                          TIME         3.30

 HYDROGRAPH AT
+                 B8         1.01     1   FLOW         669.
                                          TIME         3.00

 HYDROGRAPH AT
+                 B9          .24     1   FLOW         237.
                                          TIME         2.70

 HYDROGRAPH AT
+                 B10         .13     1   FLOW         138.
                                          TIME         2.40

  2 COMBINED AT
+                 C4          .37     1   FLOW         368.
                                          TIME         2.70

 ROUTED TO
+                 RC4         .37     1   FLOW         354.
                                          TIME         2.70

 HYDROGRAPH AT
+                 B11         .28     1   FLOW         237.
                                          TIME         2.70

  4 COMBINED AT
+                 C5         4.61     1   FLOW        2118.
                                          TIME         3.30

 HYDROGRAPH AT
+                 B12         .13     1   FLOW          90.
                                          TIME         2.70

  2 COMBINED AT
+                 Call       4.74     1   FLOW        2180.
                                          TIME         3.30

 ROUTED TO
+                 Cove       4.74     1   FLOW          41.
                                          TIME         8.40

                                    ** PEAK STAGES IN FEET **
                                    1   STAGE     5548.58
                                        TIME         8.40
1
                                        SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                            (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                INTERPOLATED TO
                                                                              COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

          FOR PLAN = 1  RATIO=  .00
             RB1    MANE         3.60    218.47    194.40      1.58     18.00    214.54    198.00        1.58


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .4234E+02 EXCESS= .0000E+00 OUTFLOW= .4236E+02 BASIN STORAGE= .4004E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
             RC1    MANE         3.60    494.09    190.80      1.54     18.00    478.26    198.00        1.53


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1002E+03 EXCESS= .0000E+00 OUTFLOW= .1002E+03 BASIN STORAGE= .2965E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC2    MANE         2.55    978.48    199.17      1.59     18.00    977.20    198.00        1.60


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2103E+03 EXCESS= .0000E+00 OUTFLOW= .2103E+03 BASIN STORAGE= .2799E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC3    MANE         7.20   1186.64    208.80      1.66     18.00   1135.13    198.00        1.66
```

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2617E+03 EXCESS= .0000E+00 OUTFLOW= .2619E+03 BASIN STORAGE= .9925E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RC4	MANE	5.40	361.92	167.40	2.62	18.00	354.00	162.00	2.62

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5187E+02 EXCESS= .0000E+00 OUTFLOW= .5189E+02 BASIN STORAGE= .2315E-02 PERCENT ERROR= .0

1 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION Cove
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	5545.50	5549.20	5552.00
STORAGE	5845.	6508.	7347.
OUTFLOW	0.	45.	435.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	5548.58	.00	6323.	41.	.00	8.40	.00

*** NORMAL END OF HEC-1 ***

Storm Event 14. General Auxiliary Spillway Hydrograph

```
1****************************************                                    ****************************************
 *                                      *                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                    *    HYDROLOGIC ENGINEERING CENTER     *
 *           VERSION 4.1                *                                    *         609 SECOND STREET            *
 *                                      *                                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   06AUG20  TIME  03:33:46  *                                    *           (916) 756-1104             *
 *                                      *                                    *                                      *
 ****************************************                                    ****************************************

                                        X     X  XXXXXXX   XXXXX           X
                                        X     X  X        X     X         XX
                                        X     X  X        X                X
                                        XXXXXXX  XXXX     X        XXXXX   X
                                        X     X  X        X                X
                                        X     X  X        X     X          X
                                        X     X  XXXXXXX   XXXXX          XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   General ASH (NEH)
           13           ID
                        *
           14           JR    PREC     1.0
           15           IT      12       0       0     200
           16           IO       0
           17           IN      12
                        *
           18           QI       0       0       0       0       0       0       0       0       0       0
           19           QI       0       0       0       0       0       0       0       0       0       0
           20           QI       0       0       0       0       0       0       0       0       0       0
           21           QI       0       0       2      11      35      83     155     249     357     473
           22           QI     589     701     807     907     999    1084    1163    1234    1300    1359
           23           QI    1414    1464    1510    1552    1590    1626    1658    1689    1716    1742
           24           QI    1766    1764    1708    1564    1350    1117     898     713     581     489
           25           QI     423     374     339     314     296     283     274     267     263     259
           26           QI     257     255     254     253     253     253     253     253     254     254
           27           QI     254     253     251     244     236     226     218     210     205     201
           28           QI     199     197     196     195     194     194     194     193     193     193
           29           QI     193     193     193     193     193     194     194     194     194     194
           30           QI     194     191     182     163     136     107      80      57      41      29
           31           QI      21      15      11       8       6       4       3       2       1       1
           32           QI       1
                        *

           33           KK   Cove Reservoir
           34           KM   Routing through Res'v
           35           RS       1    ELEV  5545.5
           36           SV       0      19      95     240     453     738    1105    1563    2217    2773
           37           SV    3542    4423    5419    6149    7347    8000
           38           SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
           39           SE    5530    5536    5542    5548    5552    5558
           40           SL  5545.5   4.909     0.6     0.5
           41           SS  5549.2      30    2.67     1.5
           42           ST  5552.0    1892     2.9     1.5
                        *
           43           ZZ
1****************************************                                    ****************************************
 *                                      *                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                    *    HYDROLOGIC ENGINEERING CENTER     *
 *           VERSION 4.1                *                                    *         609 SECOND STREET            *
 *                                      *                                    *       DAVIS, CALIFORNIA 95616        *
```

```
*  RUN DATE   06AUG20  TIME  03:33:46   *                                                    *           (916) 756-1104            *
*                                       *                                                    *                                     *
*****************************************                                                    *************************************
```

HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

General ASH (NEH)

```
 16 IO          OUTPUT CONTROL VARIABLES
                     IPRNT           0  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                      NMIN          12  MINUTES IN COMPUTATION INTERVAL
                     IDATE      1    0  STARTING DATE
                     ITIME        0000  STARTING TIME
                        NQ         200  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE      2    0  ENDING DATE
                    NDTIME        1548  ENDING TIME
                    ICENT           19  CENTURY MARK

                  COMPUTATION INTERVAL     .20 HOURS
                       TOTAL TIME BASE   39.80 HOURS

         ENGLISH UNITS
              DRAINAGE AREA         SQUARE MILES
              PRECIPITATION DEPTH   INCHES
              LENGTH, ELEVATION     FEET
              FLOW                  CUBIC FEET PER SECOND
              STORAGE VOLUME        ACRE-FEET
              SURFACE AREA          ACRES
              TEMPERATURE           DEGREES FAHRENHEIT

    JP          MULTI-PLAN OPTION
                     NPLAN           1  NUMBER OF PLANS

    JR          MULTI-RATIO OPTION
                    RATIOS OF PRECIPITATION
                   1.00

 17 IN          TIME DATA FOR INPUT TIME SERIES
                     JXMIN          12  TIME INTERVAL IN MINUTES
                    JXDATE      1    0  STARTING DATE
                    JXTIME           0  STARTING TIME

              SUBBASIN RUNOFF DATA

  0 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .00  SUBBASIN AREA
```

***

HYDROGRAPH AT STATION Cove

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		1000	51	1414.	1		2000	101	199.	2		0600	151	1.
1		0012	2	0.	1		1012	52	1464.	1		2012	102	197.	2		0612	152	1.
1		0024	3	0.	1		1024	53	1510.	1		2024	103	196.	2		0624	153	1.
1		0036	4	0.	1		1036	54	1552.	1		2036	104	195.	2		0636	154	1.
1		0048	5	0.	1		1048	55	1590.	1		2048	105	194.	2		0648	155	1.
1		0100	6	0.	1		1100	56	1626.	1		2100	106	194.	2		0700	156	1.
1		0112	7	0.	1		1112	57	1658.	1		2112	107	194.	2		0712	157	1.
1		0124	8	0.	1		1124	58	1689.	1		2124	108	193.	2		0724	158	1.
1		0136	9	0.	1		1136	59	1716.	1		2136	109	193.	2		0736	159	1.
1		0148	10	0.	1		1148	60	1742.	1		2148	110	193.	2		0748	160	1.
1		0200	11	0.	1		1200	61	1766.	1		2200	111	193.	2		0800	161	1.
1		0212	12	0.	1		1212	62	1764.	1		2212	112	193.	2		0812	162	1.
1		0224	13	0.	1		1224	63	1708.	1		2224	113	193.	2		0824	163	1.
1		0236	14	0.	1		1236	64	1564.	1		2236	114	193.	2		0836	164	1.
1		0248	15	0.	1		1248	65	1350.	1		2248	115	193.	2		0848	165	1.
1		0300	16	0.	1		1300	66	1117.	1		2300	116	194.	2		0900	166	1.
1		0312	17	0.	1		1312	67	898.	1		2312	117	194.	2		0912	167	1.

1	0324	18	0.	*	1	1324	68	713.	*	1	2324	118	194.	*	2	0924	168	1.
1	0336	19	0.	*	1	1336	69	581.	*	1	2336	119	194.	*	2	0936	169	1.
1	0348	20	0.	*	1	1348	70	489.	*	1	2348	120	194.	*	2	0948	170	1.
1	0400	21	0.	*	1	1400	71	423.	*	2	0000	121	194.	*	2	1000	171	1.
1	0412	22	0.	*	1	1412	72	374.	*	2	0012	122	191.	*	2	1012	172	1.
1	0424	23	0.	*	1	1424	73	339.	*	2	0024	123	182.	*	2	1024	173	1.
1	0436	24	0.	*	1	1436	74	314.	*	2	0036	124	163.	*	2	1036	174	1.
1	0448	25	0.	*	1	1448	75	296.	*	2	0048	125	136.	*	2	1048	175	1.
1	0500	26	0.	*	1	1500	76	283.	*	2	0100	126	107.	*	2	1100	176	1.
1	0512	27	0.	*	1	1512	77	274.	*	2	0112	127	80.	*	2	1112	177	1.
1	0524	28	0.	*	1	1524	78	267.	*	2	0124	128	57.	*	2	1124	178	1.
1	0536	29	0.	*	1	1536	79	263.	*	2	0136	129	41.	*	2	1136	179	1.
1	0548	30	0.	*	1	1548	80	259.	*	2	0148	130	29.	*	2	1148	180	1.
1	0600	31	0.	*	1	1600	81	257.	*	2	0200	131	21.	*	2	1200	181	1.
1	0612	32	0.	*	1	1612	82	255.	*	2	0212	132	15.	*	2	1212	182	1.
1	0624	33	2.	*	1	1624	83	254.	*	2	0224	133	11.	*	2	1224	183	1.
1	0636	34	11.	*	1	1636	84	253.	*	2	0236	134	8.	*	2	1236	184	1.
1	0648	35	35.	*	1	1648	85	253.	*	2	0248	135	6.	*	2	1248	185	1.
1	0700	36	83.	*	1	1700	86	253.	*	2	0300	136	4.	*	2	1300	186	1.
1	0712	37	155.	*	1	1712	87	253.	*	2	0312	137	3.	*	2	1312	187	1.
1	0724	38	249.	*	1	1724	88	253.	*	2	0324	138	2.	*	2	1324	188	1.
1	0736	39	357.	*	1	1736	89	254.	*	2	0336	139	1.	*	2	1336	189	1.
1	0748	40	473.	*	1	1748	90	254.	*	2	0348	140	1.	*	2	1348	190	1.
1	0800	41	589.	*	1	1800	91	254.	*	2	0400	141	1.	*	2	1400	191	1.
1	0812	42	701.	*	1	1812	92	253.	*	2	0412	142	1.	*	2	1412	192	1.
1	0824	43	807.	*	1	1824	93	251.	*	2	0424	143	1.	*	2	1424	193	1.
1	0836	44	907.	*	1	1836	94	244.	*	2	0436	144	1.	*	2	1436	194	1.
1	0848	45	999.	*	1	1848	95	236.	*	2	0448	145	1.	*	2	1448	195	1.
1	0900	46	1084.	*	1	1900	96	226.	*	2	0500	146	1.	*	2	1500	196	1.
1	0912	47	1163.	*	1	1912	97	218.	*	2	0512	147	1.	*	2	1512	197	1.
1	0924	48	1234.	*	1	1924	98	210.	*	2	0524	148	1.	*	2	1524	198	1.
1	0936	49	1300.	*	1	1936	99	205.	*	2	0536	149	1.	*	2	1536	199	1.
1	0948	50	1359.	*	1	1948	100	201.	*	2	0548	150	1.	*	2	1548	200	1.

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	39.80-HR
+ (CFS)	(HR)				
		(CFS)			
+ 1766.	12.00	1268.	437.	264.	264.
		(INCHES) .000	.000	.000	.000
		(AC-FT) 629.	868.	868.	868.

CUMULATIVE AREA = .00 SQ MI

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	*	1		1000	51	1414.	*	1		2000	101	199.	*	2		0600	151	1.
1		0012	2	0.	*	1		1012	52	1464.	*	1		2012	102	197.	*	2		0612	152	1.
1		0024	3	0.	*	1		1024	53	1510.	*	1		2024	103	196.	*	2		0624	153	1.
1		0036	4	0.	*	1		1036	54	1552.	*	1		2036	104	195.	*	2		0636	154	1.
1		0048	5	0.	*	1		1048	55	1590.	*	1		2048	105	194.	*	2		0648	155	1.
1		0100	6	0.	*	1		1100	56	1626.	*	1		2100	106	194.	*	2		0700	156	1.
1		0112	7	0.	*	1		1112	57	1658.	*	1		2112	107	194.	*	2		0712	157	1.
1		0124	8	0.	*	1		1124	58	1689.	*	1		2124	108	193.	*	2		0724	158	1.
1		0136	9	0.	*	1		1136	59	1716.	*	1		2136	109	193.	*	2		0736	159	1.
1		0148	10	0.	*	1		1148	60	1742.	*	1		2148	110	193.	*	2		0748	160	1.
1		0200	11	0.	*	1		1200	61	1766.	*	1		2200	111	193.	*	2		0800	161	1.
1		0212	12	0.	*	1		1212	62	1764.	*	1		2212	112	193.	*	2		0812	162	1.
1		0224	13	0.	*	1		1224	63	1708.	*	1		2224	113	193.	*	2		0824	163	1.
1		0236	14	0.	*	1		1236	64	1564.	*	1		2236	114	193.	*	2		0836	164	1.
1		0248	15	0.	*	1		1248	65	1350.	*	1		2248	115	193.	*	2		0848	165	1.
1		0300	16	0.	*	1		1300	66	1117.	*	1		2300	116	194.	*	2		0900	166	1.
1		0312	17	0.	*	1		1312	67	898.	*	1		2312	117	194.	*	2		0912	167	1.
1		0324	18	0.	*	1		1324	68	713.	*	1		2324	118	194.	*	2		0924	168	1.
1		0336	19	0.	*	1		1336	69	581.	*	1		2336	119	194.	*	2		0936	169	1.
1		0348	20	0.	*	1		1348	70	489.	*	1		2348	120	194.	*	2		0948	170	1.
1		0400	21	0.	*	1		1400	71	423.	*	2		0000	121	194.	*	2		1000	171	1.
1		0412	22	0.	*	1		1412	72	374.	*	2		0012	122	191.	*	2		1012	172	1.
1		0424	23	0.	*	1		1424	73	339.	*	2		0024	123	182.	*	2		1024	173	1.
1		0436	24	0.	*	1		1436	74	314.	*	2		0036	124	163.	*	2		1036	174	1.
1		0448	25	0.	*	1		1448	75	296.	*	2		0048	125	136.	*	2		1048	175	1.
1		0500	26	0.	*	1		1500	76	283.	*	2		0100	126	107.	*	2		1100	176	1.
1		0512	27	0.	*	1		1512	77	274.	*	2		0112	127	80.	*	2		1112	177	1.
1		0524	28	0.	*	1		1524	78	267.	*	2		0124	128	57.	*	2		1124	178	1.
1		0536	29	0.	*	1		1536	79	263.	*	2		0136	129	41.	*	2		1136	179	1.
1		0548	30	0.	*	1		1548	80	259.	*	2		0148	130	29.	*	2		1148	180	1.
1		0600	31	0.	*	1		1600	81	257.	*	2		0200	131	21.	*	2		1200	181	1.
1		0612	32	0.	*	1		1612	82	255.	*	2		0212	132	15.	*	2		1212	182	1.
1		0624	33	2.	*	1		1624	83	254.	*	2		0224	133	11.	*	2		1224	183	1.
1		0636	34	11.	*	1		1636	84	253.	*	2		0236	134	8.	*	2		1236	184	1.
1		0648	35	35.	*	1		1648	85	253.	*	2		0248	135	6.	*	2		1248	185	1.
1		0700	36	83.	*	1		1700	86	253.	*	2		0300	136	4.	*	2		1300	186	1.

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    1     0712   37      155.   *    1     1712   87      253.   *    2     0312  137        3.   *    2     1312  187        1.
    1     0724   38      249.   *    1     1724   88      253.   *    2     0324  138        2.   *    2     1324  188        1.
    1     0736   39      357.   *    1     1736   89      254.   *    2     0336  139        1.   *    2     1336  189        1.
    1     0748   40      473.   *    1     1748   90      254.   *    2     0348  140        1.   *    2     1348  190        1.
    1     0800   41      589.   *    1     1800   91      254.   *    2     0400  141        1.   *    2     1400  191        1.
    1     0812   42      701.   *    1     1812   92      253.   *    2     0412  142        1.   *    2     1412  192        1.
    1     0824   43      807.   *    1     1824   93      251.   *    2     0424  143        1.   *    2     1424  193        1.
    1     0836   44      907.   *    1     1836   94      244.   *    2     0436  144        1.   *    2     1436  194        1.
    1     0848   45      999.   *    1     1848   95      236.   *    2     0448  145        1.   *    2     1448  195        1.
    1     0900   46     1084.   *    1     1900   96      226.   *    2     0500  146        1.   *    2     1500  196        1.
    1     0912   47     1163.   *    1     1912   97      218.   *    2     0512  147        1.   *    2     1512  197        1.
    1     0924   48     1234.   *    1     1924   98      210.   *    2     0524  148        1.   *    2     1524  198        1.
    1     0936   49     1300.   *    1     1936   99      205.   *    2     0536  149        1.   *    2     1536  199        1.
    1     0948   50     1359.   *    1     1948  100      201.   *    2     0548  150        1.   *    2     1548  200        1.
                                 *                                 *                                 *
 ********************************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                  6-HR        24-HR       72-HR     39.80-HR
+   (CFS)       (HR)
                     (CFS)
+    1766.     12.00              1268.        437.        264.         264.
                    (INCHES)      .000        .000        .000         .000
                     (AC-FT)      629.        868.        868.         868.

                    CUMULATIVE AREA =     .00 SQ MI



 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
  33 KK    *     Cove   *     Reservoir
           *            *
           **************
                        Routing through Res'v

              HYDROGRAPH ROUTING DATA

  35 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC     5545.50  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

  36 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                  3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

  38 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                               5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

  40 SL          LOW-LEVEL OUTLET
                       ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                       CAREA        4.91  CROSS-SECTIONAL AREA
                        COQL         .60  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

  41 SS          SPILLWAY
                        CREL     5549.20  SPILLWAY CREST ELEVATION
                       SPWID       30.00  SPILLWAY WIDTH
                        COQW        2.67  WEIR COEFFICIENT
                        EXPW        1.50  EXPONENT OF HEAD

  42 ST          TOP OF DAM
                       TOPEL     5552.00  ELEVATION AT TOP OF DAM
                      DAMWID     1892.00  DAM WIDTH
                        COQD        2.90  WEIR COEFFICIENT
                        EXPD        1.50  EXPONENT OF HEAD

                                                    ***

                                          COMPUTED OUTFLOW-ELEVATION DATA

                                            (EXCLUDING FLOW OVER DAM)

            OUTFLOW        .00       .00     25.78     27.48     29.42     31.65     34.25     37.31     40.98     45.44
          ELEVATION    5470.00   5545.50   5546.69   5546.85   5547.05   5547.30   5547.60   5548.00   5548.51   5549.20

            OUTFLOW      49.37     68.29    113.97    198.20    332.85    529.64    800.37   1156.85   1610.93   2174.46
          ELEVATION    5549.32   5549.60   5550.06   5550.68   5551.48   5552.44   5553.58   5554.88   5556.36   5558.00


                                          COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

                                            (INCLUDING FLOW OVER DAM)

            STORAGE        .00     19.00     95.00    240.00    453.00    738.00   1105.00   1563.00   2217.00   2773.00
            OUTFLOW        .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
          ELEVATION    5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
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STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	5844.8	5545.5	1		1324	68	44.	6457.6	5549.0	2		0248	135	69.	6632.9	5549.6
1		0012	2	0.	5844.8	5545.5	1		1336	69	45.	6467.5	5549.1	2		0300	136	69.	6631.9	5549.6
1		0024	3	0.	5844.8	5545.5	1		1348	70	45.	6475.6	5549.1	2		0312	137	69.	6630.9	5549.6
1		0036	4	0.	5844.8	5545.5	1		1400	71	45.	6482.3	5549.1	2		0324	138	69.	6629.8	5549.6
1		0048	5	0.	5844.8	5545.5	1		1412	72	45.	6488.1	5549.1	2		0336	139	68.	6628.7	5549.6
1		0100	6	0.	5844.8	5545.5	1		1424	73	45.	6493.2	5549.1	2		0348	140	68.	6627.5	5549.6
1		0112	7	0.	5844.8	5545.5	1		1436	74	45.	6497.9	5549.2	2		0400	141	68.	6626.3	5549.6
1		0124	8	0.	5844.8	5545.5	1		1448	75	45.	6502.2	5549.2	2		0412	142	67.	6625.2	5549.6
1		0136	9	0.	5844.8	5545.5	1		1500	76	45.	6506.3	5549.2	2		0424	143	67.	6624.1	5549.6
1		0148	10	0.	5844.8	5545.5	1		1512	77	46.	6510.1	5549.2	2		0436	144	67.	6623.1	5549.6
1		0200	11	0.	5844.8	5545.5	1		1524	78	46.	6513.7	5549.2	2		0448	145	66.	6622.1	5549.6
1		0212	12	0.	5844.8	5545.5	1		1536	79	46.	6517.4	5549.2	2		0500	146	66.	6621.1	5549.6
1		0224	13	0.	5844.8	5545.5	1		1548	80	46.	6520.9	5549.2	2		0512	147	66.	6620.0	5549.6
1		0236	14	0.	5844.8	5545.5	1		1600	81	47.	6524.4	5549.3	2		0524	148	66.	6619.0	5549.6
1		0248	15	0.	5844.8	5545.5	1		1612	82	47.	6527.9	5549.3	2		0536	149	65.	6618.0	5549.6
1		0300	16	0.	5844.8	5545.5	1		1624	83	48.	6531.3	5549.3	2		0548	150	65.	6617.0	5549.6
1		0312	17	0.	5844.8	5545.5	1		1636	84	48.	6534.6	5549.3	2		0600	151	65.	6615.9	5549.6
1		0324	18	0.	5844.8	5545.5	1		1648	85	49.	6538.0	5549.3	2		0612	152	65.	6614.9	5549.6
1		0336	19	0.	5844.8	5545.5	1		1700	86	49.	6541.4	5549.3	2		0624	153	64.	6613.9	5549.6
1		0348	20	0.	5844.8	5545.5	1		1712	87	50.	6544.7	5549.3	2		0636	154	64.	6612.9	5549.5
1		0400	21	0.	5844.8	5545.5	1		1724	88	50.	6548.1	5549.3	2		0648	155	64.	6611.9	5549.5
1		0412	22	0.	5844.8	5545.5	1		1736	89	51.	6551.5	5549.3	2		0700	156	63.	6610.8	5549.5
1		0424	23	0.	5844.8	5545.5	1		1748	90	51.	6554.8	5549.4	2		0712	157	63.	6609.8	5549.5
1		0436	24	0.	5844.8	5545.5	1		1800	91	52.	6558.2	5549.4	2		0724	158	63.	6608.8	5549.5
1		0448	25	0.	5844.8	5545.5	1		1812	92	52.	6561.5	5549.4	2		0736	159	63.	6607.8	5549.5
1		0500	26	0.	5844.8	5545.5	1		1824	93	53.	6564.9	5549.4	2		0748	160	62.	6606.7	5549.5
1		0512	27	0.	5844.8	5545.5	1		1836	94	54.	6568.1	5549.4	2		0800	161	62.	6605.7	5549.5
1		0524	28	0.	5844.8	5545.5	1		1848	95	54.	6571.2	5549.4	2		0812	162	62.	6604.7	5549.5
1		0536	29	0.	5844.8	5545.5	1		1900	96	55.	6574.1	5549.4	2		0824	163	62.	6603.7	5549.5
1		0548	30	0.	5844.8	5545.5	1		1912	97	56.	6576.9	5549.4	2		0836	164	61.	6602.6	5549.5
1		0600	31	0.	5844.8	5545.5	1		1924	98	56.	6579.5	5549.4	2		0848	165	61.	6601.6	5549.5
1		0612	32	0.	5844.8	5545.5	1		1936	99	57.	6582.0	5549.4	2		0900	166	61.	6600.6	5549.5
1		0624	33	0.	5844.8	5545.5	1		1948	100	57.	6584.5	5549.5	2		0912	167	61.	6599.6	5549.5
1		0636	34	1.	5845.0	5545.5	1		2000	101	58.	6586.8	5549.5	2		0924	168	60.	6598.5	5549.5
1		0648	35	1.	5845.3	5545.5	1		2012	102	58.	6589.2	5549.5	2		0936	169	60.	6597.5	5549.5
1		0700	36	3.	5846.3	5545.5	1		2024	103	59.	6591.5	5549.5	2		0948	170	60.	6596.5	5549.5
1		0712	37	4.	5848.2	5545.5	1		2036	104	59.	6593.7	5549.5	2		1000	171	60.	6595.5	5549.5
1		0724	38	5.	5851.4	5545.6	1		2048	105	60.	6595.9	5549.5	2		1012	172	59.	6594.4	5549.5
1		0736	39	7.	5856.4	5545.6	1		2100	106	60.	6598.1	5549.5	2		1024	173	59.	6593.4	5549.5
1		0748	40	9.	5863.1	5545.6	1		2112	107	61.	6600.3	5549.5	2		1036	174	59.	6592.4	5549.5
1		0800	41	11.	5871.7	5545.7	1		2124	108	61.	6602.5	5549.5	2		1048	175	59.	6591.4	5549.5
1		0812	42	13.	5882.1	5545.8	1		2136	109	62.	6604.7	5549.5	2		1100	176	59.	6590.4	5549.5
1		0824	43	15.	5894.4	5545.9	1		2148	110	63.	6606.9	5549.5	2		1112	177	58.	6589.5	5549.5
1		0836	44	17.	5908.3	5546.0	1		2200	111	63.	6609.1	5549.5	2		1124	178	58.	6588.6	5549.5
1		0848	45	19.	5923.7	5546.1	1		2212	112	64.	6611.3	5549.5	2		1136	179	58.	6587.7	5549.5
1		0900	46	21.	5940.6	5546.3	1		2224	113	64.	6613.5	5549.6	2		1148	180	58.	6586.8	5549.5
1		0912	47	23.	5958.8	5546.4	1		2236	114	65.	6615.7	5549.6	2		1200	181	58.	6586.0	5549.5
1		0924	48	25.	5978.3	5546.6	1		2248	115	65.	6617.7	5549.6	2		1212	182	57.	6585.1	5549.5
1		0936	49	27.	5998.8	5546.8	1		2300	116	66.	6619.7	5549.6	2		1224	183	57.	6584.2	5549.5
1		0948	50	28.	6020.3	5546.9	1		2312	117	66.	6621.8	5549.6	2		1236	184	57.	6583.3	5549.5
1		1000	51	30.	6042.7	5547.1	1		2324	118	67.	6623.8	5549.6	2		1248	185	57.	6582.5	5549.4
1		1012	52	32.	6066.0	5547.3	1		2336	119	67.	6625.9	5549.6	2		1300	186	57.	6581.6	5549.4
1		1024	53	34.	6090.1	5547.5	1		2348	120	68.	6627.9	5549.6	2		1312	187	56.	6580.7	5549.4
1		1036	54	35.	6114.7	5547.7	2		0000	121	69.	6630.0	5549.6	2		1324	188	56.	6579.8	5549.4
1		1048	55	37.	6140.0	5547.9	2		0012	122	69.	6632.0	5549.6	2		1336	189	56.	6578.9	5549.4
1		1100	56	38.	6166.0	5548.1	2		0024	123	70.	6633.9	5549.6	2		1348	190	56.	6578.1	5549.4
1		1112	57	38.	6192.4	5548.1	2		0036	124	70.	6635.7	5549.6	2		1400	191	56.	6577.2	5549.4
1		1124	58	39.	6219.5	5548.2	2		0048	125	71.	6637.0	5549.6	2		1412	192	55.	6576.3	5549.4
1		1136	59	40.	6247.0	5548.3	2		0100	126	71.	6637.9	5549.6	2		1424	193	55.	6575.4	5549.4
1		1148	60	40.	6274.9	5548.4	2		0112	127	71.	6638.3	5549.6	2		1436	194	55.	6574.6	5549.4
1		1200	61	41.	6303.3	5548.5	2		0124	128	71.	6638.3	5549.6	2		1448	195	55.	6573.7	5549.4
1		1212	62	42.	6331.8	5548.6	2		0136	129	71.	6638.0	5549.6	2		1500	196	55.	6572.8	5549.4
1		1224	63	42.	6359.7	5548.7	2		0148	130	71.	6637.4	5549.6	2		1512	197	55.	6571.9	5549.4
1		1236	64	43.	6386.1	5548.8	2		0200	131	70.	6636.7	5549.6	2		1524	198	54.	6571.0	5549.4
1		1248	65	43.	6409.5	5548.9	2		0212	132	70.	6635.8	5549.6	2		1536	199	54.	6570.2	5549.4
1		1300	66	44.	6429.0	5548.9	2		0224	133	70.	6635.0	5549.6	2		1548	200	54.	6569.3	5549.4
1		1312	67	44.	6445.0	5549.0	2		0236	134	70.	6633.9	5549.6							

PEAK OUTFLOW IS 71. AT TIME 25.20 HOURS

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	39.80-HR
+ (CFS)	(HR)					
		(CFS)				
+ 71.	25.20		69.	61.	44.	44.
		(INCHES)	.000	.000	.000	.000
		(AC-FT)	34.	121.	145.	145.

PEAK STORAGE	TIME		MAXIMUM AVERAGE STORAGE			
			6-HR	24-HR	72-HR	39.80-HR
+ (AC-FT)	(HR)					
6638.	25.20		6631.	6598.	6379.	6379.

PEAK STAGE	TIME		MAXIMUM AVERAGE STAGE			
			6-HR	24-HR	72-HR	39.80-HR
+ (FEET)	(HR)					
5549.63	25.20		5549.61	5549.50	5548.41	5548.41

CUMULATIVE AREA = .00 SQ MI

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1
					1.00
HYDROGRAPH AT					
+	Cove	.00	1	FLOW	1766.
				TIME	12.00
ROUTED TO					
+	Cove	.00	1	FLOW	71.
				TIME	25.20

** PEAK STAGES IN FEET **

1	STAGE	5549.63
	TIME	25.20

1 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION Cove
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	5545.50	5549.20	5552.00
STORAGE	5845.	6508.	7347.
OUTFLOW	0.	45.	435.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	5549.63	.00	6638.	71.	.00	25.20	.00

*** NORMAL END OF HEC-1 ***

Storm Event 15. Local Freeboard Hydrograph

```
1****************************************                                  ****************************************
 *                                      *                                  *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                  *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                  *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1               *                                  *         609 SECOND STREET            *
 *                                      *                                  *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   06AUG20  TIME  02:59:11  *                                  *           (916) 756-1104             *
 *                                      *                                  *                                      *
 ****************************************                                  ****************************************

                                                X     X  XXXXXXX   XXXXX           X
                                                X     X  X        X     X         XX
                                                X     X  X        X                X
                                                XXXXXXX  XXXX     X        XXXXX   X
                                                X     X  X        X                X
                                                X     X  X        X     X          X
                                                X     X  XXXXXXX   XXXXX          XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   Local FBH
           13           ID
                        *
           14           JR    PREC     1.0
           15           IT      18       0       0     100
           16           IO       0
           17           IN      18
                        *

           18           KK   B1
           19           KM   Runoff from Basin 1
           20           BA   0.503
           21           PB    7.67
           22           PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
           23           PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
           24           PC   1.000
           25           LS       0    72.8
           26           UD    0.51
                        *

           27           KK   RB1
           28           KM   Route B1
           29           RD    4928    .045    .050           TRAP      20      20
                        *

           30           KK   B2
           31           KM   Runoff from Basin 2
           32           BA   0.436
           33           LS       0    72.5
           34           UD    0.52
                        *

           35           KK   B3
           36           KM   Runoff from Basin 3
           37           BA   0.279
           38           LS       0    71.0
           39           UD    0.39
                        *
1                                                HEC-1 INPUT                                                PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
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```
             40          KK   C1
             41          KM   Combine RB1, B2, B3
             42          HC       3
                         *

             43          KK   RC1
             44          KM   Route RC1
             45          RD    7255    .060    .030           TRAP      20      20
                         *

             46          KK   B4
             47          KM   Runoff from Basin 4
             48          BA   0.453
             49          LS       0    73.3
             50          UD    0.48
                         *

             51          KK   B5
             52          KM   Runoff from Basin 5
             53          BA   0.805
             54          LS       0    74.1
             55          UD    0.63
                         *

             56          KK   C2
             57          KM   Combine RC1, B4, B5
             58          HC       3
                         *

             59          KK   RC2
             60          KM   Route C2
             61          RD    2380    .039    .030           TRAP      40       2
                         *

             62          KK   B6
             63          KM   Runoff from Basin 6
             64          BA   0.150
             65          LS       0    84.3
             66          UD    0.19
                         *

             67          KK   B7
             68          KM   Runoff from Basin 7
             69          BA   0.327
             70          LS       0    75.7
             71          UD    0.46
                         *

             72          KK   C3
             73          KM   Combine RC2, B6, B7
             74          HC       3
                         *
1                                          HEC-1 INPUT                                          PAGE  3

            LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             75          KK   RC3
             76          KM   Route C3
             77          RD   11323    .023    .030           TRAP      40      20
                         *

             78          KK   B8
             79          KM   Runoff from Basin 8
             80          BA   1.012
             81          LS       0    84.0
             82          UD    0.67
                         *

             83          KK   B9
             84          KM   Runoff from Basin 9
             85          BA   0.242
             86          LS       0    85.5
             87          UD    0.26
                         *

             88          KK   B10
             89          KM   Runoff from Basin 10
             90          BA   0.129
             91          LS       0    86.7
             92          UD    0.18
                         *

             93          KK   C4
             94          KM   Combine B9, B10
             95          HC       2
                         *

             96          KK   RC4
             97          KM   Route C4
             98          RD    3380    .037    .030           TRAP      40      20
                         *
```

```
             99           KK   B11
            100           KM   Runoff from Basin 11
            101           BA   0.279
            102           LS       0    84.8
            103           UD    0.39
                          *

            104           KK   C5
            105           KM   Combine RC3, B8, RC4, B11
            106           HC       4
                          *

            107           KK   B12
            108           KM   Runoff from Basin 12
            109           BA   0.127
            110           LS       0    81.2
            111           UD    0.40
                          *
1                                          HEC-1 INPUT                                          PAGE  4

          LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            115           KK   Cove Reservoir
            116           KM   Routing through Res'v
            117           RS       1    ELEV  5545.5
            118           SV       0      19      95     240     453     738    1105    1563    2217    2773
            119           SV    3542    4423    5419    6149    7347    8000
            120           SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
            121           SE    5530    5536    5542    5548    5552    5558
            122           SL  5545.5   4.909     0.6     0.5
            123           SS  5549.2      30    2.67     1.5
            124           ST  5552.0    1892     2.9     1.5
                          *
            125           ZZ
1*************************************                                  *************************************
 *                                   *                                  *                                   *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                  *    U.S. ARMY CORPS OF ENGINEERS     *
 *              JUN   1998           *                                  *    HYDROLOGIC ENGINEERING CENTER    *
 *           VERSION 4.1             *                                  *          609 SECOND STREET          *
 *                                   *                                  *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   06AUG20  TIME  02:59:11   *                                  *          (916) 756-1104           *
 *                                   *                                  *                                   *
 *************************************                                  *************************************



                         HYDROLOGY STUDY for COVE RESERVOIR
                         Located in KANE COUNTY, UTAH

                         AUG 2020

                         PREPARED BY ALPHA ENGINEERING
                         43 SOUTH 100 EAST, SUITE 100
                         ST. GEORGE, UTAH  84770
                         TEL: (435) 628-6500
                         FAX: (435) 628-6553

                         Local FBH


   16 IO          OUTPUT CONTROL VARIABLES
                       IPRNT           0  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

      IT          HYDROGRAPH TIME DATA
                        NMIN          18  MINUTES IN COMPUTATION INTERVAL
                       IDATE       1    0  STARTING DATE
                       ITIME         0000  STARTING TIME
                          NQ          100  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE       2    0  ENDING DATE
                      NDTIME         0542  ENDING TIME
                      ICENT           19  CENTURY MARK

                    COMPUTATION INTERVAL      .30 HOURS
                         TOTAL TIME BASE   29.70 HOURS

           ENGLISH UNITS
                DRAINAGE AREA         SQUARE MILES
                PRECIPITATION DEPTH   INCHES
                LENGTH, ELEVATION     FEET
                FLOW                  CUBIC FEET PER SECOND
                STORAGE VOLUME        ACRE-FEET
```

```
             SURFACE AREA          ACRES
             TEMPERATURE           DEGREES FAHRENHEIT

     JP        MULTI-PLAN OPTION
                 NPLAN           1  NUMBER OF PLANS

     JR        MULTI-RATIO OPTION
                 RATIOS OF PRECIPITATION
               1.00


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 112 KK    *     Call   *
           *            *
           **************
                       Combine C5, B12

 114 HC          HYDROGRAPH COMBINATION
                   ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

**********************************************************************************************************************************************

                                              HYDROGRAPH AT STATION    Call
                                                   SUM OF  2 HYDROGRAPHS
                                                  PLAN 1,   RATIO =  1.00

**********************************************************************************************************************************************
                                  *                                  *                                  *
   DA MON HRMN  ORD      FLOW     *   DA MON HRMN  ORD      FLOW     *   DA MON HRMN  ORD      FLOW     *   DA MON HRMN  ORD      FLOW
                                  *                                  *                                  *
    1     0000    1        0.    *    1     0730   26       332.    *    1     1500   51        0.    *    1     2230   76        0.
    1     0018    2        0.    *    1     0748   27       201.    *    1     1518   52        0.    *    1     2248   77        0.
    1     0036    3        0.    *    1     0806   28       113.    *    1     1536   53        0.    *    1     2306   78        0.
    1     0054    4        8.    *    1     0824   29        62.    *    1     1554   54        0.    *    1     2324   79        0.
    1     0112    5       43.    *    1     0842   30        34.    *    1     1612   55        0.    *    1     2342   80        0.
    1     0130    6      129.    *    1     0900   31        18.    *    1     1630   56        0.    *    2     0000   81        0.
    1     0148    7      306.    *    1     0918   32         9.    *    1     1648   57        0.    *    2     0018   82        0.
    1     0206    8      824.    *    1     0936   33         5.    *    1     1706   58        0.    *    2     0036   83        0.
    1     0224    9     2325.    *    1     0954   34         2.    *    1     1724   59        0.    *    2     0054   84        0.
    1     0242   10     4867.    *    1     1012   35         1.    *    1     1742   60        0.    *    2     0112   85        0.
    1     0300   11     6395.    *    1     1030   36         0.    *    1     1800   61        0.    *    2     0130   86        0.
    1     0318   12     6123.    *    1     1048   37         0.    *    1     1818   62        0.    *    2     0148   87        0.
    1     0336   13     5053.    *    1     1106   38         0.    *    1     1836   63        0.    *    2     0206   88        0.
    1     0354   14     4063.    *    1     1124   39         0.    *    1     1854   64        0.    *    2     0224   89        0.
    1     0412   15     3364.    *    1     1142   40         0.    *    1     1912   65        0.    *    2     0242   90        0.
    1     0430   16     2855.    *    1     1200   41         0.    *    1     1930   66        0.    *    2     0300   91        0.
    1     0448   17     2500.    *    1     1218   42         0.    *    1     1948   67        0.    *    2     0318   92        0.
    1     0506   18     2228.    *    1     1236   43         0.    *    1     2006   68        0.    *    2     0336   93        0.
    1     0524   19     2039.    *    1     1254   44         0.    *    1     2024   69        0.    *    2     0354   94        0.
    1     0542   20     1913.    *    1     1312   45         0.    *    1     2042   70        0.    *    2     0412   95        0.
    1     0600   21     1819.    *    1     1330   46         0.    *    1     2100   71        0.    *    2     0430   96        0.
    1     0618   22     1614.    *    1     1348   47         0.    *    1     2118   72        0.    *    2     0448   97        0.
    1     0636   23     1240.    *    1     1406   48         0.    *    1     2136   73        0.    *    2     0506   98        0.
    1     0654   24      851.    *    1     1424   49         0.    *    1     2154   74        0.    *    2     0524   99        0.
    1     0712   25      540.    *    1     1442   50         0.    *    1     2212   75        0.    *    2     0542  100        0.
                                  *                                  *                                  *
**********************************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR     29.70-HR
+   (CFS)       (HR)
                    (CFS)
+    6395.      3.00              2560.        648.        524.         524.
                 (INCHES)        5.019       5.085       5.085        5.085
                  (AC-FT)        1269.       1286.       1286.        1286.

                       CUMULATIVE AREA =    4.74 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 115 KK    *     Cove   *     Reservoir
           *            *
           **************
                       Routing through Res'v

              HYDROGRAPH ROUTING DATA
```

```
117 RS          STORAGE ROUTING
                     NSTPS           1  NUMBER OF SUBREACHES
                      ITYP        ELEV  TYPE OF INITIAL CONDITION
                     RSVRIC     5545.50  INITIAL CONDITION
                         X         .00 WORKING R AND D COEFFICIENT

118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                              3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                              5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

122 SL          LOW-LEVEL OUTLET
                     ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                     CAREA        4.91  CROSS-SECTIONAL AREA
                      COQL         .60  COEFFICIENT
                      EXPL         .50  EXPONENT OF HEAD

123 SS          SPILLWAY
                      CREL     5549.20  SPILLWAY CREST ELEVATION
                     SPWID       30.00  SPILLWAY WIDTH
                      COQW        2.67  WEIR COEFFICIENT
                      EXPW        1.50  EXPONENT OF HEAD

124 ST          TOP OF DAM
                     TOPEL     5552.00  ELEVATION AT TOP OF DAM
                    DAMWID     1892.00  DAM WIDTH
                      COQD        2.90  WEIR COEFFICIENT
                      EXPD        1.50  EXPONENT OF HEAD
```

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

****

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	5844.8	5545.5	1		1012	35	233.	7019.3	5550.9	1		2024	69	154.	6859.6	5550.4
1		0018	2	0.	5844.8	5545.5	1		1030	36	230.	7013.6	5550.9	1		2042	70	152.	6855.8	5550.4
1		0036	3	0.	5844.8	5545.5	1		1048	37	227.	7007.9	5550.9	1		2100	71	150.	6852.0	5550.3
1		0054	4	1.	5845.0	5545.5	1		1106	38	224.	7002.3	5550.8	1		2118	72	149.	6848.3	5550.3
1		0112	5	2.	5845.5	5545.5	1		1124	39	221.	6996.8	5550.8	1		2136	73	147.	6844.7	5550.3
1		0130	6	4.	5847.6	5545.5	1		1142	40	218.	6991.3	5550.8	1		2154	74	146.	6841.0	5550.3
1		0148	7	6.	5852.9	5545.6	1		1200	41	216.	6985.9	5550.8	1		2212	75	144.	6837.4	5550.3
1		0206	8	10.	5866.8	5545.7	1		1218	42	213.	6980.7	5550.8	1		2230	76	142.	6833.8	5550.3
1		0224	9	17.	5905.5	5546.0	1		1236	43	210.	6975.4	5550.8	1		2248	77	141.	6830.3	5550.3
1		0242	10	26.	5994.1	5546.7	1		1254	44	207.	6970.3	5550.7	1		2306	78	139.	6826.8	5550.3
1		0300	11	36.	6133.0	5547.9	1		1312	45	205.	6965.2	5550.7	1		2324	79	138.	6823.5	5550.3
1		0318	12	41.	6287.2	5548.5	1		1330	46	202.	6960.0	5550.7	1		2342	80	136.	6820.1	5550.2
1		0336	13	44.	6424.7	5548.9	1		1348	47	200.	6955.1	5550.7	2		0000	81	135.	6816.7	5550.2
1		0354	14	48.	6536.5	5549.3	1		1406	48	197.	6950.1	5550.7	2		0018	82	134.	6813.4	5550.2
1		0412	15	68.	6627.1	5549.6	1		1424	49	195.	6945.3	5550.7	2		0036	83	132.	6810.0	5550.2
1		0430	16	91.	6702.2	5549.8	1		1442	50	192.	6940.5	5550.6	2		0054	84	131.	6806.8	5550.2
1		0448	17	114.	6766.0	5550.1	1		1500	51	190.	6935.8	5550.6	2		0112	85	129.	6803.6	5550.2
1		0506	18	137.	6821.4	5550.2	1		1518	52	188.	6931.1	5550.6	2		0130	86	128.	6800.4	5550.2
1		0524	19	159.	6870.7	5550.4	1		1536	53	185.	6926.4	5550.6	2		0148	87	127.	6797.1	5550.2
1		0542	20	180.	6915.4	5550.6	1		1554	54	183.	6921.9	5550.6	2		0206	88	126.	6794.1	5550.2

```
   1     0600  21     201.   6957.0  5550.7 *  1     1612  55     181.   6917.3  5550.6 *  2     0224  89     124.   6791.0  5550.1
   1     0618  22     220.   6994.3  5550.8 *  1     1630  56     179.   6913.0  5550.6 *  2     0242  90     123.   6787.9  5550.1
   1     0636  23     236.   7024.0  5550.9 *  1     1648  57     177.   6908.6  5550.5 *  2     0300  91     122.   6784.9  5550.1
   1     0654  24     247.   7043.8  5551.0 *  1     1706  58     175.   6904.2  5550.5 *  2     0318  92     121.   6781.8  5550.1
   1     0712  25     253.   7054.8  5551.0 *  1     1724  59     173.   6899.9  5550.5 *  2     0336  93     119.   6778.9  5550.1
   1     0730  26     255.   7059.3  5551.0 *  1     1742  60     171.   6895.7  5550.5 *  2     0354  94     118.   6775.9  5550.1
   1     0748  27     256.   7059.6  5551.0 *  1     1800  61     169.   6891.5  5550.5 *  2     0412  95     117.   6773.0  5550.1
   1     0806  28     254.   7057.2  5551.0 *  1     1818  62     167.   6887.4  5550.5 *  2     0430  96     116.   6770.1  5550.1
   1     0824  29     252.   7053.1  5551.0 *  1     1836  63     165.   6883.3  5550.5 *  2     0448  97     115.   6767.2  5550.1
   1     0842  30     249.   7048.1  5551.0 *  1     1854  64     163.   6879.2  5550.4 *  2     0506  98     114.   6764.4  5550.1
   1     0900  31     246.   7042.5  5551.0 *  1     1912  65     161.   6875.2  5550.4 *  2     0524  99     113.   6761.6  5550.0
   1     0918  32     243.   7036.8  5551.0 *  1     1930  66     159.   6871.3  5550.4 *  2     0542 100     112.   6758.8  5550.0
   1     0936  33     240.   7031.0  5550.9 *  1     1948  67     157.   6867.3  5550.4 *
   1     0954  34     237.   7025.1  5550.9 *  1     2006  68     156.   6863.4  5550.4 *
                                            *                                            *
 ********************************************************************************************************************************************

 PEAK OUTFLOW IS      256. AT TIME   7.80 HOURS


  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                  6-HR        24-HR       72-HR     29.70-HR
+   (CFS)       (HR)
                     (CFS)
+     256.      7.80                 238.        178.        151.        151.
                          (INCHES)      .466       1.393       1.470       1.470
                           (AC-FT)      118.        352.        372.        372.

 PEAK STORAGE   TIME                        MAXIMUM AVERAGE STORAGE
                                  6-HR        24-HR       72-HR     29.70-HR
+  (AC-FT)      (HR)
     7060.      7.80                7027.       6906.       6774.       6774.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                  6-HR        24-HR       72-HR     29.70-HR
+   (FEET)      (HR)
   5551.04      7.80              5550.93     5550.53     5549.96     5549.96

                         CUMULATIVE AREA =    4.74 SQ MI

1

               PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
                                   FLOWS IN CUBIC FEET PER SECOND,  AREA IN SQUARE MILES
                                                TIME TO PEAK IN HOURS


                                                                        RATIOS APPLIED TO PRECIPITATION
 OPERATION       STATION     AREA    PLAN            RATIO 1
                                                        1.00

 HYDROGRAPH AT
+                B1          .50     1   FLOW         689.
                                         TIME         3.00

 ROUTED TO
+                RB1         .50     1   FLOW         657.
                                         TIME         3.00

 HYDROGRAPH AT
+                B2          .44     1   FLOW         589.
                                         TIME         3.00

 HYDROGRAPH AT
+                B3          .28     1   FLOW         393.
                                         TIME         2.70

  3 COMBINED AT
+                C1         1.22     1   FLOW        1608.
                                         TIME         3.00

 ROUTED TO
+                RC1        1.22     1   FLOW        1507.
                                         TIME         3.00

 HYDROGRAPH AT
+                B4          .45     1   FLOW         636.
                                         TIME         3.00

 HYDROGRAPH AT
+                B5          .81     1   FLOW        1050.
                                         TIME         3.00

  3 COMBINED AT
+                C2         2.48     1   FLOW        3194.
                                         TIME         3.00

 ROUTED TO
+                RC2        2.48     1   FLOW        3137.
                                         TIME         3.00

 HYDROGRAPH AT
```

```
+                 B6          .15     1   FLOW         351.
                                          TIME         2.40

 HYDROGRAPH AT
+                 B7          .33     1   FLOW         490.
                                          TIME         3.00

  3 COMBINED AT
+                 C3         2.95     1   FLOW        3813.
                                          TIME         3.00

 ROUTED TO
+                 RC3        2.95     1   FLOW        3723.
                                          TIME         3.30

 HYDROGRAPH AT
+                 B8         1.01     1   FLOW        1656.
                                          TIME         3.00

 HYDROGRAPH AT
+                 B9          .24     1   FLOW         547.
                                          TIME         2.70

 HYDROGRAPH AT
+                 B10         .13     1   FLOW         326.
                                          TIME         2.40

  2 COMBINED AT
+                 C4          .37     1   FLOW         835.
                                          TIME         2.70

 ROUTED TO
+                 RC4         .37     1   FLOW         819.
                                          TIME         2.70

 HYDROGRAPH AT
+                 B11         .28     1   FLOW         575.
                                          TIME         2.70

  4 COMBINED AT
+                 C5         4.61     1   FLOW        6184.
                                          TIME         3.00

 HYDROGRAPH AT
+                 B12         .13     1   FLOW         238.
                                          TIME         2.70

  2 COMBINED AT
+                 Call       4.74     1   FLOW        6395.
                                          TIME         3.00

 ROUTED TO
+                 Cove       4.74     1   FLOW         256.
                                          TIME         7.80

                                    ** PEAK STAGES IN FEET **
                                    1   STAGE     5551.04
                                        TIME         7.80
1
                                        SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                            (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                INTERPOLATED TO
                                                                              COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

          FOR PLAN = 1  RATIO=  .00
             RB1    MANE         5.40    673.41    189.00      4.50     18.00    657.41    180.00        4.48


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1206E+03 EXCESS= .0000E+00 OUTFLOW= .1207E+03 BASIN STORAGE= .3686E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC1    MANE         5.40   1594.30    189.00      4.43     18.00   1507.33    180.00        4.43


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2880E+03 EXCESS= .0000E+00 OUTFLOW= .2881E+03 BASIN STORAGE= .3547E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC2    MANE         1.67   3186.21    182.05      4.52     18.00   3137.38    180.00        4.53


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5970E+03 EXCESS= .0000E+00 OUTFLOW= .5970E+03 BASIN STORAGE= .3099E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC3    MANE         7.20   3778.09    194.40      4.63     18.00   3723.23    198.00        4.64
```

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7287E+03 EXCESS= .0000E+00 OUTFLOW= .7291E+03 BASIN STORAGE= .1048E-01 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RC4	MANE	5.53	841.55	154.72	6.01	18.00	818.78	162.00	6.02

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1188E+03 EXCESS= .0000E+00 OUTFLOW= .1189E+03 BASIN STORAGE= .2808E-02 PERCENT ERROR= .0

1 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION Cove
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	5545.50	5549.20	5552.00
STORAGE	5845.	6508.	7347.
OUTFLOW	0.	45.	435.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	5551.04	.00	7060.	256.	.00	7.80	.00

*** NORMAL END OF HEC-1 ***

Storm Event 16. General Freeboard Hydrograph

```
1****************************************                                    ****************************************
 *                                      *                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                    *    HYDROLOGIC ENGINEERING CENTER     *
 *           VERSION 4.1                *                                    *         609 SECOND STREET            *
 *                                      *                                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   06AUG20  TIME  03:41:08  *                                    *           (916) 756-1104             *
 *                                      *                                    *                                      *
 ****************************************                                    ****************************************

                                        X     X  XXXXXXX   XXXXX          X
                                        X     X  X        X     X        XX
                                        X     X  X        X              X
                                        XXXXXXX  XXXX     X        XXXXX  X
                                        X     X  X        X              X
                                        X     X  X        X     X        X
                                        X     X  XXXXXXX   XXXXX        XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   General FBH (NEH)
           13           ID
                        *
           14           JR    PREC     1.0
           15           IT      12       0       0     600
           16           IO       0
           17           IN      12
                        *
           18           QI       0       0       0       0       0       0       0       0       0       0
           19           QI       0       0       0       0       0       0       0       0       0       0
           20           QI       0       0       0       0       0       1       2       4       7      10
           21           QI      15      30      74     175     342     567     829    1108    1380    1634
           22           QI    1866    2071    2260    2424    2568    2696    2807    2906    2993    3069
           23           QI    3137    3198    3252    3300    3343    3381    3416    3447    3475    3501
           24           QI    3524    3498    3371    3075    2649    2187    1755    1392    1131     950
           25           QI     820     724     655     606     570     545     526     513     503     496
           26           QI     492     488     485     483     483     483     483     483     483     484
           27           QI     484     482     477     465     448     431     414     400     390     383
           28           QI     378     375     372     370     369     368     368     367     367     367
           29           QI     367     366     366     366     367     367     367     367     367     367
           30           QI     367     362     345     308     257     202     151     108      77      56
           31           QI      40      29      21      15      11       8       5       4       3       2
           32           QI       1       1       0
                        *

           33           KK   Cove Reservoir
           34           KM   Routing through Res'v
           35           RS       1    ELEV  5545.5
           36           SV       0      19      95     240     453     738    1105    1563    2217    2773
           37           SV    3542    4423    5419    6149    7347    8000
           38           SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
           39           SE    5530    5536    5542    5548    5552    5558
           40           SL  5545.5   4.909     0.6     0.5
           41           SS  5549.2      30    2.67     1.5
           42           ST  5552.0    1892     2.9     1.5
                        *
           43           ZZ
1****************************************                                    ****************************************
 *                                      *                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                    *    HYDROLOGIC ENGINEERING CENTER     *
 *           VERSION 4.1                *                                    *         609 SECOND STREET            *
 *                                      *                                    *       DAVIS, CALIFORNIA 95616        *
```

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*  RUN DATE   06AUG20  TIME  03:41:08   *                                                *           (916) 756-1104            *
*                                       *                                                *                                     *
*****************************************                                                *****************************************
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HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

General FBH (NEH)

```
 16 IO          OUTPUT CONTROL VARIABLES
                     IPRNT           0  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                      NMIN          12  MINUTES IN COMPUTATION INTERVAL
                     IDATE      1    0  STARTING DATE
                     ITIME        0000  STARTING TIME
                        NQ         600  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE      5    0  ENDING DATE
                    NDTIME        2348  ENDING TIME
                    ICENT           19  CENTURY MARK

                  COMPUTATION INTERVAL     .20 HOURS
                       TOTAL TIME BASE  119.80 HOURS

         ENGLISH UNITS
              DRAINAGE AREA         SQUARE MILES
              PRECIPITATION DEPTH   INCHES
              LENGTH, ELEVATION     FEET
              FLOW                  CUBIC FEET PER SECOND
              STORAGE VOLUME        ACRE-FEET
              SURFACE AREA          ACRES
              TEMPERATURE           DEGREES FAHRENHEIT

    JP          MULTI-PLAN OPTION
                      NPLAN           1  NUMBER OF PLANS

    JR          MULTI-RATIO OPTION
                    RATIOS OF PRECIPITATION
                   1.00

 17 IN          TIME DATA FOR INPUT TIME SERIES
                      JXMIN          12  TIME INTERVAL IN MINUTES
                     JXDATE      1    0  STARTING DATE
                     JXTIME           0  STARTING TIME

              SUBBASIN RUNOFF DATA

  0 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .00  SUBBASIN AREA

                                                    ***
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****

HYDROGRAPH AT STATION Cove

****

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	2		0600	151	1.	3		1200	301	1.	4		1800	451	1.
1		0012	2	0.	2		0612	152	1.	3		1212	302	1.	4		1812	452	1.
1		0024	3	0.	2		0624	153	1.	3		1224	303	1.	4		1824	453	1.
1		0036	4	0.	2		0636	154	1.	3		1236	304	1.	4		1836	454	1.
1		0048	5	0.	2		0648	155	1.	3		1248	305	1.	4		1848	455	1.
1		0100	6	0.	2		0700	156	1.	3		1300	306	1.	4		1900	456	1.
1		0112	7	0.	2		0712	157	1.	3		1312	307	1.	4		1912	457	1.
1		0124	8	0.	2		0724	158	1.	3		1324	308	1.	4		1924	458	1.
1		0136	9	0.	2		0736	159	1.	3		1336	309	1.	4		1936	459	1.
1		0148	10	0.	2		0748	160	1.	3		1348	310	1.	4		1948	460	1.
1		0200	11	0.	2		0800	161	1.	3		1400	311	1.	4		2000	461	1.
1		0212	12	0.	2		0812	162	1.	3		1412	312	1.	4		2012	462	1.
1		0224	13	0.	2		0824	163	1.	3		1424	313	1.	4		2024	463	1.
1		0236	14	0.	2		0836	164	1.	3		1436	314	1.	4		2036	464	1.
1		0248	15	0.	2		0848	165	1.	3		1448	315	1.	4		2048	465	1.
1		0300	16	0.	2		0900	166	1.	3		1500	316	1.	4		2100	466	1.
1		0312	17	0.	2		0912	167	1.	3		1512	317	1.	4		2112	467	1.

1	0324	18	0.	*	2	0924	168	1.	*	3	1524	318	1.	*	4	2124	468	1.
1	0336	19	0.	*	2	0936	169	1.	*	3	1536	319	1.	*	4	2136	469	1.
1	0348	20	0.	*	2	0948	170	1.	*	3	1548	320	1.	*	4	2148	470	1.
1	0400	21	0.	*	2	1000	171	1.	*	3	1600	321	1.	*	4	2200	471	1.
1	0412	22	0.	*	2	1012	172	1.	*	3	1612	322	1.	*	4	2212	472	1.
1	0424	23	0.	*	2	1024	173	1.	*	3	1624	323	1.	*	4	2224	473	1.
1	0436	24	0.	*	2	1036	174	1.	*	3	1636	324	1.	*	4	2236	474	1.
1	0448	25	0.	*	2	1048	175	1.	*	3	1648	325	1.	*	4	2248	475	1.
1	0500	26	1.	*	2	1100	176	1.	*	3	1700	326	1.	*	4	2300	476	1.
1	0512	27	2.	*	2	1112	177	1.	*	3	1712	327	1.	*	4	2312	477	1.
1	0524	28	4.	*	2	1124	178	1.	*	3	1724	328	1.	*	4	2324	478	1.
1	0536	29	7.	*	2	1136	179	1.	*	3	1736	329	1.	*	4	2336	479	1.
1	0548	30	10.	*	2	1148	180	1.	*	3	1748	330	1.	*	4	2348	480	1.
1	0600	31	15.	*	2	1200	181	1.	*	3	1800	331	1.	*	5	0000	481	1.
1	0612	32	30.	*	2	1212	182	1.	*	3	1812	332	1.	*	5	0012	482	1.
1	0624	33	74.	*	2	1224	183	1.	*	3	1824	333	1.	*	5	0024	483	1.
1	0636	34	175.	*	2	1236	184	1.	*	3	1836	334	1.	*	5	0036	484	1.
1	0648	35	342.	*	2	1248	185	1.	*	3	1848	335	1.	*	5	0048	485	1.
1	0700	36	567.	*	2	1300	186	1.	*	3	1900	336	1.	*	5	0100	486	1.
1	0712	37	829.	*	2	1312	187	1.	*	3	1912	337	1.	*	5	0112	487	1.
1	0724	38	1108.	*	2	1324	188	1.	*	3	1924	338	1.	*	5	0124	488	1.
1	0736	39	1380.	*	2	1336	189	1.	*	3	1936	339	1.	*	5	0136	489	1.
1	0748	40	1634.	*	2	1348	190	1.	*	3	1948	340	1.	*	5	0148	490	1.
1	0800	41	1866.	*	2	1400	191	1.	*	3	2000	341	1.	*	5	0200	491	1.
1	0812	42	2071.	*	2	1412	192	1.	*	3	2012	342	1.	*	5	0212	492	1.
1	0824	43	2260.	*	2	1424	193	1.	*	3	2024	343	1.	*	5	0224	493	1.
1	0836	44	2424.	*	2	1436	194	1.	*	3	2036	344	1.	*	5	0236	494	1.
1	0848	45	2568.	*	2	1448	195	1.	*	3	2048	345	1.	*	5	0248	495	1.
1	0900	46	2696.	*	2	1500	196	1.	*	3	2100	346	1.	*	5	0300	496	1.
1	0912	47	2807.	*	2	1512	197	1.	*	3	2112	347	1.	*	5	0312	497	1.
1	0924	48	2906.	*	2	1524	198	1.	*	3	2124	348	1.	*	5	0324	498	1.
1	0936	49	2993.	*	2	1536	199	1.	*	3	2136	349	1.	*	5	0336	499	1.
1	0948	50	3069.	*	2	1548	200	1.	*	3	2148	350	1.	*	5	0348	500	1.
1	1000	51	3137.	*	2	1600	201	1.	*	3	2200	351	1.	*	5	0400	501	1.
1	1012	52	3198.	*	2	1612	202	1.	*	3	2212	352	1.	*	5	0412	502	1.
1	1024	53	3252.	*	2	1624	203	1.	*	3	2224	353	1.	*	5	0424	503	1.
1	1036	54	3300.	*	2	1636	204	1.	*	3	2236	354	1.	*	5	0436	504	1.
1	1048	55	3343.	*	2	1648	205	1.	*	3	2248	355	1.	*	5	0448	505	1.
1	1100	56	3381.	*	2	1700	206	1.	*	3	2300	356	1.	*	5	0500	506	1.
1	1112	57	3416.	*	2	1712	207	1.	*	3	2312	357	1.	*	5	0512	507	1.
1	1124	58	3447.	*	2	1724	208	1.	*	3	2324	358	1.	*	5	0524	508	1.
1	1136	59	3475.	*	2	1736	209	1.	*	3	2336	359	1.	*	5	0536	509	1.
1	1148	60	3501.	*	2	1748	210	1.	*	3	2348	360	1.	*	5	0548	510	1.
1	1200	61	3524.	*	2	1800	211	1.	*	4	0000	361	1.	*	5	0600	511	1.
1	1212	62	3498.	*	2	1812	212	1.	*	4	0012	362	1.	*	5	0612	512	1.
1	1224	63	3371.	*	2	1824	213	1.	*	4	0024	363	1.	*	5	0624	513	1.
1	1236	64	3075.	*	2	1836	214	1.	*	4	0036	364	1.	*	5	0636	514	1.
1	1248	65	2649.	*	2	1848	215	1.	*	4	0048	365	1.	*	5	0648	515	1.
1	1300	66	2187.	*	2	1900	216	1.	*	4	0100	366	1.	*	5	0700	516	1.
1	1312	67	1755.	*	2	1912	217	1.	*	4	0112	367	1.	*	5	0712	517	1.
1	1324	68	1392.	*	2	1924	218	1.	*	4	0124	368	1.	*	5	0724	518	1.
1	1336	69	1131.	*	2	1936	219	1.	*	4	0136	369	1.	*	5	0736	519	1.
1	1348	70	950.	*	2	1948	220	1.	*	4	0148	370	1.	*	5	0748	520	1.
1	1400	71	820.	*	2	2000	221	1.	*	4	0200	371	1.	*	5	0800	521	1.
1	1412	72	724.	*	2	2012	222	1.	*	4	0212	372	1.	*	5	0812	522	1.
1	1424	73	655.	*	2	2024	223	1.	*	4	0224	373	1.	*	5	0824	523	1.
1	1436	74	606.	*	2	2036	224	1.	*	4	0236	374	1.	*	5	0836	524	1.
1	1448	75	570.	*	2	2048	225	1.	*	4	0248	375	1.	*	5	0848	525	1.
1	1500	76	545.	*	2	2100	226	1.	*	4	0300	376	1.	*	5	0900	526	1.
1	1512	77	526.	*	2	2112	227	1.	*	4	0312	377	1.	*	5	0912	527	1.
1	1524	78	513.	*	2	2124	228	1.	*	4	0324	378	1.	*	5	0924	528	1.
1	1536	79	503.	*	2	2136	229	1.	*	4	0336	379	1.	*	5	0936	529	1.
1	1548	80	496.	*	2	2148	230	1.	*	4	0348	380	1.	*	5	0948	530	1.
1	1600	81	492.	*	2	2200	231	1.	*	4	0400	381	1.	*	5	1000	531	1.
1	1612	82	488.	*	2	2212	232	1.	*	4	0412	382	1.	*	5	1012	532	1.
1	1624	83	485.	*	2	2224	233	1.	*	4	0424	383	1.	*	5	1024	533	1.
1	1636	84	483.	*	2	2236	234	1.	*	4	0436	384	1.	*	5	1036	534	1.
1	1648	85	483.	*	2	2248	235	1.	*	4	0448	385	1.	*	5	1048	535	1.
1	1700	86	483.	*	2	2300	236	1.	*	4	0500	386	1.	*	5	1100	536	1.
1	1712	87	483.	*	2	2312	237	1.	*	4	0512	387	1.	*	5	1112	537	1.
1	1724	88	483.	*	2	2324	238	1.	*	4	0524	388	1.	*	5	1124	538	1.
1	1736	89	483.	*	2	2336	239	1.	*	4	0536	389	1.	*	5	1136	539	1.
1	1748	90	484.	*	2	2348	240	1.	*	4	0548	390	1.	*	5	1148	540	1.
1	1800	91	484.	*	3	0000	241	1.	*	4	0600	391	1.	*	5	1200	541	1.
1	1812	92	482.	*	3	0012	242	1.	*	4	0612	392	1.	*	5	1212	542	1.
1	1824	93	477.	*	3	0024	243	1.	*	4	0624	393	1.	*	5	1224	543	1.
1	1836	94	465.	*	3	0036	244	1.	*	4	0636	394	1.	*	5	1236	544	1.
1	1848	95	448.	*	3	0048	245	1.	*	4	0648	395	1.	*	5	1248	545	1.
1	1900	96	431.	*	3	0100	246	1.	*	4	0700	396	1.	*	5	1300	546	1.
1	1912	97	414.	*	3	0112	247	1.	*	4	0712	397	1.	*	5	1312	547	1.
1	1924	98	400.	*	3	0124	248	1.	*	4	0724	398	1.	*	5	1324	548	1.
1	1936	99	390.	*	3	0136	249	1.	*	4	0736	399	1.	*	5	1336	549	1.
1	1948	100	383.	*	3	0148	250	1.	*	4	0748	400	1.	*	5	1348	550	1.
1	2000	101	378.	*	3	0200	251	1.	*	4	0800	401	1.	*	5	1400	551	1.
1	2012	102	375.	*	3	0212	252	1.	*	4	0812	402	1.	*	5	1412	552	1.
1	2024	103	372.	*	3	0224	253	1.	*	4	0824	403	1.	*	5	1424	553	1.
1	2036	104	370.	*	3	0236	254	1.	*	4	0836	404	1.	*	5	1436	554	1.
1	2048	105	369.	*	3	0248	255	1.	*	4	0848	405	1.	*	5	1448	555	1.
1	2100	106	368.	*	3	0300	256	1.	*	4	0900	406	1.	*	5	1500	556	1.
1	2112	107	368.	*	3	0312	257	1.	*	4	0912	407	1.	*	5	1512	557	1.
1	2124	108	367.	*	3	0324	258	1.	*	4	0924	408	1.	*	5	1524	558	1.
1	2136	109	367.	*	3	0336	259	1.	*	4	0936	409	1.	*	5	1536	559	1.

1	2148	110	367.	*	3	0348	260	1.	*	4	0948	410	1.	*	5	1548	560	1.
1	2200	111	367.	*	3	0400	261	1.	*	4	1000	411	1.	*	5	1600	561	1.
1	2212	112	366.	*	3	0412	262	1.	*	4	1012	412	1.	*	5	1612	562	1.
1	2224	113	366.	*	3	0424	263	1.	*	4	1024	413	1.	*	5	1624	563	1.
1	2236	114	366.	*	3	0436	264	1.	*	4	1036	414	1.	*	5	1636	564	1.
1	2248	115	367.	*	3	0448	265	1.	*	4	1048	415	1.	*	5	1648	565	1.
1	2300	116	367.	*	3	0500	266	1.	*	4	1100	416	1.	*	5	1700	566	1.
1	2312	117	367.	*	3	0512	267	1.	*	4	1112	417	1.	*	5	1712	567	1.
1	2324	118	367.	*	3	0524	268	1.	*	4	1124	418	1.	*	5	1724	568	1.
1	2336	119	367.	*	3	0536	269	1.	*	4	1136	419	1.	*	5	1736	569	1.
1	2348	120	367.	*	3	0548	270	1.	*	4	1148	420	1.	*	5	1748	570	1.
2	0000	121	367.	*	3	0600	271	1.	*	4	1200	421	1.	*	5	1800	571	1.
2	0012	122	362.	*	3	0612	272	1.	*	4	1212	422	1.	*	5	1812	572	1.
2	0024	123	345.	*	3	0624	273	1.	*	4	1224	423	1.	*	5	1824	573	1.
2	0036	124	308.	*	3	0636	274	1.	*	4	1236	424	1.	*	5	1836	574	1.
2	0048	125	257.	*	3	0648	275	1.	*	4	1248	425	1.	*	5	1848	575	1.
2	0100	126	202.	*	3	0700	276	1.	*	4	1300	426	1.	*	5	1900	576	1.
2	0112	127	151.	*	3	0712	277	1.	*	4	1312	427	1.	*	5	1912	577	1.
2	0124	128	108.	*	3	0724	278	1.	*	4	1324	428	1.	*	5	1924	578	1.
2	0136	129	77.	*	3	0736	279	1.	*	4	1336	429	1.	*	5	1936	579	1.
2	0148	130	56.	*	3	0748	280	1.	*	4	1348	430	1.	*	5	1948	580	1.
2	0200	131	40.	*	3	0800	281	1.	*	4	1400	431	1.	*	5	2000	581	1.
2	0212	132	29.	*	3	0812	282	1.	*	4	1412	432	1.	*	5	2012	582	1.
2	0224	133	21.	*	3	0824	283	1.	*	4	1424	433	1.	*	5	2024	583	1.
2	0236	134	15.	*	3	0836	284	1.	*	4	1436	434	1.	*	5	2036	584	1.
2	0248	135	11.	*	3	0848	285	1.	*	4	1448	435	1.	*	5	2048	585	1.
2	0300	136	8.	*	3	0900	286	1.	*	4	1500	436	1.	*	5	2100	586	1.
2	0312	137	5.	*	3	0912	287	1.	*	4	1512	437	1.	*	5	2112	587	1.
2	0324	138	4.	*	3	0924	288	1.	*	4	1524	438	1.	*	5	2124	588	1.
2	0336	139	3.	*	3	0936	289	1.	*	4	1536	439	1.	*	5	2136	589	1.
2	0348	140	2.	*	3	0948	290	1.	*	4	1548	440	1.	*	5	2148	590	1.
2	0400	141	1.	*	3	1000	291	1.	*	4	1600	441	1.	*	5	2200	591	1.
2	0412	142	1.	*	3	1012	292	1.	*	4	1612	442	1.	*	5	2212	592	1.
2	0424	143	1.	*	3	1024	293	1.	*	4	1624	443	1.	*	5	2224	593	1.
2	0436	144	1.	*	3	1036	294	1.	*	4	1636	444	1.	*	5	2236	594	1.
2	0448	145	1.	*	3	1048	295	1.	*	4	1648	445	1.	*	5	2248	595	1.
2	0500	146	1.	*	3	1100	296	1.	*	4	1700	446	1.	*	5	2300	596	1.
2	0512	147	1.	*	3	1112	297	1.	*	4	1712	447	1.	*	5	2312	597	1.
2	0524	148	1.	*	3	1124	298	1.	*	4	1724	448	1.	*	5	2324	598	1.
2	0536	149	1.	*	3	1136	299	1.	*	4	1736	449	1.	*	5	2336	599	1.
2	0548	150	1.	*	3	1148	300	1.	*	4	1748	450	1.	*	5	2348	600	1.

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	119.80-HR
+ (CFS)	(HR)				
	(CFS)				
+ 3524.	12.00	2782.	948.	317.	191.
	(INCHES)	.000	.000	.000	.000
	(AC-FT)	1379.	1880.	1884.	1888.

CUMULATIVE AREA = .00 SQ MI

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	2		0600	151	1.	3		1200	301	1.	4		1800	451	1.
1		0012	2	0.	2		0612	152	1.	3		1212	302	1.	4		1812	452	1.
1		0024	3	0.	2		0624	153	1.	3		1224	303	1.	4		1824	453	1.
1		0036	4	0.	2		0636	154	1.	3		1236	304	1.	4		1836	454	1.
1		0048	5	0.	2		0648	155	1.	3		1248	305	1.	4		1848	455	1.
1		0100	6	0.	2		0700	156	1.	3		1300	306	1.	4		1900	456	1.
1		0112	7	0.	2		0712	157	1.	3		1312	307	1.	4		1912	457	1.
1		0124	8	0.	2		0724	158	1.	3		1324	308	1.	4		1924	458	1.
1		0136	9	0.	2		0736	159	1.	3		1336	309	1.	4		1936	459	1.
1		0148	10	0.	2		0748	160	1.	3		1348	310	1.	4		1948	460	1.
1		0200	11	0.	2		0800	161	1.	3		1400	311	1.	4		2000	461	1.
1		0212	12	0.	2		0812	162	1.	3		1412	312	1.	4		2012	462	1.
1		0224	13	0.	2		0824	163	1.	3		1424	313	1.	4		2024	463	1.
1		0236	14	0.	2		0836	164	1.	3		1436	314	1.	4		2036	464	1.
1		0248	15	0.	2		0848	165	1.	3		1448	315	1.	4		2048	465	1.
1		0300	16	0.	2		0900	166	1.	3		1500	316	1.	4		2100	466	1.
1		0312	17	0.	2		0912	167	1.	3		1512	317	1.	4		2112	467	1.
1		0324	18	0.	2		0924	168	1.	3		1524	318	1.	4		2124	468	1.
1		0336	19	0.	2		0936	169	1.	3		1536	319	1.	4		2136	469	1.
1		0348	20	0.	2		0948	170	1.	3		1548	320	1.	4		2148	470	1.
1		0400	21	0.	2		1000	171	1.	3		1600	321	1.	4		2200	471	1.
1		0412	22	0.	2		1012	172	1.	3		1612	322	1.	4		2212	472	1.
1		0424	23	0.	2		1024	173	1.	3		1624	323	1.	4		2224	473	1.
1		0436	24	0.	2		1036	174	1.	3		1636	324	1.	4		2236	474	1.
1		0448	25	0.	2		1048	175	1.	3		1648	325	1.	4		2248	475	1.
1		0500	26	1.	2		1100	176	1.	3		1700	326	1.	4		2300	476	1.
1		0512	27	2.	2		1112	177	1.	3		1712	327	1.	4		2312	477	1.
1		0524	28	4.	2		1124	178	1.	3		1724	328	1.	4		2324	478	1.

1	0536	29	7.	*	2	1136	179	1.	*	3	1736	329	1.	*	4	2336	479	1.
1	0548	30	10.	*	2	1148	180	1.	*	3	1748	330	1.	*	4	2348	480	1.
1	0600	31	15.	*	2	1200	181	1.	*	3	1800	331	1.	*	5	0000	481	1.
1	0612	32	30.	*	2	1212	182	1.	*	3	1812	332	1.	*	5	0012	482	1.
1	0624	33	74.	*	2	1224	183	1.	*	3	1824	333	1.	*	5	0024	483	1.
1	0636	34	175.	*	2	1236	184	1.	*	3	1836	334	1.	*	5	0036	484	1.
1	0648	35	342.	*	2	1248	185	1.	*	3	1848	335	1.	*	5	0048	485	1.
1	0700	36	567.	*	2	1300	186	1.	*	3	1900	336	1.	*	5	0100	486	1.
1	0712	37	829.	*	2	1312	187	1.	*	3	1912	337	1.	*	5	0112	487	1.
1	0724	38	1108.	*	2	1324	188	1.	*	3	1924	338	1.	*	5	0124	488	1.
1	0736	39	1380.	*	2	1336	189	1.	*	3	1936	339	1.	*	5	0136	489	1.
1	0748	40	1634.	*	2	1348	190	1.	*	3	1948	340	1.	*	5	0148	490	1.
1	0800	41	1866.	*	2	1400	191	1.	*	3	2000	341	1.	*	5	0200	491	1.
1	0812	42	2071.	*	2	1412	192	1.	*	3	2012	342	1.	*	5	0212	492	1.
1	0824	43	2260.	*	2	1424	193	1.	*	3	2024	343	1.	*	5	0224	493	1.
1	0836	44	2424.	*	2	1436	194	1.	*	3	2036	344	1.	*	5	0236	494	1.
1	0848	45	2568.	*	2	1448	195	1.	*	3	2048	345	1.	*	5	0248	495	1.
1	0900	46	2696.	*	2	1500	196	1.	*	3	2100	346	1.	*	5	0300	496	1.
1	0912	47	2807.	*	2	1512	197	1.	*	3	2112	347	1.	*	5	0312	497	1.
1	0924	48	2906.	*	2	1524	198	1.	*	3	2124	348	1.	*	5	0324	498	1.
1	0936	49	2993.	*	2	1536	199	1.	*	3	2136	349	1.	*	5	0336	499	1.
1	0948	50	3069.	*	2	1548	200	1.	*	3	2148	350	1.	*	5	0348	500	1.
1	1000	51	3137.	*	2	1600	201	1.	*	3	2200	351	1.	*	5	0400	501	1.
1	1012	52	3198.	*	2	1612	202	1.	*	3	2212	352	1.	*	5	0412	502	1.
1	1024	53	3252.	*	2	1624	203	1.	*	3	2224	353	1.	*	5	0424	503	1.
1	1036	54	3300.	*	2	1636	204	1.	*	3	2236	354	1.	*	5	0436	504	1.
1	1048	55	3343.	*	2	1648	205	1.	*	3	2248	355	1.	*	5	0448	505	1.
1	1100	56	3381.	*	2	1700	206	1.	*	3	2300	356	1.	*	5	0500	506	1.
1	1112	57	3416.	*	2	1712	207	1.	*	3	2312	357	1.	*	5	0512	507	1.
1	1124	58	3447.	*	2	1724	208	1.	*	3	2324	358	1.	*	5	0524	508	1.
1	1136	59	3475.	*	2	1736	209	1.	*	3	2336	359	1.	*	5	0536	509	1.
1	1148	60	3501.	*	2	1748	210	1.	*	3	2348	360	1.	*	5	0548	510	1.
1	1200	61	3524.	*	2	1800	211	1.	*	4	0000	361	1.	*	5	0600	511	1.
1	1212	62	3498.	*	2	1812	212	1.	*	4	0012	362	1.	*	5	0612	512	1.
1	1224	63	3371.	*	2	1824	213	1.	*	4	0024	363	1.	*	5	0624	513	1.
1	1236	64	3075.	*	2	1836	214	1.	*	4	0036	364	1.	*	5	0636	514	1.
1	1248	65	2649.	*	2	1848	215	1.	*	4	0048	365	1.	*	5	0648	515	1.
1	1300	66	2187.	*	2	1900	216	1.	*	4	0100	366	1.	*	5	0700	516	1.
1	1312	67	1755.	*	2	1912	217	1.	*	4	0112	367	1.	*	5	0712	517	1.
1	1324	68	1392.	*	2	1924	218	1.	*	4	0124	368	1.	*	5	0724	518	1.
1	1336	69	1131.	*	2	1936	219	1.	*	4	0136	369	1.	*	5	0736	519	1.
1	1348	70	950.	*	2	1948	220	1.	*	4	0148	370	1.	*	5	0748	520	1.
1	1400	71	820.	*	2	2000	221	1.	*	4	0200	371	1.	*	5	0800	521	1.
1	1412	72	724.	*	2	2012	222	1.	*	4	0212	372	1.	*	5	0812	522	1.
1	1424	73	655.	*	2	2024	223	1.	*	4	0224	373	1.	*	5	0824	523	1.
1	1436	74	606.	*	2	2036	224	1.	*	4	0236	374	1.	*	5	0836	524	1.
1	1448	75	570.	*	2	2048	225	1.	*	4	0248	375	1.	*	5	0848	525	1.
1	1500	76	545.	*	2	2100	226	1.	*	4	0300	376	1.	*	5	0900	526	1.
1	1512	77	526.	*	2	2112	227	1.	*	4	0312	377	1.	*	5	0912	527	1.
1	1524	78	513.	*	2	2124	228	1.	*	4	0324	378	1.	*	5	0924	528	1.
1	1536	79	503.	*	2	2136	229	1.	*	4	0336	379	1.	*	5	0936	529	1.
1	1548	80	496.	*	2	2148	230	1.	*	4	0348	380	1.	*	5	0948	530	1.
1	1600	81	492.	*	2	2200	231	1.	*	4	0400	381	1.	*	5	1000	531	1.
1	1612	82	488.	*	2	2212	232	1.	*	4	0412	382	1.	*	5	1012	532	1.
1	1624	83	485.	*	2	2224	233	1.	*	4	0424	383	1.	*	5	1024	533	1.
1	1636	84	483.	*	2	2236	234	1.	*	4	0436	384	1.	*	5	1036	534	1.
1	1648	85	483.	*	2	2248	235	1.	*	4	0448	385	1.	*	5	1048	535	1.
1	1700	86	483.	*	2	2300	236	1.	*	4	0500	386	1.	*	5	1100	536	1.
1	1712	87	483.	*	2	2312	237	1.	*	4	0512	387	1.	*	5	1112	537	1.
1	1724	88	483.	*	2	2324	238	1.	*	4	0524	388	1.	*	5	1124	538	1.
1	1736	89	483.	*	2	2336	239	1.	*	4	0536	389	1.	*	5	1136	539	1.
1	1748	90	484.	*	2	2348	240	1.	*	4	0548	390	1.	*	5	1148	540	1.
1	1800	91	484.	*	3	0000	241	1.	*	4	0600	391	1.	*	5	1200	541	1.
1	1812	92	482.	*	3	0012	242	1.	*	4	0612	392	1.	*	5	1212	542	1.
1	1824	93	477.	*	3	0024	243	1.	*	4	0624	393	1.	*	5	1224	543	1.
1	1836	94	465.	*	3	0036	244	1.	*	4	0636	394	1.	*	5	1236	544	1.
1	1848	95	448.	*	3	0048	245	1.	*	4	0648	395	1.	*	5	1248	545	1.
1	1900	96	431.	*	3	0100	246	1.	*	4	0700	396	1.	*	5	1300	546	1.
1	1912	97	414.	*	3	0112	247	1.	*	4	0712	397	1.	*	5	1312	547	1.
1	1924	98	400.	*	3	0124	248	1.	*	4	0724	398	1.	*	5	1324	548	1.
1	1936	99	390.	*	3	0136	249	1.	*	4	0736	399	1.	*	5	1336	549	1.
1	1948	100	383.	*	3	0148	250	1.	*	4	0748	400	1.	*	5	1348	550	1.
1	2000	101	378.	*	3	0200	251	1.	*	4	0800	401	1.	*	5	1400	551	1.
1	2012	102	375.	*	3	0212	252	1.	*	4	0812	402	1.	*	5	1412	552	1.
1	2024	103	372.	*	3	0224	253	1.	*	4	0824	403	1.	*	5	1424	553	1.
1	2036	104	370.	*	3	0236	254	1.	*	4	0836	404	1.	*	5	1436	554	1.
1	2048	105	369.	*	3	0248	255	1.	*	4	0848	405	1.	*	5	1448	555	1.
1	2100	106	368.	*	3	0300	256	1.	*	4	0900	406	1.	*	5	1500	556	1.
1	2112	107	368.	*	3	0312	257	1.	*	4	0912	407	1.	*	5	1512	557	1.
1	2124	108	367.	*	3	0324	258	1.	*	4	0924	408	1.	*	5	1524	558	1.
1	2136	109	367.	*	3	0336	259	1.	*	4	0936	409	1.	*	5	1536	559	1.
1	2148	110	367.	*	3	0348	260	1.	*	4	0948	410	1.	*	5	1548	560	1.
1	2200	111	367.	*	3	0400	261	1.	*	4	1000	411	1.	*	5	1600	561	1.
1	2212	112	366.	*	3	0412	262	1.	*	4	1012	412	1.	*	5	1612	562	1.
1	2224	113	366.	*	3	0424	263	1.	*	4	1024	413	1.	*	5	1624	563	1.
1	2236	114	366.	*	3	0436	264	1.	*	4	1036	414	1.	*	5	1636	564	1.
1	2248	115	367.	*	3	0448	265	1.	*	4	1048	415	1.	*	5	1648	565	1.
1	2300	116	367.	*	3	0500	266	1.	*	4	1100	416	1.	*	5	1700	566	1.
1	2312	117	367.	*	3	0512	267	1.	*	4	1112	417	1.	*	5	1712	567	1.
1	2324	118	367.	*	3	0524	268	1.	*	4	1124	418	1.	*	5	1724	568	1.
1	2336	119	367.	*	3	0536	269	1.	*	4	1136	419	1.	*	5	1736	569	1.
1	2348	120	367.	*	3	0548	270	1.	*	4	1148	420	1.	*	5	1748	570	1.

2	0000	121	367.	*	3	0600	271	1.	*	4	1200	421	1.	*	5	1800	571	1.
2	0012	122	362.	*	3	0612	272	1.	*	4	1212	422	1.	*	5	1812	572	1.
2	0024	123	345.	*	3	0624	273	1.	*	4	1224	423	1.	*	5	1824	573	1.
2	0036	124	308.	*	3	0636	274	1.	*	4	1236	424	1.	*	5	1836	574	1.
2	0048	125	257.	*	3	0648	275	1.	*	4	1248	425	1.	*	5	1848	575	1.
2	0100	126	202.	*	3	0700	276	1.	*	4	1300	426	1.	*	5	1900	576	1.
2	0112	127	151.	*	3	0712	277	1.	*	4	1312	427	1.	*	5	1912	577	1.
2	0124	128	108.	*	3	0724	278	1.	*	4	1324	428	1.	*	5	1924	578	1.
2	0136	129	77.	*	3	0736	279	1.	*	4	1336	429	1.	*	5	1936	579	1.
2	0148	130	56.	*	3	0748	280	1.	*	4	1348	430	1.	*	5	1948	580	1.
2	0200	131	40.	*	3	0800	281	1.	*	4	1400	431	1.	*	5	2000	581	1.
2	0212	132	29.	*	3	0812	282	1.	*	4	1412	432	1.	*	5	2012	582	1.
2	0224	133	21.	*	3	0824	283	1.	*	4	1424	433	1.	*	5	2024	583	1.
2	0236	134	15.	*	3	0836	284	1.	*	4	1436	434	1.	*	5	2036	584	1.
2	0248	135	11.	*	3	0848	285	1.	*	4	1448	435	1.	*	5	2048	585	1.
2	0300	136	8.	*	3	0900	286	1.	*	4	1500	436	1.	*	5	2100	586	1.
2	0312	137	5.	*	3	0912	287	1.	*	4	1512	437	1.	*	5	2112	587	1.
2	0324	138	4.	*	3	0924	288	1.	*	4	1524	438	1.	*	5	2124	588	1.
2	0336	139	3.	*	3	0936	289	1.	*	4	1536	439	1.	*	5	2136	589	1.
2	0348	140	2.	*	3	0948	290	1.	*	4	1548	440	1.	*	5	2148	590	1.
2	0400	141	1.	*	3	1000	291	1.	*	4	1600	441	1.	*	5	2200	591	1.
2	0412	142	1.	*	3	1012	292	1.	*	4	1612	442	1.	*	5	2212	592	1.
2	0424	143	1.	*	3	1024	293	1.	*	4	1624	443	1.	*	5	2224	593	1.
2	0436	144	1.	*	3	1036	294	1.	*	4	1636	444	1.	*	5	2236	594	1.
2	0448	145	1.	*	3	1048	295	1.	*	4	1648	445	1.	*	5	2248	595	1.
2	0500	146	1.	*	3	1100	296	1.	*	4	1700	446	1.	*	5	2300	596	1.
2	0512	147	1.	*	3	1112	297	1.	*	4	1712	447	1.	*	5	2312	597	1.
2	0524	148	1.	*	3	1124	298	1.	*	4	1724	448	1.	*	5	2324	598	1.
2	0536	149	1.	*	3	1136	299	1.	*	4	1736	449	1.	*	5	2336	599	1.
2	0548	150	1.	*	3	1148	300	1.	*	4	1748	450	1.	*	5	2348	600	1.
				*					*					*					

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PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW				
		6-HR	24-HR	72-HR	119.80-HR	
+ (CFS)	(HR)					
		(CFS)				
+ 3524.	12.00	2782.	948.	317.	191.	
		(INCHES)	.000	.000	.000	.000
		(AC-FT)	1379.	1880.	1884.	1888.

CUMULATIVE AREA = .00 SQ MI

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            **************
            *            *
   33 KK    *     Cove   *     Reservoir
            *            *
            **************
                        Routing through Res'v

               HYDROGRAPH ROUTING DATA

   35 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC     5545.50  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

   36 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                  3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

   38 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                                5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

   40 SL          LOW-LEVEL OUTLET
                       ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                       CAREA        4.91  CROSS-SECTIONAL AREA
                        COQL         .60  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

   41 SS          SPILLWAY
                        CREL     5549.20  SPILLWAY CREST ELEVATION
                       SPWID       30.00  SPILLWAY WIDTH
                        COQW        2.67  WEIR COEFFICIENT
                        EXPW        1.50  EXPONENT OF HEAD

   42 ST          TOP OF DAM
                       TOPEL     5552.00  ELEVATION AT TOP OF DAM
                      DAMWID     1892.00  DAM WIDTH
                        COQD        2.90  WEIR COEFFICIENT
                        EXPD        1.50  EXPONENT OF HEAD

                                                  ***

                                  COMPUTED OUTFLOW-ELEVATION DATA
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(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	5844.8	5545.5	2		1600	201	195.	6946.4	5550.7	4		0800	401	60.	6596.5	5549.5
1		0012	2	0.	5844.8	5545.5	2		1612	202	194.	6943.2	5550.7	4		0812	402	60.	6595.5	5549.5
1		0024	3	0.	5844.8	5545.5	2		1624	203	192.	6940.0	5550.6	4		0824	403	59.	6594.4	5549.5
1		0036	4	0.	5844.8	5545.5	2		1636	204	191.	6936.8	5550.6	4		0836	404	59.	6593.4	5549.5
1		0048	5	0.	5844.8	5545.5	2		1648	205	189.	6933.7	5550.6	4		0848	405	59.	6592.4	5549.5
1		0100	6	0.	5844.8	5545.5	2		1700	206	187.	6930.7	5550.6	4		0900	406	59.	6591.4	5549.5
1		0112	7	0.	5844.8	5545.5	2		1712	207	186.	6927.6	5550.6	4		0912	407	59.	6590.4	5549.5
1		0124	8	0.	5844.8	5545.5	2		1724	208	184.	6924.5	5550.6	4		0924	408	58.	6589.5	5549.5
1		0136	9	0.	5844.8	5545.5	2		1736	209	183.	6921.4	5550.6	4		0936	409	58.	6588.6	5549.5
1		0148	10	0.	5844.8	5545.5	2		1748	210	182.	6918.5	5550.6	4		0948	410	58.	6587.7	5549.5
1		0200	11	0.	5844.8	5545.5	2		1800	211	180.	6915.6	5550.6	4		1000	411	58.	6586.8	5549.5
1		0212	12	0.	5844.8	5545.5	2		1812	212	179.	6912.7	5550.5	4		1012	412	58.	6586.0	5549.5
1		0224	13	0.	5844.8	5545.5	2		1824	213	177.	6909.7	5550.5	4		1024	413	57.	6585.1	5549.5
1		0236	14	0.	5844.8	5545.5	2		1836	214	176.	6906.8	5550.5	4		1036	414	57.	6584.2	5549.5
1		0248	15	0.	5844.8	5545.5	2		1848	215	174.	6903.9	5550.5	4		1048	415	57.	6583.3	5549.5
1		0300	16	0.	5844.8	5545.5	2		1900	216	173.	6901.0	5550.5	4		1100	416	57.	6582.5	5549.4
1		0312	17	0.	5844.8	5545.5	2		1912	217	172.	6898.2	5550.5	4		1112	417	57.	6581.6	5549.4
1		0324	18	0.	5844.8	5545.5	2		1924	218	170.	6895.4	5550.5	4		1124	418	56.	6580.7	5549.4
1		0336	19	0.	5844.8	5545.5	2		1936	219	169.	6892.6	5550.5	4		1136	419	56.	6579.8	5549.4
1		0348	20	0.	5844.8	5545.5	2		1948	220	168.	6889.9	5550.5	4		1148	420	56.	6578.9	5549.4
1		0400	21	0.	5844.8	5545.5	2		2000	221	166.	6887.1	5550.5	4		1200	421	56.	6578.1	5549.4
1		0412	22	0.	5844.8	5545.5	2		2012	222	165.	6884.3	5550.5	4		1212	422	56.	6577.2	5549.4
1		0424	23	0.	5844.8	5545.5	2		2024	223	164.	6881.7	5550.4	4		1224	423	55.	6576.3	5549.4
1		0436	24	0.	5844.8	5545.5	2		2036	224	163.	6879.0	5550.4	4		1236	424	55.	6575.4	5549.4
1		0448	25	0.	5844.8	5545.5	2		2048	225	162.	6876.4	5550.4	4		1248	425	55.	6574.6	5549.4
1		0500	26	0.	5844.8	5545.5	2		2100	226	160.	6873.8	5550.4	4		1300	426	55.	6573.7	5549.4
1		0512	27	0.	5844.8	5545.5	2		2112	227	159.	6871.1	5550.4	4		1312	427	55.	6572.8	5549.4
1		0524	28	1.	5844.9	5545.5	2		2124	228	158.	6868.5	5550.4	4		1324	428	55.	6571.9	5549.4
1		0536	29	1.	5845.0	5545.5	2		2136	229	157.	6865.9	5550.4	4		1336	429	54.	6571.0	5549.4
1		0548	30	1.	5845.1	5545.5	2		2148	230	155.	6863.2	5550.4	4		1348	430	54.	6570.2	5549.4
1		0600	31	1.	5845.2	5545.5	2		2200	231	154.	6860.8	5550.4	4		1400	431	54.	6569.3	5549.4
1		0612	32	2.	5845.6	5545.5	2		2212	232	153.	6858.3	5550.4	4		1412	432	54.	6568.4	5549.4
1		0624	33	3.	5846.4	5545.5	2		2224	233	152.	6855.8	5550.4	4		1424	433	54.	6567.5	5549.4
1		0636	34	4.	5848.5	5545.5	2		2236	234	151.	6853.3	5550.4	4		1436	434	53.	6566.7	5549.4
1		0648	35	6.	5852.7	5545.6	2		2248	235	150.	6850.8	5550.3	4		1448	435	53.	6565.8	5549.4
1		0700	36	8.	5860.1	5545.6	2		2300	236	149.	6848.3	5550.3	4		1500	436	53.	6564.9	5549.4
1		0712	37	11.	5871.5	5545.7	2		2312	237	148.	6845.8	5550.3	4		1512	437	53.	6564.0	5549.4
1		0724	38	14.	5887.3	5545.8	2		2324	238	147.	6843.3	5550.3	4		1524	438	53.	6563.2	5549.4
1		0736	39	17.	5907.6	5546.0	2		2336	239	146.	6841.0	5550.3	4		1536	439	53.	6562.3	5549.4
1		0748	40	20.	5932.2	5546.2	2		2348	240	144.	6838.7	5550.3	4		1548	440	52.	6561.4	5549.4
1		0800	41	23.	5960.8	5546.5	3		0000	241	143.	6836.3	5550.3	4		1600	441	52.	6560.5	5549.4
1		0812	42	26.	5992.9	5546.7	3		0012	242	142.	6834.0	5550.3	4		1612	442	52.	6559.6	5549.4
1		0824	43	29.	6028.3	5547.0	3		0024	243	141.	6831.6	5550.3	4		1624	443	52.	6558.8	5549.4
1		0836	44	32.	6066.5	5547.3	3		0036	244	140.	6829.3	5550.3	4		1636	444	52.	6557.9	5549.4
1		0848	45	35.	6107.2	5547.7	3		0048	245	139.	6827.0	5550.3	4		1648	445	52.	6557.0	5549.4
1		0900	46	37.	6150.0	5548.0	3		0100	246	138.	6824.6	5550.3	4		1700	446	51.	6556.1	5549.4
1		0912	47	38.	6194.9	5548.2	3		0112	247	137.	6822.4	5550.2	4		1712	447	51.	6555.3	5549.4
1		0924	48	40.	6241.4	5548.3	3		0124	248	137.	6820.2	5550.2	4		1724	448	51.	6554.4	5549.4
1		0936	49	41.	6289.5	5548.5	3		0136	249	136.	6818.0	5550.2	4		1736	449	51.	6553.5	5549.4
1		0948	50	42.	6339.0	5548.6	3		0148	250	135.	6815.9	5550.2	4		1748	450	51.	6552.6	5549.3
1		1000	51	43.	6389.6	5548.8	3		0200	251	134.	6813.7	5550.2	4		1800	451	51.	6551.7	5549.3
1		1012	52	44.	6441.2	5549.0	3		0212	252	133.	6811.5	5550.2	4		1812	452	51.	6550.9	5549.3
1		1024	53	45.	6493.7	5549.2	3		0224	253	132.	6809.3	5550.2	4		1824	453	50.	6550.0	5549.3
1		1036	54	50.	6547.1	5549.3	3		0236	254	131.	6807.1	5550.2	4		1836	454	50.	6549.1	5549.3

1	1048	55	61.	6601.0	5549.5 *	3	0248	255	130.	6804.9	5550.2 *	4	1848	455	50.	6548.2	5549.3
1	1100	56	76.	6655.4	5549.7 *	3	0300	256	129.	6802.7	5550.2 *	4	1900	456	50.	6547.4	5549.3
1	1112	57	94.	6710.1	5549.9 *	3	0312	257	128.	6800.6	5550.2 *	4	1912	457	50.	6546.5	5549.3
1	1124	58	114.	6765.1	5550.1 *	3	0324	258	127.	6798.6	5550.2 *	4	1924	458	50.	6545.6	5549.3
1	1136	59	137.	6820.2	5550.2 *	3	0336	259	127.	6796.6	5550.2 *	4	1936	459	50.	6544.9	5549.3
1	1148	60	161.	6875.4	5550.4 *	3	0348	260	126.	6794.5	5550.2 *	4	1948	460	49.	6544.1	5549.3
1	1200	61	187.	6930.5	5550.6 *	3	0400	261	125.	6792.5	5550.1 *	4	2000	461	49.	6543.4	5549.3
1	1212	62	215.	6985.2	5550.8 *	3	0412	262	124.	6790.4	5550.1 *	4	2012	462	49.	6542.7	5549.3
1	1224	63	244.	7038.1	5551.0 *	3	0424	263	123.	6788.4	5550.1 *	4	2024	463	49.	6541.9	5549.3
1	1236	64	271.	7087.1	5551.1 *	3	0436	264	122.	6786.3	5550.1 *	4	2036	464	49.	6541.2	5549.3
1	1248	65	296.	7129.7	5551.3 *	3	0448	265	122.	6784.3	5550.1 *	4	2048	465	49.	6540.5	5549.3
1	1300	66	317.	7164.6	5551.4 *	3	0500	266	121.	6782.2	5550.1 *	4	2100	466	49.	6539.8	5549.3
1	1312	67	334.	7191.8	5551.5 *	3	0512	267	120.	6780.3	5550.1 *	4	2112	467	49.	6539.0	5549.3
1	1324	68	347.	7212.2	5551.5 *	3	0524	268	119.	6778.4	5550.1 *	4	2124	468	49.	6538.3	5549.3
1	1336	69	356.	7227.2	5551.6 *	3	0536	269	118.	6776.5	5550.1 *	4	2136	469	48.	6537.6	5549.3
1	1348	70	363.	7238.5	5551.6 *	3	0548	270	118.	6774.6	5550.1 *	4	2148	470	48.	6536.8	5549.3
1	1400	71	369.	7247.1	5551.7 *	3	0600	271	117.	6772.7	5550.1 *	4	2200	471	48.	6536.1	5549.3
1	1412	72	373.	7253.7	5551.7 *	3	0612	272	116.	6770.8	5550.1 *	4	2212	472	48.	6535.4	5549.3
1	1424	73	377.	7259.0	5551.7 *	3	0624	273	115.	6768.9	5550.1 *	4	2224	473	48.	6534.6	5549.3
1	1436	74	379.	7263.2	5551.7 *	3	0636	274	115.	6767.0	5550.1 *	4	2236	474	48.	6533.9	5549.3
1	1448	75	382.	7266.6	5551.7 *	3	0648	275	114.	6765.1	5550.1 *	4	2248	475	48.	6533.2	5549.3
1	1500	76	383.	7269.5	5551.7 *	3	0700	276	113.	6763.2	5550.1 *	4	2300	476	48.	6532.4	5549.3
1	1512	77	385.	7272.0	5551.7 *	3	0712	277	112.	6761.3	5550.0 *	4	2312	477	48.	6531.7	5549.3
1	1524	78	387.	7274.2	5551.8 *	3	0724	278	112.	6759.4	5550.0 *	4	2324	478	48.	6531.0	5549.3
1	1536	79	388.	7276.2	5551.8 *	3	0736	279	111.	6757.7	5550.0 *	4	2336	479	47.	6530.2	5549.3
1	1548	80	389.	7278.1	5551.8 *	3	0748	280	110.	6755.9	5550.0 *	4	2348	480	47.	6529.5	5549.3
1	1600	81	390.	7279.9	5551.8 *	3	0800	281	110.	6754.1	5550.0 *	5	0000	481	47.	6528.8	5549.3
1	1612	82	391.	7281.5	5551.8 *	3	0812	282	109.	6752.4	5550.0 *	5	0012	482	47.	6528.1	5549.3
1	1624	83	392.	7283.1	5551.8 *	3	0824	283	108.	6750.6	5550.0 *	5	0024	483	47.	6527.3	5549.3
1	1636	84	393.	7284.6	5551.8 *	3	0836	284	108.	6748.9	5550.0 *	5	0036	484	47.	6526.6	5549.3
1	1648	85	394.	7286.0	5551.8 *	3	0848	285	107.	6747.1	5550.0 *	5	0048	485	47.	6525.9	5549.3
1	1700	86	395.	7287.5	5551.8 *	3	0900	286	106.	6745.4	5550.0 *	5	0100	486	47.	6525.1	5549.3
1	1712	87	396.	7288.9	5551.8 *	3	0912	287	106.	6743.6	5550.0 *	5	0112	487	47.	6524.4	5549.3
1	1724	88	397.	7290.4	5551.8 *	3	0924	288	105.	6741.9	5550.0 *	5	0124	488	47.	6523.7	5549.3
1	1736	89	398.	7291.9	5551.8 *	3	0936	289	104.	6740.1	5550.0 *	5	0136	489	47.	6522.9	5549.2
1	1748	90	399.	7293.3	5551.8 *	3	0948	290	104.	6738.3	5550.0 *	5	0148	490	47.	6522.2	5549.2
1	1800	91	400.	7294.8	5551.8 *	3	1000	291	103.	6736.6	5550.0 *	5	0200	491	46.	6521.5	5549.2
1	1812	92	401.	7296.1	5551.8 *	3	1012	292	103.	6734.8	5550.0 *	5	0212	492	46.	6520.7	5549.2
1	1824	93	402.	7297.4	5551.8 *	3	1024	293	102.	6733.2	5550.0 *	5	0224	493	46.	6520.0	5549.2
1	1836	94	403.	7298.6	5551.8 *	3	1036	294	101.	6731.6	5549.9 *	5	0236	494	46.	6519.3	5549.2
1	1848	95	403.	7299.5	5551.8 *	3	1048	295	101.	6730.0	5549.9 *	5	0248	495	46.	6518.5	5549.2
1	1900	96	404.	7300.1	5551.8 *	3	1100	296	100.	6728.4	5549.9 *	5	0300	496	46.	6517.8	5549.2
1	1912	97	404.	7300.3	5551.8 *	3	1112	297	100.	6726.8	5549.9 *	5	0312	497	46.	6517.1	5549.2
1	1924	98	404.	7300.3	5551.8 *	3	1124	298	99.	6725.2	5549.9 *	5	0324	498	46.	6516.4	5549.2
1	1936	99	404.	7300.2	5551.8 *	3	1136	299	98.	6723.6	5549.9 *	5	0336	499	46.	6515.6	5549.2
1	1948	100	404.	7299.9	5551.8 *	3	1148	300	98.	6722.0	5549.9 *	5	0348	500	46.	6514.9	5549.2
1	2000	101	403.	7299.5	5551.8 *	3	1200	301	97.	6720.4	5549.9 *	5	0400	501	46.	6514.2	5549.2
1	2012	102	403.	7299.0	5551.8 *	3	1212	302	97.	6718.8	5549.9 *	5	0412	502	46.	6513.4	5549.2
1	2024	103	403.	7298.6	5551.8 *	3	1224	303	96.	6717.1	5549.9 *	5	0424	503	46.	6512.7	5549.2
1	2036	104	402.	7298.0	5551.8 *	3	1236	304	96.	6715.5	5549.9 *	5	0436	504	46.	6512.0	5549.2
1	2048	105	402.	7297.4	5551.8 *	3	1248	305	95.	6713.9	5549.9 *	5	0448	505	46.	6511.2	5549.2
1	2100	106	402.	7296.8	5551.8 *	3	1300	306	94.	6712.3	5549.9 *	5	0500	506	46.	6510.5	5549.2
1	2112	107	401.	7296.3	5551.8 *	3	1312	307	94.	6710.7	5549.9 *	5	0512	507	45.	6509.8	5549.2
1	2124	108	401.	7295.7	5551.8 *	3	1324	308	93.	6709.2	5549.9 *	5	0524	508	45.	6509.0	5549.2
1	2136	109	400.	7295.1	5551.8 *	3	1336	309	93.	6707.8	5549.9 *	5	0536	509	45.	6508.3	5549.2
1	2148	110	400.	7294.5	5551.8 *	3	1348	310	92.	6706.3	5549.9 *	5	0548	510	45.	6507.6	5549.2
1	2200	111	400.	7293.9	5551.8 *	3	1400	311	92.	6704.9	5549.9 *	5	0600	511	45.	6506.8	5549.2
1	2212	112	399.	7293.3	5551.8 *	3	1412	312	91.	6703.4	5549.9 *	5	0612	512	45.	6506.1	5549.2
1	2224	113	399.	7292.7	5551.8 *	3	1424	313	91.	6701.9	5549.8 *	5	0624	513	45.	6505.4	5549.2
1	2236	114	398.	7292.2	5551.8 *	3	1436	314	90.	6700.5	5549.8 *	5	0636	514	45.	6504.7	5549.2
1	2248	115	398.	7291.6	5551.8 *	3	1448	315	90.	6699.0	5549.8 *	5	0648	515	45.	6503.9	5549.2
1	2300	116	398.	7291.1	5551.8 *	3	1500	316	89.	6697.5	5549.8 *	5	0700	516	45.	6503.2	5549.2
1	2312	117	397.	7290.7	5551.8 *	3	1512	317	89.	6696.1	5549.8 *	5	0712	517	45.	6502.5	5549.2
1	2324	118	397.	7290.3	5551.8 *	3	1524	318	88.	6694.6	5549.8 *	5	0724	518	45.	6501.7	5549.2
1	2336	119	397.	7289.8	5551.8 *	3	1536	319	88.	6693.2	5549.8 *	5	0736	519	45.	6501.0	5549.2
1	2348	120	397.	7289.4	5551.8 *	3	1548	320	87.	6691.7	5549.8 *	5	0748	520	45.	6500.3	5549.2
2	0000	121	396.	7288.9	5551.8 *	3	1600	321	87.	6690.2	5549.8 *	5	0800	521	45.	6499.5	5549.2
2	0012	122	396.	7288.4	5551.8 *	3	1612	322	86.	6688.8	5549.8 *	5	0812	522	45.	6498.8	5549.2
2	0024	123	395.	7287.6	5551.8 *	3	1624	323	86.	6687.3	5549.8 *	5	0824	523	45.	6498.1	5549.2
2	0036	124	395.	7286.5	5551.8 *	3	1636	324	85.	6685.8	5549.8 *	5	0836	524	45.	6497.3	5549.2
2	0048	125	393.	7284.6	5551.8 *	3	1648	325	85.	6684.4	5549.8 *	5	0848	525	45.	6496.6	5549.2
2	0100	126	392.	7281.9	5551.8 *	3	1700	326	85.	6683.1	5549.8 *	5	0900	526	45.	6495.9	5549.2
2	0112	127	389.	7278.4	5551.8 *	3	1712	327	84.	6681.8	5549.8 *	5	0912	527	45.	6495.2	5549.2
2	0124	128	387.	7274.2	5551.8 *	3	1724	328	84.	6680.4	5549.8 *	5	0924	528	45.	6494.4	5549.2
2	0136	129	383.	7269.3	5551.7 *	3	1736	329	83.	6679.1	5549.8 *	5	0936	529	45.	6493.7	5549.2
2	0148	130	380.	7264.1	5551.7 *	3	1748	330	83.	6677.8	5549.8 *	5	0948	530	45.	6493.0	5549.1
2	0200	131	376.	7258.7	5551.7 *	3	1800	331	82.	6676.5	5549.8 *	5	1000	531	45.	6492.2	5549.1
2	0212	132	373.	7253.1	5551.7 *	3	1812	332	82.	6675.2	5549.8 *	5	1012	532	45.	6491.5	5549.1
2	0224	133	369.	7247.4	5551.7 *	3	1824	333	82.	6673.9	5549.8 *	5	1024	533	45.	6490.8	5549.1
2	0236	134	365.	7241.7	5551.6 *	3	1836	334	81.	6672.5	5549.7 *	5	1036	534	45.	6490.0	5549.1
2	0248	135	362.	7235.9	5551.6 *	3	1848	335	81.	6671.2	5549.7 *	5	1048	535	45.	6489.3	5549.1
2	0300	136	358.	7230.0	5551.6 *	3	1900	336	80.	6669.9	5549.7 *	5	1100	536	45.	6488.6	5549.1
2	0312	137	354.	7224.2	5551.6 *	3	1912	337	80.	6668.6	5549.7 *	5	1112	537	45.	6487.8	5549.1
2	0324	138	351.	7218.5	5551.6 *	3	1924	338	80.	6667.3	5549.7 *	5	1124	538	45.	6487.1	5549.1
2	0336	139	347.	7212.8	5551.6 *	3	1936	339	79.	6666.0	5549.7 *	5	1136	539	45.	6486.4	5549.1
2	0348	140	343.	7207.0	5551.5 *	3	1948	340	79.	6664.6	5549.7 *	5	1148	540	45.	6485.6	5549.1
2	0400	141	340.	7201.5	5551.5 *	3	2000	341	78.	6663.3	5549.7 *	5	1200	541	45.	6484.9	5549.1
2	0412	142	336.	7195.9	5551.5 *	3	2012	342	78.	6662.0	5549.7 *	5	1212	542	45.	6484.2	5549.1
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2	0436	144	330.	7185.0	5551.5 *	3	2036	344	77.	6659.4	5549.7 *	5	1236	544	45.	6482.7	5549.1
2	0448	145	326.	7179.6	5551.4 *	3	2048	345	77.	6658.1	5549.7 *	5	1248	545	45.	6482.0	5549.1
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   2     0512 147     320.   7168.9  5551.4 *  3     2112 347      76.   6655.6  5549.7 *  5     1312 547      45.   6480.5  5549.1
   2     0524 148     316.   7163.6  5551.4 *  3     2124 348      76.   6654.4  5549.7 *  5     1324 548      45.   6479.8  5549.1
   2     0536 149     313.   7158.5  5551.4 *  3     2136 349      75.   6653.2  5549.7 *  5     1336 549      45.   6479.1  5549.1
   2     0548 150     310.   7153.4  5551.4 *  3     2148 350      75.   6652.1  5549.7 *  5     1348 550      45.   6478.3  5549.1
   2     0600 151     307.   7148.3  5551.3 *  3     2200 351      75.   6650.9  5549.7 *  5     1400 551      45.   6477.6  5549.1
   2     0612 152     304.   7143.3  5551.3 *  3     2212 352      74.   6649.7  5549.7 *  5     1412 552      45.   6476.9  5549.1
   2     0624 153     301.   7138.3  5551.3 *  3     2224 353      74.   6648.6  5549.7 *  5     1424 553      45.   6476.1  5549.1
   2     0636 154     298.   7133.3  5551.3 *  3     2236 354      74.   6647.4  5549.7 *  5     1436 554      45.   6475.4  5549.1
   2     0648 155     295.   7128.5  5551.3 *  3     2248 355      73.   6646.2  5549.7 *  5     1448 555      45.   6474.7  5549.1
   2     0700 156     292.   7123.7  5551.3 *  3     2300 356      73.   6645.0  5549.7 *  5     1500 556      45.   6473.9  5549.1
   2     0712 157     290.   7118.9  5551.2 *  3     2312 357      72.   6643.9  5549.7 *  5     1512 557      45.   6473.2  5549.1
   2     0724 158     287.   7114.2  5551.2 *  3     2324 358      72.   6642.7  5549.6 *  5     1524 558      45.   6472.5  5549.1
   2     0736 159     284.   7109.5  5551.2 *  3     2336 359      72.   6641.5  5549.6 *  5     1536 559      45.   6471.8  5549.1
   2     0748 160     281.   7104.8  5551.2 *  3     2348 360      71.   6640.4  5549.6 *  5     1548 560      45.   6471.0  5549.1
   2     0800 161     279.   7100.1  5551.2 *  4     0000 361      71.   6639.2  5549.6 *  5     1600 561      45.   6470.3  5549.1
   2     0812 162     276.   7095.6  5551.2 *  4     0012 362      71.   6638.0  5549.6 *  5     1612 562      45.   6469.6  5549.1
   2     0824 163     273.   7091.1  5551.1 *  4     0024 363      70.   6636.9  5549.6 *  5     1624 563      45.   6468.8  5549.1
   2     0836 164     271.   7086.5  5551.1 *  4     0036 364      70.   6635.7  5549.6 *  5     1636 564      45.   6468.1  5549.1
   2     0848 165     268.   7082.2  5551.1 *  4     0048 365      70.   6634.5  5549.6 *  5     1648 565      45.   6467.4  5549.1
   2     0900 166     266.   7077.8  5551.1 *  4     0100 366      70.   6633.3  5549.6 *  5     1700 566      45.   6466.6  5549.1
   2     0912 167     263.   7073.4  5551.1 *  4     0112 367      69.   6632.2  5549.6 *  5     1712 567      45.   6465.9  5549.1
   2     0924 168     261.   7069.0  5551.1 *  4     0124 368      69.   6631.0  5549.6 *  5     1724 568      45.   6465.2  5549.1
   2     0936 169     258.   7064.8  5551.1 *  4     0136 369      69.   6629.8  5549.6 *  5     1736 569      45.   6464.4  5549.1
   2     0948 170     256.   7060.5  5551.0 *  4     0148 370      68.   6628.7  5549.6 *  5     1748 570      45.   6463.7  5549.1
   2     1000 171     254.   7056.3  5551.0 *  4     0200 371      68.   6627.5  5549.6 *  5     1800 571      44.   6463.0  5549.0
   2     1012 172     251.   7052.2  5551.0 *  4     0212 372      68.   6626.3  5549.6 *  5     1812 572      44.   6462.2  5549.0
   2     1024 173     249.   7048.1  5551.0 *  4     0224 373      67.   6625.2  5549.6 *  5     1824 573      44.   6461.5  5549.0
   2     1036 174     247.   7044.0  5551.0 *  4     0236 374      67.   6624.1  5549.6 *  5     1836 574      44.   6460.8  5549.0
   2     1048 175     245.   7039.9  5551.0 *  4     0248 375      67.   6623.1  5549.6 *  5     1848 575      44.   6460.1  5549.0
   2     1100 176     242.   7035.9  5551.0 *  4     0300 376      66.   6622.1  5549.6 *  5     1900 576      44.   6459.3  5549.0
   2     1112 177     240.   7032.0  5550.9 *  4     0312 377      66.   6621.1  5549.6 *  5     1912 577      44.   6458.6  5549.0
   2     1124 178     238.   7028.0  5550.9 *  4     0324 378      66.   6620.0  5549.6 *  5     1924 578      44.   6457.9  5549.0
   2     1136 179     236.   7024.1  5550.9 *  4     0336 379      66.   6619.0  5549.6 *  5     1936 579      44.   6457.1  5549.0
   2     1148 180     234.   7020.3  5550.9 *  4     0348 380      65.   6618.0  5549.6 *  5     1948 580      44.   6456.4  5549.0
   2     1200 181     232.   7016.5  5550.9 *  4     0400 381      65.   6617.0  5549.6 *  5     2000 581      44.   6455.7  5549.0
   2     1212 182     230.   7012.7  5550.9 *  4     0412 382      65.   6615.9  5549.6 *  5     2012 582      44.   6454.9  5549.0
   2     1224 183     228.   7008.9  5550.9 *  4     0424 383      65.   6614.9  5549.6 *  5     2024 583      44.   6454.2  5549.0
   2     1236 184     226.   7005.1  5550.9 *  4     0436 384      64.   6613.9  5549.6 *  5     2036 584      44.   6453.5  5549.0
   2     1248 185     224.   7001.4  5550.8 *  4     0448 385      64.   6612.9  5549.5 *  5     2048 585      44.   6452.7  5549.0
   2     1300 186     222.   6997.8  5550.8 *  4     0500 386      64.   6611.9  5549.5 *  5     2100 586      44.   6452.0  5549.0
   2     1312 187     220.   6994.1  5550.8 *  4     0512 387      63.   6610.8  5549.5 *  5     2112 587      44.   6451.3  5549.0
   2     1324 188     218.   6990.5  5550.8 *  4     0524 388      63.   6609.8  5549.5 *  5     2124 588      44.   6450.5  5549.0
   2     1336 189     216.   6987.0  5550.8 *  4     0536 389      63.   6608.8  5549.5 *  5     2136 589      44.   6449.8  5549.0
   2     1348 190     214.   6983.4  5550.8 *  4     0548 390      63.   6607.8  5549.5 *  5     2148 590      44.   6449.1  5549.0
   2     1400 191     212.   6979.9  5550.8 *  4     0600 391      62.   6606.7  5549.5 *  5     2200 591      44.   6448.4  5549.0
   2     1412 192     211.   6976.4  5550.8 *  4     0612 392      62.   6605.7  5549.5 *  5     2212 592      44.   6447.6  5549.0
   2     1424 193     209.   6972.9  5550.8 *  4     0624 393      62.   6604.7  5549.5 *  5     2224 593      44.   6446.9  5549.0
   2     1436 194     207.   6969.6  5550.7 *  4     0636 394      62.   6603.7  5549.5 *  5     2236 594      44.   6446.2  5549.0
   2     1448 195     205.   6966.2  5550.7 *  4     0648 395      61.   6602.6  5549.5 *  5     2248 595      44.   6445.4  5549.0
   2     1500 196     204.   6962.8  5550.7 *  4     0700 396      61.   6601.6  5549.5 *  5     2300 596      44.   6444.7  5549.0
   2     1512 197     202.   6959.5  5550.7 *  4     0712 397      61.   6600.6  5549.5 *  5     2312 597      44.   6444.0  5549.0
   2     1524 198     200.   6956.1  5550.7 *  4     0724 398      61.   6599.6  5549.5 *  5     2324 598      44.   6443.2  5549.0
   2     1536 199     199.   6952.9  5550.7 *  4     0736 399      60.   6598.5  5549.5 *  5     2336 599      44.   6442.5  5549.0
   2     1548 200     197.   6949.7  5550.7 *  4     0748 400      60.   6597.5  5549.5 *  5     2348 600      44.   6441.8  5549.0
                                        *                                                     *
 ********************************************************************************************************************************************************

 PEAK OUTFLOW IS      404. AT TIME  19.20 HOURS


  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR    119.80-HR
+   (CFS)       (HR)
                      (CFS)
+     404.     19.20                401.        346.        191.         130.
                     (INCHES)      .000        .000        .000         .000
                      (AC-FT)      199.        687.       1135.        1291.

 PEAK STORAGE   TIME                       MAXIMUM AVERAGE STORAGE
                                   6-HR       24-HR       72-HR    119.80-HR
+  (AC-FT)      (HR)
     7300.     19.20               7296.       7209.       6902.        6696.

  PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                   6-HR       24-HR       72-HR    119.80-HR
+   (FEET)      (HR)
   5551.84     19.20             5551.83     5551.54     5550.52      5549.72

                      CUMULATIVE AREA =     .00 SQ MI

1

              PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
                          FLOWS IN CUBIC FEET PER SECOND,  AREA IN SQUARE MILES
                                       TIME TO PEAK IN HOURS


                                                          RATIOS APPLIED TO PRECIPITATION
 OPERATION       STATION     AREA    PLAN            RATIO 1
                                                       1.00

 HYDROGRAPH AT
```

```
+                 Cove        .00     1   FLOW        3524.
                                          TIME       12.00

 ROUTED TO
+                 Cove        .00     1   FLOW         404.
                                          TIME       19.20

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     5551.84
                                           TIME       19.20
1                                   SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                                  (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


      PLAN  1 ..............                  INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                  ELEVATION        5545.50           5549.20          5552.00
                                  STORAGE             5845.             6508.            7347.
                                  OUTFLOW                0.               45.              435.


                     RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                       OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                      PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                     1.00      5551.84         .00       7300.       404.       .00        19.20         .00


 *** NORMAL END OF HEC-1 ***
```

Spillway Analysis

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********************************************************************************
SITES XEQ 08/20/2020   WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
     VER 2005.1.8              (USER MANUAL - DATED DECEMBER 2005)
     TIME 06:12:11

************************ 80-80 LIST OF INPUT Data **************************

SITES     01/01/2005COVRES    COV RES                       4.74      C3
SAVMOV    0    101
SAVMOV    101  1                                                      1
STRUCTURE STR1      Cove Res
                    5470                                    0.18
                    5480                                    62.26
                    5490                                    303.40
                    5500                                    738.03
                    5510                                    1400.09
                    5520                                    2323.02
                    5530                                    3541.97
                    5540                                    5073.81
                    5545.5                                  6055.03
                    5550                                    6934.92
                    5552                                    7347.18
                    5552.5                                  7450.25
ENDTABLE
HYD       1                 Principal Spillway
                    1
                    0         11        14        15        15
                    15        15        15        15        15
                    15        16        16        16        16
                    16        16        16        16        16
                    16        17        17        17        17
                    17        17        17        17        17
                    17        18        18        18        18
                    18        18        18        18        19
                    19        19        19        19        19
                    20        20        20        20        20
                    20        21        21        21        21
                    21        21        22        22        22
                    22        23        23        23        23
                    24        24        24        24        25
                    25        25        26        26        26
                    27        27        27        28        28
                    29        29        29        30        30
                    31        31        32        33        33
                    34        35        35        36        37
                    38        39        40        41        42
                    43        45        46        48        49
                    51        53        56        58        61
                    65        69        74        80        87
                    96        109       127       157       219
                    850       479       259       172       132
                    111       98        88        81        75
                    70        65        62        59        56
                    54        51        50        48        46
                    45        43        42        41        40
                    39        38        37        36        35
                    35        34        33        33        32
                    32        31        30        30        29
                    29        29        28        28        27
                    27        27        26        26        26
                    25        25        25        24        24
                    24        24        23        23        23
                    23        22        22        22        22
                    22        21        21        21        21
                    21        20        20        20        20
                    20        20        19        19        19
                    19        19        19        19        18
                    18        18        18        18        18
                    18        17        17        17        17
                    17        17        17        17        17
                    17        16        16        16        16
                    16        16        16        16        16
                    16        15        15        15        15
                    15        15        15        15        15
                    15        4         1
ENDTABLE
HYD       3                 Auxiliary Spillway (Local)
                    0.3
                    0         0         0         0         0
                    6         39        194       687       1365
                    2027      2180      1955      1683      1441
                    1248      1107      1001      924       874
                    833       748       589       423       283
                    180       112       73        47        28
                    16        9         5         3         1
                    1         0
ENDTABLE
HYD       5                 Freeboard (General)
                    1.2
                    0         0         4         35        84
                    195       425       1352      3365      3296
                    2008      1331      1060      912       792
```

```
                  742       664       624       613       611
                  547       262       90        24        5
                  1         0
ENDTABLE
WSDATA    2C CR             4.74
PDIRECT                               9.40      16.00
POOLDATA  ELEV              5545.5              5552      5435      SC
PSINLET           1         3.75
PSDATA    1       1000      30                  0.012     5450
ASSPRFL   41
          0       5530      75        5549.2    155       5549.2
          237     5517.6    600       5481.7    1049      5453.3
          1170    5435
ENDTABLE
ASSURFACE 41      1170      1
          0       1170      1         0         1
ENDTABLE
ASDATA    41                          2                             1
BTMWIDTH  FEET    30
ASMATERIAL
          1       50        1         75        115       .2
ENDTABLE
ASCOORD    1      W.Shale   N
          0       5530      75        5550      125       5565
          200     5552      250       5520      600       5485
          1050    5460      1150      5435      1300      5432.4
ENDTABLE
GRAPHICS  I
GO,DESIGN LP      TYPE2     24
SAVMOV    2   101 1                   STR1
ENDJOB

********************************************************************************

***** MESSAGE - DEFAULT TOPSOIL FILL MATERIAL PARAMETERS USED.

***** MESSAGE - AUXILIARY SPILLWAY CREST ELEVATION IS SET TO  5549.20
               FROM THE ASSPRFL RECORDS.

***** MESSAGE - ASSURFACE REACH  1: ZERO ROOTING DEPTH IS DEFAULTED TO 0.5 FT.


1SITES ----------------------------------------------------------------------
 XEQ 08/20/2020                   COV RES                       WSID= COVRES
 VER 2005.1.8                       Cove Res                      SUBW= CR
 TIME 06:12:11           SITE = STR1             PASS=    1     PART=   1



**********    MATERIAL PROPERTIES    **************************
                        DRY                  PERCENT       DETACH.      REP.
     MATERIAL       PI  DENSITY       Kh       CLAY         RATE      DIAMETER
                       lbs/CuFt                        (Ft/H)/(lb/SqFt)  inches
    W.Shale        50.      115.     0.20       75.0          --        1.00000
    TS_FILL         0.      100.     0.05        0.0          --        0.05000
    GEN_FILL       50.      115.     0.20       75.0          --        1.00000

**************************    BASIC Data    ********************************
HUMID- SUBHUMID CLIMATE AREA                    DESIGN CLASS  C

INFLOW HYDROGRAPH(S) ENTERED

PRECIP. - Q-PS,1-DAY    Q-PS,10-DAY       P-SD          P-FB
              0.00          0.00          9.40         16.00

WSDATA -       CN          DA-SM          TC/L           -/H          QRF
              0.00          4.74          0.00          0.00         0.00

SITEDATA- PERM POOL     CREST PS        FP SED       VALLEY FL        378?
              0.00       5545.50          0.00       5435.00           NO

          BASEFLOW      INITIAL EL     EXTRA VOL      SITE TYPE
              0.00          0.00          0.00         DESIGN

PSDATA -  NO. COND        COND L         DIA/W           -/H
              1.00       1000.00         30.00          0.00

               PS N            KE         WEIR L        TW EL
             0.012          1.00          3.75       5450.00

           2ND STG         ORF H          ORF L      START AUX.
              0.00          0.00          0.00          0.00

ASCRESTS -   AUX.1         AUX.2         AUX.3         AUX.4         AUX.5
            5549.20          0.00          0.00          0.00         0.00

AUX.Data -  REF.NO.    RETARD. Ci   TIE STATION    INLET LENGTH
                41          0.00       155.00             0

AUX.Data - INLET Ci    SIDE SLOPE       EXIT Ci     EXIT SLOPE     ACTUAL AUX?
             1.000          2.00         1.000          0.385           NO
```

```
 BTM WIDTH -    BW1           BW2           BW3           BW4           BW5
   ft         30.00          0.00          0.00          0.00          0.00

 AUXILIARY SPILLWAY RATING DEVELOPED USING WSPVRT.


1SITES ----------------------------------------------------------------------
 XEQ 08/20/2020                    COV RES                        WSID= COVRES
 VER 2005.1.8                        Cove Res                       SUBW= CR
 TIME 06:12:11            SITE = STR1              PASS=    1     PART=   2

MESSAGE ---- Climatic Index changed from 0.0 to 1.0 for this run.

 CREST PS       5545.50 FT    6055.0 ACFT      0.00 AC     126.3 CFS

 SED ACCUM      5545.50 FT    6055.0 ACFT      0.00 AC     126.3 CFS

 START ELEV     5545.50 FT    6055.0 ACFT      0.00 AC       0.0 CFS

 INFLOW HYDROGRAPH PROVIDED IN LOCATION  1,  PEAK=    850.00 CFS, AT 120.00 HRS.
 TITLE = Principal Spillway


 CREST PS       5545.50 FT    6055.0 ACFT      0.00 AC     126.3 CFS

 SED ACCUM      5545.50 FT    6055.0 ACFT      0.00 AC     126.3 CFS

 START ELEV     5545.50 FT    6055.0 ACFT      0.00 AC       0.0 CFS


 NRCS-PSH  RAINFALL   1-DAY =   0.00 IN    10-DAY =   0.00 IN    DA =   4.74 SM
           RUNOFF     1-DAY =   0.00 IN    10-DAY =   0.00 IN

      CLIMATIC INDEX = 1.00    CN 10-DAY =  0.    CN 1-DAY =   0.

      PEAK =       850.0 CFS, AT  120.0 HRS.


 ROUTED RESULT - HYD TYPE       EMAX         VOL-MAX        AMAX         QMAX
                 NRCS-PSH   5547.76 FT    6496.1 ACFT      0.00 AC     40.0 CFS

      PS STORAGE     441.0 ACFT,  BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

 DRAWDOWN (DDT) TEST       5545.84 FT    6121.2 ACFT      4.35 CFS
      CONTROL IS 0.150 DETENTION STORAGE

      TIME LIMIT REACHED = 10.00 DAYS. FLOW WAS     9.73 CFS,  ELEV =  5546.26
      (ELEVATION TO START ROUTING SDH AND/OR FBH HAS BEEN RAISED.)

      TIME TO DDT TEST DISCHARGE IS 15.79 DAYS - DRAWDOWN STOPPED.

 ***** NOTE - CREST OF AUX. RAISED TO HOLD   148.03 ACFT NOT EVACUATED IN
              DRAWDOWN TIME LIMIT.  TOTAL STORAGE REQUIRED =  6644.08 ACFT,
              NEW ELEVATION OF AUXILIARY SPILLWAY CREST    =  5548.51 FT.

 PLOT OF PRINCIPAL SPILLWAY HYDROGRAPH,  1 INCH=     200. CFS
                                                      0.      200.      400.      600.      800.     1000.     1200.     1400.
  Time    Qin  Qout   Elev    Vol   Area  ExtVel  I         I         I         I         I         I         I         I
  0.00   0.0   0.0 5545.5  6055.5   0.0          .
  1.00  11.0   0.0 5545.5  6055.5   0.0          .I
  2.00  14.0   0.1 5545.5  6056.5   0.0          .I
  3.00  15.0   0.2 5545.5  6057.7   0.0          .I
  4.00  15.0   0.3 5545.5  6058.9   0.0          .I
  5.00  15.0   0.3 5545.5  6060.1   0.0          .I
  6.00  15.0   0.4 5545.5  6061.3   0.0          .I
  7.00  15.0   0.5 5545.5  6062.5   0.0          .I
  8.00  15.0   0.6 5545.5  6063.7   0.0          .I
  9.00  15.0   0.7 5545.6  6064.9   0.0          .I
 10.00  15.0   0.7 5545.6  6066.1   0.0          .I
 11.00  16.0   0.8 5545.6  6067.3   0.0          .I
 12.00  16.0   0.9 5545.6  6068.6   0.0          .I
 13.00  16.0   1.0 5545.6  6069.8   0.0          .I
 14.00  16.0   1.1 5545.6  6071.1   0.0          .I
 15.00  16.0   1.1 5545.6  6072.3   0.0          .I
 16.00  16.0   1.2 5545.6  6073.5   0.0          .I
 17.00  16.0   1.3 5545.6  6074.7   0.0          .I
 18.00  16.0   1.4 5545.6  6076.0   0.0          .I
 19.00  16.0   1.5 5545.6  6077.2   0.0          .I
 20.00  16.0   1.5 5545.6  6078.4   0.0          .I
 21.00  17.0   1.6 5545.6  6079.6   0.0          .I
 22.00  17.0   1.7 5545.6  6080.9   0.0          .I
 23.00  17.0   1.8 5545.6  6082.1   0.0          .I
 24.00  17.0   1.9 5545.6  6083.4   0.0          .I
 25.00  17.0   1.9 5545.7  6084.6   0.0          .I
 26.00  17.0   2.0 5545.7  6085.9   0.0          .I
 27.00  17.0   2.1 5545.7  6087.1   0.0          .I
 28.00  17.0   2.2 5545.7  6088.3   0.0          .I
 29.00  17.0   2.3 5545.7  6089.5   0.0          .I
 30.00  17.0   2.3 5545.7  6090.8   0.0          .I
 31.00  18.0   2.4 5545.7  6092.0   0.0          .I
 32.00  18.0   2.5 5545.7  6093.3   0.0          .I
 33.00  18.0   2.6 5545.7  6094.6   0.0          .I
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 34.00  18.0   2.7 5545.7  6095.8   0.0         .I
 35.00  18.0   2.8 5545.7  6097.1   0.0         .I
 36.00  18.0   2.8 5545.7  6098.4   0.0         .I
 37.00  18.0   2.9 5545.7  6099.6   0.0         .I
 38.00  18.0   3.0 5545.7  6100.8   0.0         .I
 39.00  19.0   3.1 5545.7  6102.1   0.0         .I
 40.00  19.0   3.2 5545.7  6103.4   0.0         .I
 41.00  19.0   3.3 5545.8  6104.7   0.0         .I
 42.00  19.0   3.4 5545.8  6106.0   0.0         .I
 43.00  19.0   3.4 5545.8  6107.3   0.0         .I
 44.00  19.0   3.5 5545.8  6108.6   0.0         .I
 45.00  20.0   3.6 5545.8  6109.9   0.0         .I
 46.00  20.0   3.7 5545.8  6111.3   0.0         .I
 47.00  20.0   3.8 5545.8  6112.6   0.0         .I
 48.00  20.0   3.9 5545.8  6114.0   0.0         .I
 49.00  20.0   4.0 5545.8  6115.3   0.0         .I
 50.00  20.0   4.0 5545.8  6116.6   0.0         .I
 51.00  21.0   4.1 5545.8  6118.0   0.0         .I
 52.00  21.0   4.2 5545.8  6119.4   0.0         .I
 53.00  21.0   4.3 5545.8  6120.7   0.0         .I
 54.00  21.0   4.4 5545.8  6122.1   0.0         .I
 55.00  21.0   4.5 5545.9  6123.5   0.0         .I
 56.00  21.0   4.6 5545.9  6124.8   0.0         .I
 57.00  22.0   4.7 5545.9  6126.2   0.0         .I
 58.00  22.0   4.8 5545.9  6127.7   0.0         .I
 59.00  22.0   4.9 5545.9  6129.1   0.0         .I
 60.00  22.0   5.0 5545.9  6130.5   0.0         .I
 61.00  23.0   5.1 5545.9  6131.9   0.0         .I
 62.00  23.0   5.2 5545.9  6133.4   0.0         .I
 63.00  23.0   5.2 5545.9  6134.9   0.0         .I
 64.00  23.0   5.3 5545.9  6136.4   0.0         .I
 65.00  24.0   5.4 5545.9  6137.8   0.0         .I
 66.00  24.0   5.5 5545.9  6139.4   0.0         .I
 67.00  24.0   5.6 5545.9  6140.9   0.0         .I
 68.00  24.0   5.7 5545.9  6142.4   0.0         .I
 69.00  25.0   5.8 5546.0  6144.0   0.0         .I
 70.00  25.0   5.9 5546.0  6145.5   0.0         .I
 71.00  25.0   6.1 5546.0  6147.1   0.0         .I
 72.00  26.0   6.2 5546.0  6148.7   0.0         .I
 73.00  26.0   6.3 5546.0  6150.3   0.0         .I
 74.00  26.0   6.4 5546.0  6152.0   0.0         .I
 75.00  27.0   6.5 5546.0  6153.6   0.0         .I
 76.00  27.0   6.6 5546.0  6155.3   0.0         .I
 77.00  27.0   6.7 5546.0  6157.0   0.0         .I
 78.00  28.0   6.8 5546.0  6158.7   0.0         .I
 79.00  28.0   6.9 5546.0  6160.5   0.0         .I
 80.00  29.0   7.0 5546.0  6162.2   0.0         .I
 81.00  29.0   7.2 5546.1  6164.1   0.0         .I
 82.00  29.0   7.3 5546.1  6165.9   0.0         .I
 83.00  30.0   7.4 5546.1  6167.7   0.0         . I
 84.00  30.0   7.5 5546.1  6169.5   0.0         . I
 85.00  31.0   7.7 5546.1  6171.4   0.0         . I
 86.00  31.0   7.8 5546.1  6173.4   0.0         . I
 87.00  32.0   7.9 5546.1  6175.3   0.0         . I
 88.00  33.0   8.0 5546.1  6177.3   0.0         . I
 89.00  33.0   8.2 5546.1  6179.4   0.0         . I
 90.00  34.0   8.3 5546.1  6181.5   0.0         . I
 91.00  35.0   8.5 5546.2  6183.6   0.0         . I
 92.00  35.0   8.6 5546.2  6185.8   0.0         . I
 93.00  36.0   8.7 5546.2  6188.1   0.0         . I
 94.00  37.0   8.9 5546.2  6190.3   0.0         . I
 95.00  38.0   9.0 5546.2  6192.7   0.0         . I
 96.00  39.0   9.2 5546.2  6195.1   0.0         . I
 97.00  40.0   9.4 5546.2  6197.6   0.0         . I
 98.00  41.0   9.5 5546.2  6200.2   0.0         . I
 99.00  42.0   9.7 5546.3  6202.8   0.0         . I
100.00  43.0   9.9 5546.3  6205.5   0.0         . I
101.00  45.0  10.1 5546.3  6208.3   0.0         .PI
102.00  46.0  10.3 5546.3  6211.3   0.0         .PI
103.00  48.0  10.5 5546.3  6214.3   0.0         .PI
104.00  49.0  10.7 5546.3  6217.4   0.0         .PI
105.00  51.0  10.9 5546.3  6220.7   0.0         .P I
106.00  53.0  11.1 5546.4  6224.0   0.0         .P I
107.00  56.0  11.3 5546.4  6227.6   0.0         .P I
108.00  58.0  11.6 5546.4  6231.4   0.0         .P I
109.00  61.0  11.9 5546.4  6235.3   0.0         .P I
110.00  65.0  12.1 5546.4  6239.5   0.0         .P I
111.00  69.0  12.4 5546.5  6244.1   0.0         .P I
112.00  74.0  12.7 5546.5  6248.9   0.0         .P  I
113.00  80.0  13.1 5546.5  6254.2   0.0         .P  I
114.00  87.0  13.5 5546.5  6260.0   0.0         .P  I
115.00  96.0  13.9 5546.6  6266.5   0.0         .P   I
116.00 109.0  14.4 5546.6  6273.8   0.0         .P   I
117.00 127.0  14.9 5546.7  6282.3   0.0         .P    I
118.00 157.0  15.6 5546.7  6292.8   0.0         .P      I
119.00 219.0  17.3 5546.8  6307.0   0.0         .P         I
120.00 850.0  22.4 5547.0  6349.5   0.0         .P                                       X
121.00 479.0  28.7 5547.3  6402.3   0.0         .P                    I
122.00 259.0  32.1 5547.4  6430.3   0.0         . P          I
123.00 172.0  33.9 5547.5  6445.4   0.0         . P      I
124.00 132.0  35.1 5547.5  6455.1   0.0         . P    I
125.00 111.0  35.9 5547.6  6462.2   0.0         . P   I
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126.00	98.0	36.6	5547.6	6467.8	0.0	. P I
127.00	88.0	37.2	5547.6	6472.5	0.0	. P I
128.00	81.0	37.6	5547.7	6476.4	0.0	. P I
129.00	75.0	38.0	5547.7	6479.7	0.0	. P I
130.00	70.0	38.4	5547.7	6482.5	0.0	. P I
131.00	65.0	38.7	5547.7	6484.9	0.0	. PI
132.00	62.0	38.9	5547.7	6487.0	0.0	. PI
133.00	59.0	39.1	5547.7	6488.7	0.0	. PI
134.00	56.0	39.3	5547.7	6490.2	0.0	. PI
135.00	54.0	39.4	5547.7	6491.5	0.0	. PI
136.00	51.0	39.6	5547.7	6492.6	0.0	. PI
137.00	50.0	39.7	5547.7	6493.5	0.0	. PI
138.00	48.0	39.8	5547.7	6494.3	0.0	. P
139.00	46.0	39.8	5547.7	6494.9	0.0	. P
140.00	45.0	39.9	5547.8	6495.3	0.0	. P
141.00	43.0	39.9	5547.8	6495.7	0.0	. P
142.00	42.0	40.0	5547.8	6495.9	0.0	. P
143.00	41.0	40.0	5547.8	6496.0	0.0	. P
144.00	40.0	40.0	5547.8	6496.1	0.0	. X
145.00	39.0	40.0	5547.8	6496.0	0.0	. P
146.00	38.0	40.0	5547.8	6495.9	0.0	. P
147.00	37.0	39.9	5547.8	6495.7	0.0	. P
148.00	36.0	39.9	5547.8	6495.4	0.0	. P
149.00	35.0	39.9	5547.8	6495.0	0.0	. P
150.00	35.0	39.8	5547.7	6494.6	0.0	. P
151.00	34.0	39.8	5547.7	6494.2	0.0	. P
152.00	33.0	39.7	5547.7	6493.7	0.0	. P
153.00	33.0	39.6	5547.7	6493.1	0.0	. P
154.00	32.0	39.6	5547.7	6492.6	0.0	. P
155.00	32.0	39.5	5547.7	6491.9	0.0	. P
156.00	31.0	39.4	5547.7	6491.3	0.0	. P
157.00	30.0	39.3	5547.7	6490.5	0.0	. P
158.00	30.0	39.2	5547.7	6489.8	0.0	. P
159.00	29.0	39.1	5547.7	6489.0	0.0	.IP
160.00	29.0	39.0	5547.7	6488.1	0.0	.IP
161.00	29.0	38.9	5547.7	6487.3	0.0	.IP
162.00	28.0	38.8	5547.7	6486.5	0.0	.IP
163.00	28.0	38.7	5547.7	6485.6	0.0	.IP
164.00	27.0	38.6	5547.7	6484.6	0.0	.IP
165.00	27.0	38.5	5547.7	6483.7	0.0	.IP
166.00	27.0	38.4	5547.7	6482.7	0.0	.IP
167.00	26.0	38.3	5547.7	6481.8	0.0	.IP
168.00	26.0	38.1	5547.7	6480.8	0.0	.IP
169.00	26.0	38.0	5547.7	6479.8	0.0	.IP
170.00	25.0	37.9	5547.7	6478.7	0.0	.IP
171.00	25.0	37.8	5547.7	6477.7	0.0	.IP
172.00	25.0	37.7	5547.7	6476.6	0.0	.IP
173.00	24.0	37.5	5547.7	6475.5	0.0	.IP
174.00	24.0	37.4	5547.6	6474.4	0.0	.IP
175.00	24.0	37.3	5547.6	6473.3	0.0	.IP
176.00	24.0	37.1	5547.6	6472.2	0.0	.IP
177.00	23.0	37.0	5547.6	6471.1	0.0	.IP
178.00	23.0	36.9	5547.6	6470.0	0.0	.IP
179.00	23.0	36.7	5547.6	6468.8	0.0	.IP
180.00	23.0	36.6	5547.6	6467.7	0.0	.IP
181.00	22.0	36.4	5547.6	6466.5	0.0	.IP
182.00	22.0	36.3	5547.6	6465.3	0.0	.IP
183.00	22.0	36.2	5547.6	6464.2	0.0	.IP
184.00	22.0	36.0	5547.6	6463.0	0.0	.IP
185.00	22.0	35.9	5547.6	6461.8	0.0	.IP
186.00	21.0	35.7	5547.6	6460.7	0.0	.IP
187.00	21.0	35.6	5547.6	6459.5	0.0	.IP
188.00	21.0	35.4	5547.6	6458.3	0.0	.IP
189.00	21.0	35.3	5547.6	6457.1	0.0	.IP
190.00	21.0	35.2	5547.6	6455.9	0.0	.IP
191.00	20.0	35.0	5547.5	6454.7	0.0	.IP
192.00	20.0	34.9	5547.5	6453.4	0.0	.IP
193.00	20.0	34.7	5547.5	6452.2	0.0	.IP
194.00	20.0	34.6	5547.5	6451.0	0.0	.IP
195.00	20.0	34.4	5547.5	6449.8	0.0	.IP
196.00	20.0	34.3	5547.5	6448.6	0.0	.IP
197.00	19.0	34.1	5547.5	6447.4	0.0	.IP
198.00	19.0	34.0	5547.5	6446.2	0.0	.IP
199.00	19.0	33.8	5547.5	6444.9	0.0	.IP
200.00	19.0	33.7	5547.5	6443.7	0.0	.IP
201.00	19.0	33.6	5547.5	6442.5	0.0	.IP
202.00	19.0	33.4	5547.5	6441.3	0.0	.IP
203.00	19.0	33.3	5547.5	6440.1	0.0	.IP
204.00	18.0	33.1	5547.5	6438.9	0.0	.IP
205.00	18.0	33.0	5547.5	6437.7	0.0	.IP
206.00	18.0	32.8	5547.5	6436.4	0.0	.IP
207.00	18.0	32.7	5547.4	6435.2	0.0	.IP
208.00	18.0	32.5	5547.4	6434.0	0.0	.IP
209.00	18.0	32.4	5547.4	6432.8	0.0	.IP
210.00	18.0	32.2	5547.4	6431.6	0.0	.IP
211.00	17.0	32.1	5547.4	6430.4	0.0	.IP
212.00	17.0	32.0	5547.4	6429.2	0.0	.IP
213.00	17.0	31.8	5547.4	6427.9	0.0	.IP
214.00	17.0	31.7	5547.4	6426.7	0.0	.IP
215.00	17.0	31.5	5547.4	6425.5	0.0	.IP
216.00	17.0	31.4	5547.4	6424.3	0.0	.IP
217.00	17.0	31.2	5547.4	6423.1	0.0	.IP

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218.00  17.0  31.1 5547.4  6422.0   0.0          .IP
219.00  17.0  30.9 5547.4  6420.8   0.0          .IP
220.00  17.0  30.8 5547.4  6419.7   0.0          .IP
221.00  16.0  30.7 5547.4  6418.5   0.0          .IP
222.00  16.0  30.5 5547.4  6417.3   0.0          .IP
223.00  16.0  30.4 5547.3  6416.1   0.0          .IP
224.00  16.0  30.2 5547.3  6414.9   0.0          .IP
225.00  16.0  30.1 5547.3  6413.7   0.0          .IP
226.00  16.0  30.0 5547.3  6412.6   0.0          .P
227.00  16.0  29.8 5547.3  6411.4   0.0          .P
228.00  16.0  29.7 5547.3  6410.3   0.0          .P
229.00  16.0  29.5 5547.3  6409.2   0.0          .P
230.00  16.0  29.4 5547.3  6408.1   0.0          .P
231.00  15.0  29.3 5547.3  6406.9   0.0          .P
232.00  15.0  29.1 5547.3  6405.7   0.0          .P
233.00  15.0  29.0 5547.3  6404.6   0.0          .P
234.00  15.0  28.9 5547.3  6403.4   0.0          .P
235.00  15.0  28.7 5547.3  6402.3   0.0          .P
236.00  15.0  28.6 5547.3  6401.2   0.0          .P
237.00  15.0  28.5 5547.3  6400.0   0.0          .P
238.00  15.0  28.3 5547.3  6398.9   0.0          .P
239.00  15.0  28.2 5547.3  6397.8   0.0          .P
 Time    Qin  Qout   Elev    Vol   Area  ExtVel  I         I         I         I         I         I         I         I
                                                 0.      200.      400.      600.      800.     1000.     1200.     1400.
        END NRCS-PSH   PLOT


**************************************************************************
RATING TABLE DEVELOPED, SITE = STR1 :
 BY PROGRAM FOR PS AND AUX. SPILLWAYS
 AUX. RATING USED WSPVRT METHOD.


RATING TABLE NUMBER  1
       ELEV.    Q-TOTAL    Q-PS     Q-AUX.    VOLUME     AREA
       FEET       CFS       CFS       CFS      AC-FT     ACRE
  1  5545.50      0.00      0.00      0.00   6055.03      0.00
  2  5546.72     15.71     15.71      0.00   6294.00      0.00
  3  5547.94     44.43     44.43      0.00   6532.97      0.00
  4  5549.17     81.62     81.62      0.00   6771.95      0.00
                                          FULL CONDUIT FLOW, ELEV = 5550.39 FT
  5  5550.39    125.65    125.65      0.00   7015.04      0.00
  6  5550.65    125.84    125.84      0.00   7069.39      0.00
  7  5550.92    126.01    126.01      0.00   7123.74      0.00
  8  5551.18    126.17    126.17      0.00   7178.09      0.00
  9  5551.44    126.34    126.34      0.00   7232.44      0.00
 10  5551.71    126.50    126.50      0.00   7286.79      0.00
 11  5551.97    126.67    126.67      0.00   7341.14      0.00
 12  5552.23    126.83    126.83      0.00   7395.49      0.00
 13  5552.50    126.99    126.99      0.00   7449.85      0.00

INFLOW HYDROGRAPH PROVIDED IN LOCATION  3,  PEAK=   2180.00 CFS, AT   3.30 HRS.
TITLE = Auxiliary Spillway (Local)


INFLOW HYDROGRAPH PROVIDED IN LOCATION  5,  PEAK=   3365.00 CFS, AT   9.60 HRS.
TITLE = Freeboard (General)



1SITES ----------------------------------------------------------------------
 XEQ 08/20/2020                    COV RES                       WSID= COVRES
 VER 2005.1.8                        Cove Res                      SUBW= CR
 TIME 06:12:11            SITE = STR1              PASS=    1     PART=   3


 AUX. CREST     5548.51 FT    6644.1 ACFT      0.00 AC      61.7 CFS

      PS STORAGE    589.1 ACFT,  BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

 START ELEV     5546.26 FT    6203.0 ACFT      0.00 AC       9.7 CFS

 ***** WARNING - AUXILIARY CREST LOWER THAN LOW POINT IN SITE.

 NRCS-SDH   INFLOW HYDROGRAPH INPUT, DA =    4.74 SQUARE MILES

      PEAK =      2180.0 CFS, AT    3.3 HRS.

 NRCS-FBH   INFLOW HYDROGRAPH INPUT, DA =    4.74 SQUARE MILES

      PEAK =      3365.0 CFS, AT    9.6 HRS.

 ***** WARNING - MAXIMUM AUX. SURFACE PROFILE ELEVATION ( 5549.20) AND AUXILIARY
                 CREST ( 5548.51) ELEVATION Do NOT MATCH.  MAXIMUM AUX. SURFACE
                 PROFILE ELEVATION USED IN WSPVRT PROCEDURE.


 ***** MESSAGE - INPUT(5549.14) TO INTERPOLATION ROUTINE IS BELOW
                 ARRAY LIMIT(5549.20).


 **************************************************************************
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RATING TABLE DEVELOPED, SITE = STR1 :
 BY PROGRAM FOR PS AND AUX. SPILLWAYS
 AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 2

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE	
1	5545.50	0.00	0.00	0.00	6055.03	0.00	
2	5545.83	2.25	2.25	0.00	6120.52	0.00	
3	5546.17	6.37	6.37	0.00	6186.02	0.00	
4	5546.50	11.71	11.71	0.00	6251.52	0.00	
5	5546.84	18.03	18.03	0.00	6317.01	0.00	
6	5547.17	25.20	25.20	0.00	6382.51	0.00	
7	5547.51	33.12	33.12	0.00	6448.00	0.00	
8	5547.84	41.74	41.74	0.00	6513.50	0.00	
9	5548.18	50.99	50.99	0.00	6578.99	0.00	
10	5548.51	60.85	60.85	0.00	6644.49	0.00	
11	5549.14	80.67	80.67	0.00	6766.41	0.00	
12	5549.76	126.50	102.35	24.15	6888.71	0.00	
					FULL CONDUIT FLOW, ELEV = 5550.39 FT		
13	5550.39	223.05	125.67	97.38	7015.14	0.00	
14	5550.49	237.89	125.75	112.14	7036.88	0.00	
15	5550.60	255.98	125.81	130.16	7058.62	0.00	
16	5550.79	290.40	125.93	164.47	7097.77	0.00	
17	5551.02	332.53	126.08	206.45	7145.68	0.00	
18	5551.44	422.70	126.34	296.36	7232.64	0.00	
19	5551.97	551.57	126.67	424.90	7341.44	0.00	
20	5552.50	697.75	126.99	570.75	7450.25	0.00	

****

SUMMARY OF AUXILIARY SPILLWAY SURFACE CONDITIONS USED IN COMPUTATIONS BY REACH

REACH	FROM STA (ft)	TO STA (ft)	SLOPE (%)	RETARDANCE CURVE INDEX	VEGETAL COVER FACTOR	MAINT. CODE +	ROOTING DEPTH (ft)	REACH LOCATION *
1	0.	75.	-25.6	1.000	**	**	**	INLET
2	75.	155.	0.0	1.000	**	**	**	CREST
3	155.	237.	38.5	1.000	0.00	1		EXIT !
4	237.	600.	9.9	1.000	0.00	1		EXIT
5	600.	1049.	6.3	1.000	0.00	1		EXIT
6	1049.	1170.	15.1	1.000	0.00	1		EXIT

 + The minimum maintenance code value of 2 is used in INTEGRITY computations
     (the program changes values of 1 to 2 during computation).
 * Upper case indicates a reach of constructed spillway channel.
** The program does not use vegetal cover factor, maintenance code, and
     rooting depth for inlet and crest reaches in computations.
 ! Reach   3 used in computing exit channel velocities.
 ****

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-SDH	30.0	5548.67	6675.5	0.0	0.16	31.0

	PEAK - CFS	Q-PS	Q-AUX.	Q-TOT.
	DISCHARGE =	65.7	0.2	65.9

	CRITICAL DEPTH	CRITICAL VELOCITY	CRITICAL SLOPE-Sc	25% OF Q Sc
AUXILIARY SPILLWAY ---	FT 0.01	FT/SEC 0.57	FT/FT 0.148	FT/FT 0.308

AUXILIARY SPILLWAY DURATION FLOW = 8.7 HOURS

PLOT NRCS-SDH 1 IN = 500. CFS EXIT SLOPE = 0.385

Time	Qin	Qout	Elev	Vol	Area	ExtVel	0. 500. 1000. 1500. 2000. 2500. 3000. 3500.
1.50	0	8	5546.3	6203.0	0.0	0.00	.
1.80	6	8	5546.3	6203.0	0.0	0.00	.
2.10	39	8	5546.3	6203.4	0.0	0.00	.I
2.40	194	8	5546.3	6206.1	0.0	0.00	. I
2.70	687	9	5546.3	6216.8	0.0	0.00	. I
3.00	1365	11	5546.5	6242.0	0.0	0.00	. I
3.30	2027	15	5546.7	6283.7	0.0	0.00	. I
3.60	2180	20	5546.9	6335.4	0.0	0.00	. X
3.90	1955	26	5547.2	6386.1	0.0	0.00	.P I
4.20	1683	31	5547.4	6430.5	0.0	0.00	.P I
4.50	1441	36	5547.6	6468.4	0.0	0.00	.P I
4.80	1248	40	5547.8	6500.8	0.0	0.00	.P I
5.10	1107	44	5547.9	6528.9	0.0	0.00	.P I
5.40	1001	47	5548.1	6553.9	0.0	0.00	.P I
5.70	924	51	5548.2	6576.6	0.0	0.00	.P I
6.00	874	54	5548.3	6597.6	0.0	0.00	.P I
6.30	833	57	5548.4	6617.4	0.0	0.00	.P I
6.60	748	60	5548.5	6635.5	0.0	0.00	.P I
6.90	589	62	5548.5	6650.6	0.0	0.00	.A I
7.20	423	64	5548.6	6661.6	0.0	0.00	.A I
7.50	283	65	5548.6	6668.8	0.0	0.00	.A I
7.80	180	65	5548.7	6672.9	0.0	0.00	.A I
8.10	112	66	5548.7	6674.9	0.0	0.00	.AI

8.40	73	66	5548.7	6675.5	0.0	0.00	.X
8.70	47	66	5548.7	6675.4	0.0	0.00	.A
9.00	28	66	5548.7	6674.7	0.0	0.00	.A
9.30	16	66	5548.7	6673.6	0.0	0.00	.A
9.60	9	65	5548.7	6672.3	0.0	0.00	.A
9.90	5	65	5548.6	6670.8	0.0	0.00	.A
10.20	3	65	5548.6	6669.3	0.0	0.00	.A
10.50	1	65	5548.6	6667.8	0.0	0.00	.A
10.80	1	64	5548.6	6666.2	0.0	0.00	.A
11.10	0	64	5548.6	6664.6	0.0	0.00	.A
11.40	0	64	5548.6	6663.1	0.0	0.00	.A
11.70	0	64	5548.6	6661.5	0.0	0.00	.A
12.00	0	63	5548.6	6660.0	0.0	0.00	.A
12.30	0	63	5548.6	6658.4	0.0	0.00	.A
12.60	0	63	5548.6	6656.9	0.0	0.00	.A
12.90	0	63	5548.6	6655.4	0.0	0.00	.A
13.20	0	62	5548.6	6653.8	0.0	0.00	.A
13.50	0	62	5548.6	6652.3	0.0	0.00	.A
13.80	0	62	5548.5	6650.8	0.0	0.00	.A
14.10	0	62	5548.5	6649.3	0.0	0.00	.A
14.40	0	61	5548.5	6647.8	0.0	0.00	.A
14.70	0	61	5548.5	6646.3	0.0	0.00	.A
15.00	0	61	5548.5	6644.8	0.0	0.00	.A
15.30	0	61	5548.5	6643.3	0.0	0.00	.P
15.60	0	60	5548.5	6641.9	0.0	0.00	.P
15.90	0	60	5548.5	6640.4	0.0	0.00	.P
16.20	0	60	5548.5	6638.9	0.0	0.00	.P
16.50	0	60	5548.5	6637.5	0.0	0.00	.P
16.80	0	60	5548.5	6636.0	0.0	0.00	.P
17.10	0	59	5548.5	6634.5	0.0	0.00	.P
17.40	0	59	5548.5	6633.1	0.0	0.00	.P
17.70	0	59	5548.4	6631.7	0.0	0.00	.P
18.00	0	59	5548.4	6630.2	0.0	0.00	.P
18.30	0	58	5548.4	6628.8	0.0	0.00	.P
18.60	0	58	5548.4	6627.4	0.0	0.00	.P
18.90	0	58	5548.4	6626.0	0.0	0.00	.P
19.20	0	58	5548.4	6624.6	0.0	0.00	.P
19.50	0	58	5548.4	6623.1	0.0	0.00	.P
19.80	0	57	5548.4	6621.7	0.0	0.00	.P
20.10	0	57	5548.4	6620.3	0.0	0.00	.P
20.40	0	57	5548.4	6619.0	0.0	0.00	.P
20.70	0	57	5548.4	6617.6	0.0	0.00	.P
21.00	0	57	5548.4	6616.2	0.0	0.00	.P
21.30	0	56	5548.4	6614.8	0.0	0.00	.P
21.60	0	56	5548.4	6613.4	0.0	0.00	.P
21.90	0	56	5548.3	6612.1	0.0	0.00	.P
22.20	0	56	5548.3	6610.7	0.0	0.00	.P
22.50	0	56	5548.3	6609.4	0.0	0.00	.P
22.80	0	55	5548.3	6608.0	0.0	0.00	.P
23.10	0	55	5548.3	6606.7	0.0	0.00	.P
23.40	0	55	5548.3	6605.3	0.0	0.00	.P
23.70	0	55	5548.3	6604.0	0.0	0.00	.P
24.00	0	55	5548.3	6602.7	0.0	0.00	.P
24.30	0	54	5548.3	6601.3	0.0	0.00	.P
24.60	0	54	5548.3	6600.0	0.0	0.00	.P
24.90	0	54	5548.3	6598.7	0.0	0.00	.P
25.20	0	54	5548.3	6597.4	0.0	0.00	.P
25.50	0	54	5548.3	6596.1	0.0	0.00	.P
25.80	0	53	5548.3	6594.8	0.0	0.00	.P
26.10	0	53	5548.3	6593.5	0.0	0.00	.P
26.40	0	53	5548.2	6592.2	0.0	0.00	.P
26.70	0	53	5548.2	6590.9	0.0	0.00	.P
27.00	0	53	5548.2	6589.6	0.0	0.00	.P
27.30	0	52	5548.2	6588.4	0.0	0.00	.P
27.60	0	52	5548.2	6587.1	0.0	0.00	.P
27.90	0	52	5548.2	6585.8	0.0	0.00	.P
28.20	0	52	5548.2	6584.5	0.0	0.00	.P
28.50	0	52	5548.2	6583.3	0.0	0.00	.P
28.80	0	51	5548.2	6582.0	0.0	0.00	.P
29.10	0	51	5548.2	6580.8	0.0	0.00	.P
29.40	0	51	5548.2	6579.5	0.0	0.00	.P
29.70	0	51	5548.2	6578.3	0.0	0.00	.P
30.00	0	51	5548.2	6577.1	0.0	0.00	.P
30.30	0	51	5548.2	6575.8	0.0	0.00	.P
30.60	0	50	5548.2	6574.6	0.0	0.00	.P
30.90	0	50	5548.2	6573.4	0.0	0.00	.P
31.20	0	50	5548.1	6572.2	0.0	0.00	.P
31.50	0	50	5548.1	6571.0	0.0	0.00	.P
31.80	0	50	5548.1	6569.8	0.0	0.00	.P
32.10	0	50	5548.1	6568.5	0.0	0.00	.P
32.40	0	49	5548.1	6567.3	0.0	0.00	.P
32.70	0	49	5548.1	6566.1	0.0	0.00	.P
33.00	0	49	5548.1	6565.0	0.0	0.00	.P
33.30	0	49	5548.1	6563.8	0.0	0.00	.P
33.60	0	49	5548.1	6562.6	0.0	0.00	.P
33.90	0	49	5548.1	6561.4	0.0	0.00	.P
34.20	0	48	5548.1	6560.2	0.0	0.00	.P
34.50	0	48	5548.1	6559.1	0.0	0.00	.P
34.80	0	48	5548.1	6557.9	0.0	0.00	.P
35.10	0	48	5548.1	6556.7	0.0	0.00	.P
35.40	0	48	5548.1	6555.6	0.0	0.00	.P
35.70	0	48	5548.1	6554.4	0.0	0.00	.P

36.00	0	47	5548.0	6553.3	0.0	0.00	.P
36.30	0	47	5548.0	6552.1	0.0	0.00	.P
36.60	0	47	5548.0	6551.0	0.0	0.00	.P
36.90	0	47	5548.0	6549.8	0.0	0.00	.P
37.20	0	47	5548.0	6548.7	0.0	0.00	.P
37.50	0	47	5548.0	6547.6	0.0	0.00	.P
37.80	0	46	5548.0	6546.4	0.0	0.00	.P
38.10	0	46	5548.0	6545.3	0.0	0.00	.P
38.40	0	46	5548.0	6544.2	0.0	0.00	.P
38.70	0	46	5548.0	6543.1	0.0	0.00	.P
39.00	0	46	5548.0	6542.0	0.0	0.00	.P
39.30	0	46	5548.0	6540.9	0.0	0.00	.P
39.60	0	45	5548.0	6539.8	0.0	0.00	.P
39.90	0	45	5548.0	6538.7	0.0	0.00	.P
40.20	0	45	5548.0	6537.6	0.0	0.00	.P
40.50	0	45	5548.0	6536.5	0.0	0.00	.P
40.80	0	45	5548.0	6535.4	0.0	0.00	.P
41.10	0	45	5548.0	6534.3	0.0	0.00	.P
41.40	0	45	5547.9	6533.2	0.0	0.00	.P
41.70	0	44	5547.9	6532.1	0.0	0.00	.P
42.00	0	44	5547.9	6531.1	0.0	0.00	.P
42.30	0	44	5547.9	6530.0	0.0	0.00	.P
42.60	0	44	5547.9	6528.9	0.0	0.00	.P
42.90	0	44	5547.9	6527.9	0.0	0.00	.P
43.20	0	44	5547.9	6526.8	0.0	0.00	.P
43.50	0	43	5547.9	6525.7	0.0	0.00	.P
43.80	0	43	5547.9	6524.7	0.0	0.00	.P
44.10	0	43	5547.9	6523.6	0.0	0.00	.P
44.40	0	43	5547.9	6522.6	0.0	0.00	.P
44.70	0	43	5547.9	6521.6	0.0	0.00	.P
45.00	0	43	5547.9	6520.5	0.0	0.00	.P
45.30	0	43	5547.9	6519.5	0.0	0.00	.P
45.60	0	42	5547.9	6518.5	0.0	0.00	.P
45.90	0	42	5547.9	6517.4	0.0	0.00	.P
46.20	0	42	5547.9	6516.4	0.0	0.00	.P
46.50	0	42	5547.9	6515.4	0.0	0.00	.P
46.80	0	42	5547.8	6514.4	0.0	0.00	.P
47.10	0	42	5547.8	6513.4	0.0	0.00	.P
47.40	0	42	5547.8	6512.4	0.0	0.00	.P
47.70	0	41	5547.8	6511.4	0.0	0.00	.P
48.00	0	41	5547.8	6510.4	0.0	0.00	.P
48.30	0	41	5547.8	6509.4	0.0	0.00	.P
48.60	0	41	5547.8	6508.4	0.0	0.00	.P
48.90	0	41	5547.8	6507.4	0.0	0.00	.P
49.20	0	41	5547.8	6506.4	0.0	0.00	.P
49.50	0	41	5547.8	6505.4	0.0	0.00	.P
49.80	0	41	5547.8	6504.4	0.0	0.00	.P
50.10	0	40	5547.8	6503.4	0.0	0.00	.P
50.40	0	40	5547.8	6502.5	0.0	0.00	.P
50.70	0	40	5547.8	6501.5	0.0	0.00	.P
51.00	0	40	5547.8	6500.5	0.0	0.00	.P
51.30	0	40	5547.8	6499.6	0.0	0.00	.P
51.60	0	40	5547.8	6498.6	0.0	0.00	.P
51.90	0	40	5547.8	6497.6	0.0	0.00	.P
52.20	0	40	5547.8	6496.7	0.0	0.00	.P
52.50	0	39	5547.8	6495.7	0.0	0.00	.P
52.80	0	39	5547.7	6494.8	0.0	0.00	.P
53.10	0	39	5547.7	6493.8	0.0	0.00	.P
53.40	0	39	5547.7	6492.9	0.0	0.00	.P
53.70	0	39	5547.7	6491.9	0.0	0.00	.P
54.00	0	39	5547.7	6491.0	0.0	0.00	.P
54.30	0	39	5547.7	6490.1	0.0	0.00	.P
54.60	0	39	5547.7	6489.1	0.0	0.00	.P
54.90	0	38	5547.7	6488.2	0.0	0.00	.P
55.20	0	38	5547.7	6487.3	0.0	0.00	.P
55.50	0	38	5547.7	6486.4	0.0	0.00	.P
55.80	0	38	5547.7	6485.4	0.0	0.00	.P
56.10	0	38	5547.7	6484.5	0.0	0.00	.P
56.40	0	38	5547.7	6483.6	0.0	0.00	.P
56.70	0	38	5547.7	6482.7	0.0	0.00	.P
57.00	0	38	5547.7	6481.8	0.0	0.00	.P
57.30	0	37	5547.7	6480.9	0.0	0.00	.P
57.60	0	37	5547.7	6480.0	0.0	0.00	.P
57.90	0	37	5547.7	6479.1	0.0	0.00	.P
58.20	0	37	5547.7	6478.2	0.0	0.00	.P
58.50	0	37	5547.7	6477.3	0.0	0.00	.P
58.80	0	37	5547.7	6476.4	0.0	0.00	.P
59.10	0	37	5547.7	6475.5	0.0	0.00	.P
59.40	0	37	5547.6	6474.6	0.0	0.00	.P
59.70	0	37	5547.6	6473.7	0.0	0.00	.P
60.00	0	36	5547.6	6472.9	0.0	0.00	.P
60.30	0	36	5547.6	6472.0	0.0	0.00	.P
60.60	0	36	5547.6	6471.1	0.0	0.00	.P
60.90	0	36	5547.6	6470.2	0.0	0.00	.P
61.20	0	36	5547.6	6469.4	0.0	0.00	.P
61.50	0	36	5547.6	6468.5	0.0	0.00	.P
61.80	0	36	5547.6	6467.7	0.0	0.00	.P
62.10	0	36	5547.6	6466.8	0.0	0.00	.P
62.40	0	35	5547.6	6465.9	0.0	0.00	.P
62.70	0	35	5547.6	6465.1	0.0	0.00	.P
63.00	0	35	5547.6	6464.2	0.0	0.00	.P
63.30	0	35	5547.6	6463.4	0.0	0.00	.P

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63.60     0    35 5547.6  6462.5   0.0   0.00   .P
63.90     0    35 5547.6  6461.7   0.0   0.00   .P
64.20     0    35 5547.6  6460.9   0.0   0.00   .P
64.50     0    35 5547.6  6460.0   0.0   0.00   .P
64.80     0    35 5547.6  6459.2   0.0   0.00   .P
65.10     0    34 5547.6  6458.4   0.0   0.00   .P
65.40     0    34 5547.6  6457.5   0.0   0.00   .P
65.70     0    34 5547.6  6456.7   0.0   0.00   .P
66.00     0    34 5547.5  6455.9   0.0   0.00   .P
66.30     0    34 5547.5  6455.1   0.0   0.00   .P
66.60     0    34 5547.5  6454.2   0.0   0.00   .P
66.90     0    34 5547.5  6453.4   0.0   0.00   .P
67.20     0    34 5547.5  6452.6   0.0   0.00   .P
67.50     0    34 5547.5  6451.8   0.0   0.00   .P
67.80     0    34 5547.5  6451.0   0.0   0.00   .P
68.10     0    33 5547.5  6450.2   0.0   0.00   .P
68.40     0    33 5547.5  6449.4   0.0   0.00   .P
68.70     0    33 5547.5  6448.6   0.0   0.00   .P
69.00     0    33 5547.5  6447.8   0.0   0.00   .P
69.30     0    33 5547.5  6447.0   0.0   0.00   .P
69.60     0    33 5547.5  6446.2   0.0   0.00   .P
69.90     0    33 5547.5  6445.4   0.0   0.00   .P
70.20     0    33 5547.5  6444.6   0.0   0.00   .P
70.50     0    33 5547.5  6443.8   0.0   0.00   .P
70.80     0    33 5547.5  6443.1   0.0   0.00   .P
71.10     0    32 5547.5  6442.3   0.0   0.00   .P
71.40     0    32 5547.5  6441.5   0.0   0.00   .P
71.70     0    32 5547.5  6440.7   0.0   0.00   .P
72.00     0    32 5547.5  6439.9   0.0   0.00   .P
72.30     0    32 5547.5  6439.2   0.0   0.00   .P
72.60     0    32 5547.5  6438.4   0.0   0.00   .P
72.90     0    32 5547.5  6437.6   0.0   0.00   .P
73.20     0    32 5547.5  6436.9   0.0   0.00   .P
73.50     0    32 5547.4  6436.1   0.0   0.00   .P
73.80     0    32 5547.4  6435.4   0.0   0.00   .P
74.10     0    31 5547.4  6434.6   0.0   0.00   .P
74.40     0    31 5547.4  6433.8   0.0   0.00   .P
74.70     0    31 5547.4  6433.1   0.0   0.00   .P
75.00     0    31 5547.4  6432.3   0.0   0.00   .P
75.30     0    31 5547.4  6431.6   0.0   0.00   .P
75.60     0    31 5547.4  6430.8   0.0   0.00   .P
75.90     0    31 5547.4  6430.1   0.0   0.00   .P
76.20     0    31 5547.4  6429.4   0.0   0.00   .P
76.50     0    31 5547.4  6428.6   0.0   0.00   .P
76.80     0    31 5547.4  6427.9   0.0   0.00   .P
77.10     0    31 5547.4  6427.1   0.0   0.00   .P
77.40     0    31 5547.4  6426.4   0.0   0.00   .P
77.70     0    30 5547.4  6425.7   0.0   0.00   .P
78.00     0    30 5547.4  6425.0   0.0   0.00   .P
78.30     0    30 5547.4  6424.2   0.0   0.00   .P
78.60     0    30 5547.4  6423.5   0.0   0.00   .P
78.90     0    30 5547.4  6422.8   0.0   0.00   .P
79.20     0    30 5547.4  6422.1   0.0   0.00   .P
79.50     0    30 5547.4  6421.3   0.0   0.00   .P
79.80     0    30 5547.4  6420.6   0.0   0.00   .P
80.10     0    30 5547.4  6419.9   0.0   0.00   .P
80.40     0    30 5547.4  6419.2   0.0   0.00   .P
80.70     0    30 5547.4  6418.5   0.0   0.00   .P
81.00     0    29 5547.4  6417.8   0.0   0.00   .P
81.30     0    29 5547.4  6417.1   0.0   0.00   .P
81.60     0    29 5547.3  6416.4   0.0   0.00   .P
81.90     0    29 5547.3  6415.7   0.0   0.00   .P
82.20     0    29 5547.3  6415.0   0.0   0.00   .P
82.50     0    29 5547.3  6414.3   0.0   0.00   .P
82.80     0    29 5547.3  6413.6   0.0   0.00   .P
83.10     0    29 5547.3  6412.9   0.0   0.00   .P
83.40     0    29 5547.3  6412.2   0.0   0.00   .P
83.70     0    29 5547.3  6411.5   0.0   0.00   .P
84.00     0    29 5547.3  6410.8   0.0   0.00   .P
84.30     0    29 5547.3  6410.2   0.0   0.00   .P
84.60     0    28 5547.3  6409.5   0.0   0.00   .P
84.90     0    28 5547.3  6408.8   0.0   0.00   .P
85.20     0    28 5547.3  6408.1   0.0   0.00   .P
85.50     0    28 5547.3  6407.4   0.0   0.00   .P
85.80     0    28 5547.3  6406.8   0.0   0.00   .P
86.10     0    28 5547.3  6406.1   0.0   0.00   .P
86.40     0    28 5547.3  6405.4   0.0   0.00   .P
86.70     0    28 5547.3  6404.8   0.0   0.00   .P
87.00     0    28 5547.3  6404.1   0.0   0.00   .P
87.30     0    28 5547.3  6403.4   0.0   0.00   .P
87.60     0    28 5547.3  6402.8   0.0   0.00   .P
87.90     0    28 5547.3  6402.1   0.0   0.00   .P
88.20     0    27 5547.3  6401.4   0.0   0.00   .P
88.50     0    27 5547.3  6400.8   0.0   0.00   .P
88.80     0    27 5547.3  6400.1   0.0   0.00   .P
89.10     0    27 5547.3  6399.5   0.0   0.00   .P
89.40     0    27 5547.3  6398.8   0.0   0.00   .P
89.70     0    27 5547.3  6398.2   0.0   0.00   .P
90.00     0    27 5547.3  6397.5   0.0   0.00   .P
90.30     0    27 5547.2  6396.9   0.0   0.00   .P
90.60     0    27 5547.2  6396.3   0.0   0.00   .P
90.90     0    27 5547.2  6395.6   0.0   0.00   .P
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 91.20     0    27 5547.2  6395.0   0.0   0.00   .P
 91.50     0    27 5547.2  6394.3   0.0   0.00   .P
 91.80     0    27 5547.2  6393.7   0.0   0.00   .P
 92.10     0    26 5547.2  6393.1   0.0   0.00   .P
 92.40     0    26 5547.2  6392.4   0.0   0.00   .P
 92.70     0    26 5547.2  6391.8   0.0   0.00   .P
 93.00     0    26 5547.2  6391.2   0.0   0.00   .P
 93.30     0    26 5547.2  6390.6   0.0   0.00   .P
 93.60     0    26 5547.2  6389.9   0.0   0.00   .P
 93.90     0    26 5547.2  6389.3   0.0   0.00   .P
 94.20     0    26 5547.2  6388.7   0.0   0.00   .P
 94.50     0    26 5547.2  6388.1   0.0   0.00   .P
 94.80     0    26 5547.2  6387.5   0.0   0.00   .P
 95.10     0    26 5547.2  6386.9   0.0   0.00   .P
 95.40     0    26 5547.2  6386.2   0.0   0.00   .P
 95.70     0    26 5547.2  6385.6   0.0   0.00   .P
 96.00     0    26 5547.2  6385.0   0.0   0.00   .P
 96.30     0    25 5547.2  6384.4   0.0   0.00   .P
 96.60     0    25 5547.2  6383.8   0.0   0.00   .P
 96.90     0    25 5547.2  6383.2   0.0   0.00   .P
 97.20     0    25 5547.2  6382.6   0.0   0.00   .P
 Time    Qin  Qout   Elev    Vol   Area  ExtVel  I         I         I         I         I         I         I         I
                                                 0.      500.     1000.     1500.     2000.     2500.     3000.     3500.
        END NRCS-SDH   PLOT

ROUTED       BTM WIDTH  MAX ELEV   VOL-MAX  AREA-MAX   AUX.-HP   VOL-AUX.
RESULTS          FT        FT        ACFT      AC         FT       ACFT
NRCS-FBH          30.0   5552.32    7413.5       0.0      3.81     769.0

          PEAK - CFS        Q-PS     Q-AUX.    Q-TOT.
          DISCHARGE  =     126.9     521.5     648.3

                        CRITICAL  CRITICAL   CRITICAL  25% OF Q
                          DEPTH   VELOCITY   SLOPE-Sc     Sc
          AUXILIARY         FT      FT/SEC     FT/FT     FT/FT
          SPILLWAY ---     2.01      7.61     0.008     0.011

          INTEGRITY ANALYSIS - REACH SURFACE PERFORMANCE SUMMARY
           (The auxiliary spillway began flow at time =    9.6 hours
            and peaked at time =   20.4 hours.)


            REACH   3: FROM STATION    155. TO    237. ON   38.5% SLOPE.
               Non-vegetated conditions implied: flow concentration
                assumed with minimal flow: Time =   12.0 hours.


            REACH   4: FROM STATION    237. TO    600. ON    9.9% SLOPE.
               Non-vegetated conditions implied: flow concentration
                assumed with minimal flow: Time =   12.0 hours.


            REACH   5: FROM STATION    600. TO   1049. ON    6.3% SLOPE.
               Non-vegetated conditions implied: flow concentration
                assumed with minimal flow: Time =   12.0 hours.


            REACH   6: FROM STATION   1049. TO   1170. ON   15.1% SLOPE.
               Non-vegetated conditions implied: flow concentration
                assumed with minimal flow: Time =   12.0 hours.


          INTEGRITY ANALYSIS - HEADCUT EROSION DAMAGE SUMMARY

            The headcut BREACHED the spillway crest at
            time equal approximately    27.6 hours.
            Computations terminated at that point!

            The most upstream headcut began at station    237.
            and progressed upstream to station     75.
            The final height of the headcut was   36.2 ft.

            The deepest headcut is also the furthest upstream.

          THE HYDROGRAPH WAS NOT ADJUSTED FOR THE EFFECTS OF EROSION.

                          DURATION    ATTACK   DIST. FROM MOST U/S
                            FLOW       OE/B    HEADCUT TO U/S EDGE
          AUXILIARY          HRS     ACFT/FT     AUX. CREST, FT
          SPILLWAY----      74.4      27.8         >>>BREACH<<<
                                                Depth =   36.2 ft

          EXIT CHANNEL FLOW SUPERCRITICAL: MAX VELOCITY=  25.9 FT/SEC
                                           EXIT SLOPE  = 0.385 FT/FT
                                           FLOW DEPTH  =   0.6 FT

          PLOT NRCS-FBH                 1 IN =    500. CFS                                EXIT SLOPE = 0.385
                                                 0.      500.     1000.     1500.     2000.     2500.     3000.     3500.
 Time    Qin  Qout   Elev    Vol   Area  ExtVel  I         I         I         I         I         I         I         I
  2.40     0     8 5546.3  6203.0   0.0   0.00   .
  3.60     4     8 5546.3  6203.0   0.0   0.00   .
  4.80    35     8 5546.3  6204.0   0.0   0.00   .I
```

```
  6.00    84     8 5546.3  6209.1   0.0   0.00   . I
  7.20   195     9 5546.4  6222.1   0.0   0.00   .   I
  8.40   425    12 5546.5  6251.8   0.0   0.00   .        I
  9.60  1352    20 5546.9  6338.3   0.0   0.00   .                         I
 10.80  3365    50 5548.1  6568.7   0.0   0.00   .P                                                    X
 12.00  3296   128 5549.8  6890.2   0.0   7.93   .  A                                                  I
 13.20  2008   320 5551.0  7131.1   0.0  17.72   .     A                                  I
 14.40  1331   453 5551.6  7258.3   0.0  21.69   .        A               I
 15.60  1060   535 5551.9  7327.8   0.0  23.63   .          A         I
 16.80   912   590 5552.1  7369.8   0.0  24.78   .           A     I
 18.00   792   622 5552.2  7394.2   0.0  25.43   .           A   I
 19.20   742   641 5552.3  7407.7   0.0  25.78   .            A I
 20.40   664   648 5552.3  7413.5   0.0  25.92   .            X
 21.60   624   648 5552.3  7413.1   0.0  25.91   .           IA
 22.80   613   644 5552.3  7410.3   0.0  25.85   .           IA
 24.00   611   640 5552.3  7407.4   0.0  25.77   .           IA
 25.20   547   632 5552.3  7401.7   0.0  25.62   .          I A
 26.40   262   604 5552.2  7380.5   0.0  25.07   .    I      A
 27.60    90   551 5552.0  7340.7   0.0  23.96   . I       A
 28.80    24   496 5551.7  7294.4   0.0  22.73   .        A
 30.00     5   442 5551.5  7249.3   0.0  21.41   .       A
 31.20     1   397 5551.3  7208.0   0.0  20.18   .      A
 32.40     0   358 5551.1  7170.6   0.0  19.01   .     A
 33.60     0   325 5551.0  7136.9   0.0  17.90   .    A
 34.80     0   298 5550.8  7106.1   0.0  16.91   .    A
 36.00     0   273 5550.7  7077.9   0.0  15.92   .   A
 37.20     0   251 5550.6  7052.0   0.0  14.93   .   A
 38.40     0   232 5550.5  7028.2   0.0  14.02   .   A
 39.60     0   216 5550.3  7006.1   0.0  13.26   .  A
 40.80     0   200 5550.2  6985.5   0.0  12.56   .  A
 42.00     0   186 5550.2  6966.5   0.0  11.85   .  A
 43.20     0   172 5550.1  6948.8   0.0  11.12   .  A
 44.40     0   160 5550.0  6932.4   0.0  10.38   .  A
 45.60     0   148 5549.9  6917.2   0.0   9.61   .  A
 46.80     0   138 5549.8  6903.2   0.0   8.80   .  A
 48.00     0   128 5549.8  6890.1   0.0   7.92   .  A
 49.20     0   122 5549.7  6877.8   0.0   7.54   . A
 50.40     0   118 5549.6  6866.0   0.0   7.23   . A
 51.60     0   114 5549.6  6854.6   0.0   6.89   . A
 52.80     0   110 5549.5  6843.6   0.0   6.55   . A
 54.00     0   106 5549.5  6833.1   0.0   6.18   . A
 55.20     0   102 5549.4  6822.9   0.0   5.80   . A
 56.40     0    98 5549.4  6813.1   0.0   5.38   . A
 57.60     0    95 5549.3  6803.6   0.0   4.92   . A
 58.80     0    91 5549.3  6794.5   0.0   4.40   . A
 60.00     0    88 5549.2  6785.7   0.0   3.68   . A
 61.20     0    85 5549.2  6777.2   0.0   2.77   . A
 62.40     0    82 5549.2  6769.1   0.0   1.37   . A
 63.60     0    80 5549.1  6761.2   0.0   0.00   . A
 64.80     0    79 5549.1  6753.4   0.0   0.00   . A
 66.00     0    77 5549.0  6745.8   0.0   0.00   . A
 67.20     0    76 5549.0  6738.3   0.0   0.00   . A
 68.40     0    75 5549.0  6730.9   0.0   0.00   .A
 69.60     0    74 5548.9  6723.6   0.0   0.00   .A
 70.80     0    73 5548.9  6716.5   0.0   0.00   .A
 72.00     0    71 5548.8  6709.4   0.0   0.00   .A
 73.20     0    70 5548.8  6702.5   0.0   0.00   .A
 74.40     0    69 5548.8  6695.7   0.0   0.00   .A
 75.60     0    68 5548.7  6689.0   0.0   0.00   .A
 76.80     0    67 5548.7  6682.4   0.0   0.00   .A
 78.00     0    66 5548.7  6675.9   0.0   0.00   .A
 79.20     0    65 5548.6  6669.5   0.0   0.00   .A
 80.40     0    64 5548.6  6663.2   0.0   0.00   .A
 Time    Qin  Qout   Elev    Vol   Area  ExtVel  I         I         I         I         I         I         I         I
                                                 0.      500.     1000.     1500.     2000.     2500.     3000.     3500.
        END NRCS-FBH   PLOT
 ------------------------------------------------------------------------------

 Inflow Hyd 1 PSH-Peak =         39.99 CFS  at  143.00 hrs.,  Location Point

 Inflow Hyd 1 SDH-Peak =         65.90 CFS  at    8.10 hrs.,  Location Point

 Inflow Hyd 1 FBH-Peak =        648.34 CFS  at   19.20 hrs.,  Location Point
HYDOUT   1     STR1

1SITES....JOB NO.  1 COMPLETE.
 ------------------------------------------------------------------------------

 COVRES        COV RES

       0 SUBWATERSHED(S) ANALYZED.

       1 STRUCTURE(S) ANALYZED.

       3 HYDROGRAPHS ROUTED AT LOWEST SITE.

       0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

 ******************************************************************************
```

SITES.....COMPUTATIONS COMPLETE

SUMMARY TABLE 1 SITES VERSION 2005.1.8
DATED 01/01/2005

WATERSHED ID	RUN DATE	RUN TIME
COVRES	08/20/2020	06:12:11

>>> SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS <<<
STR1	CR	4.74	0.	0.00	4.74	TR60	C

PASS NO.	DIA./ WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD
1	30.0	5548.5	30.0	3.8	5552.3	0.<BREACH>		25.9	NRCS-FBH

* INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED HYDROGRAPH SHOWN UNDER TYPE HYD.

SITES.......SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.8 ,01/01/2005
COVRES FILES

INPUT = c:\USDA\SITES\080620-PSH-ASHL-FBHG.d2c
OUTPUT = c:\USDA\SITES\080620-PSH-ASHL-FBHG.OUT
DATED 08/20/2020 06:12:11

GRAPHICS FILES GENERATED

OPTION "L" = c:\USDA\SITES\080620-PSH-ASHL-FBHG.DRG DATED 08/20/2020 06:12:11

OPTION "P" = c:\USDA\SITES\080620-PSH-ASHL-FBHG.DHY DATED 08/20/2020 06:12:11

OPTION "E" = c:\USDA\SITES\080620-PSH-ASHL-FBHG.DEM DATED 08/20/2020 06:12:11

AUX.GRAPHICS = c:\USDA\SITES\080620-PSH-ASHL-FBHG.DG* DATED 08/20/2020 06:12:11

```
********************************************************************************
SITES XEQ 08/20/2020   WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
     VER 2005.1.8               (USER MANUAL - DATED DECEMBER 2005)
     TIME 06:12:11

************************ 80-80 LIST OF INPUT Data **************************

SITES     01/01/2005COVRES    COV RES                       4.74      C3
SAVMOV    0    101
SAVMOV    101  1                                                      1
STRUCTURE STR1      Cove Res
                    5470                                    0.18
                    5480                                    62.26
                    5490                                    303.40
                    5500                                    738.03
                    5510                                    1400.09
                    5520                                    2323.02
                    5530                                    3541.97
                    5540                                    5073.81
                    5545.5                                  6055.03
                    5550                                    6934.92
                    5552                                    7347.18
                    5552.5                                  7450.25
ENDTABLE
HYD       1                 Principal Spillway
                    1
                    0         11        14        15        15
                    15        15        15        15        15
                    15        16        16        16        16
                    16        16        16        16        16
                    16        17        17        17        17
                    17        17        17        17        17
                    17        18        18        18        18
                    18        18        18        18        19
                    19        19        19        19        19
                    20        20        20        20        20
                    20        21        21        21        21
                    21        21        22        22        22
                    22        23        23        23        23
                    24        24        24        24        25
                    25        25        26        26        26
                    27        27        27        28        28
                    29        29        29        30        30
                    31        31        32        33        33
                    34        35        35        36        37
                    38        39        40        41        42
                    43        45        46        48        49
                    51        53        56        58        61
                    65        69        74        80        87
                    96        109       127       157       219
                    850       479       259       172       132
                    111       98        88        81        75
                    70        65        62        59        56
                    54        51        50        48        46
                    45        43        42        41        40
                    39        38        37        36        35
                    35        34        33        33        32
                    32        31        30        30        29
                    29        29        28        28        27
                    27        27        26        26        26
                    25        25        25        24        24
                    24        24        23        23        23
                    23        22        22        22        22
                    22        21        21        21        21
                    21        20        20        20        20
                    20        20        19        19        19
                    19        19        19        19        18
                    18        18        18        18        18
                    18        17        17        17        17
                    17        17        17        17        17
                    17        16        16        16        16
                    16        16        16        16        16
                    16        15        15        15        15
                    15        15        15        15        15
                    15        4         1
ENDTABLE
HYD       3                 Auxiliary Spillway (Local)
                    0.3
                    0         0         0         0         0
                    6         39        194       687       1365
                    2027      2180      1955      1683      1441
                    1248      1107      1001      924       874
                    833       748       589       423       283
                    180       112       73        47        28
                    16        9         5         3         1
                    1         0
ENDTABLE
HYD       5                 Freeboard (Local)
                    0.3
                    0         0         0         8         43
                    129       306       824       2325      4867
                    6395      6123      5053      4063      3364
```

```
                    2855      2500      2228      2039      1913
                    1819      1614      1240      851       540
                    332       201       113       62        34
                    18        9         5         2         1
                    0
 ENDTABLE
 WSDATA    2C CR               4.74
 PDIRECT                                 9.40      16.00
 POOLDATA  ELEV                5545.5              5552      5435      SC
 PSINLET             1         3.75
 PSDATA    1         1000      30                  0.012     5450
 ASSPRFL   41
           0         5530      75        5549.2    155       5549.2
           237       5517.6    600       5481.7    1049      5453.3
           1170      5435
 ENDTABLE
 ASSURFACE 41        1170      1
           0         1170      1         0         1
 ENDTABLE
 ASDATA    41                            2                               1
 BTMWIDTH  FEET      30
 ASMATERIAL
           1         50        1         75        115       .2
 ENDTABLE
 ASCOORD    1        W.Shale   N
           0         5530      75        5550      125       5565
           200       5552      250       5520      600       5485
           1050      5460      1150      5435      1300      5432.4
 ENDTABLE
 GRAPHICS  I
 GO,DESIGN LCP       TYPE2     24
 SAVMOV    2    101  1                   STR1
 ENDJOB

 ********************************************************************************

 ***** MESSAGE - DEFAULT TOPSOIL FILL MATERIAL PARAMETERS USED.

 ***** MESSAGE - AUXILIARY SPILLWAY CREST ELEVATION IS SET TO  5549.20
                FROM THE ASSPRFL RECORDS.

 ***** MESSAGE - ASSURFACE REACH  1: ZERO ROOTING DEPTH IS DEFAULTED TO 0.5 FT.


1SITES ----------------------------------------------------------------------
 XEQ 08/20/2020                    COV RES                       WSID= COVRES
 VER 2005.1.8                        Cove Res                      SUBW= CR
 TIME 06:12:11            SITE = STR1              PASS=    1     PART=   1



 **********************    MATERIAL PROPERTIES    ***************************
                            DRY                  PERCENT       DETACH.      REP.
      MATERIAL       PI   DENSITY        Kh        CLAY         RATE      DIAMETER
                          lbs/CuFt                          (Ft/H)/(lb/SqFt)  inches
     W.Shale        50.      115.      0.20        75.0          --        1.00000
     TS_FILL         0.      100.      0.05         0.0          --        0.05000
     GEN_FILL       50.      115.      0.20        75.0          --        1.00000

 ***************************    BASIC Data    ********************************
 HUMID- SUBHUMID CLIMATE AREA                    DESIGN CLASS  C

 INFLOW HYDROGRAPH(S) ENTERED

 PRECIP. - Q-PS,1-DAY    Q-PS,10-DAY       P-SD          P-FB
               0.00          0.00          9.40         16.00

 WSDATA -       CN          DA-SM          TC/L           -/H          QRF
               0.00          4.74          0.00          0.00         0.00

 SITEDATA- PERM POOL     CREST PS        FP SED        VALLEY FL         378?
               0.00       5545.50          0.00        5435.00           NO

           BASEFLOW      INITIAL EL     EXTRA VOL      SITE TYPE
               0.00          0.00          0.00         DESIGN

 PSDATA -  NO. COND        COND L         DIA/W           -/H
               1.00       1000.00         30.00          0.00

              PS N            KE         WEIR L         TW EL
             0.012          1.00          3.75        5450.00

            2ND STG         ORF H          ORF L      START AUX.
               0.00          0.00          0.00          0.00

 ASCRESTS -   AUX.1         AUX.2         AUX.3         AUX.4         AUX.5
            5549.20          0.00          0.00          0.00         0.00

 AUX.Data -  REF.NO.    RETARD. Ci   TIE STATION    INLET LENGTH
                41          0.00        155.00             0

 AUX.Data - INLET Ci    SIDE SLOPE       EXIT Ci     EXIT SLOPE     ACTUAL AUX?
```

```
             1.000          2.00         1.000          0.385            NO

 BTM WIDTH -    BW1           BW2           BW3           BW4           BW5
   ft         30.00          0.00          0.00          0.00          0.00

 AUXILIARY SPILLWAY RATING DEVELOPED USING WSPVRT.

1*********************     DETAILED LIST OF BASIC Data     **********************
 WEIR COEF. FOR ORIFICES.......... 3.10    RATIO OF Ia TO S (CH.10,NEH4). 0.20
 WEIR COEF. FOR DROP INLET........ 3.10    TIME INCS TO PEAK OF UNIT HYD.  10.
 DISCHARGE COEF. FOR ORIFICES..... 0.60    NO. POINTS FOR DESIGN HYD. ... 5000

 HOOD, WEIR INLET COEF. .......... 0.60    DRAWDOWN TIME LIMIT - DAYS.... 10.0
 HOOD, PIPE ENTRANCE COEF. ....... 0.60    DRAWDOWN RATIO STORAGE LIMIT.. 0.15
 HOOD, SLUG FLOW COEF. ........... 0.00    OTHER DRAWDOWN RATIOS APPLY ?.   NO

 PS ACCURACY OF FULL FLOW CALC.,FT 0.01    WSP ALLOWABLE FSS VEL. CHANGE. 0.05
 FILLET SIZE FOR BOX CONDUITS..... 6.00    WSP FSS CALC. PRECISION, FT.. 0.005

 GRAVITATIONAL CONSTANT.......... 32.16    AUX. SPILLWAY MIN. CAP. COEF. 237.0
 MIN. NHCP378 PS PIPE AREA SQFT.. 0.545    AUX. SPILLWAY MIN. CAP. EXP.  0.493

 MIN. TR60 DEPTH AUX. TO TOP DAM.. 3.00    MIN. AUX. BW IN BW SOLUTION,FT 20.0
 MIN. NHCP378 DEPTH AUX.TO TOP DAM 2.00    PRECISION OF BW SOLUTION......  1.0
 MIN. NHCP378 DEPTH PS - AUX.CREST 1.00    OLD TR60 CRITERIA USED .......   NO
 MIN. NHCP378 DEPTH DESIGN Q - TOD 1.00    OLD NHCP378 CRITERIA USED ....   NO

 EMBANKMENT TEMPLATE:  TOP WIDTH = (calc.),  MAX. CROWN = 0.667 ft,
 SIDE SLOPE   WAVE BERM   MULTIPLE STABILITY BERMS    SEPARATE STABILITY BERMS
    RATIOS      WIDTH      U&D/S WIDTHS   DELTA H     WIDTHS, ft   HEIGHTS, ft
   U/S  D/S       ft             ft          ft       U/S   D/S    U/S   D/S
  2.50 2.50      10.0            0.0        0.00       0.00  0.00   0.00  0.00


 DIMENSIONLESS UNIT HYDROGRAPH
 STANDARD DIMENSIONLESS UNIT HYDROGRAPH
 PEAK FACTOR = 484.0 | TIME INC. =0.020 | NO. INC. TO PEAK =  10.
 VOLUME FACTOR =  48.3429

      0.0000     0.0300     0.1000     0.1900     0.3100
      0.4700     0.6600     0.8200     0.9300     0.9900
      1.0000     0.9900     0.9300     0.8600     0.7800
      0.6800     0.5600     0.4600     0.3900     0.3300
      0.2800     0.2410     0.2070     0.1740     0.1470
      0.1260     0.1070     0.0910     0.0770     0.0660
      0.0550     0.0470     0.0400     0.0340     0.0290
      0.0250     0.0210     0.0180     0.0150     0.0130
      0.0110     0.0090     0.0080     0.0070     0.0060
      0.0050     0.0040     0.0030     0.0020     0.0010
      0.0000

 EXISTING NATURAL SURFACE AT AUXILIARY SPILLWAY SITE - X,Y COORDINATES:

               0.     5530.00
              75.     5550.00
             125.     5565.00
             200.     5552.00
             250.     5520.00
             600.     5485.00
            1050.     5460.00
            1150.     5435.00


1NRCS DESIGN STORM RAINFALL DISTRIBUTION  (CHAPTER 21, NEH4 & TR-60).

       0.000      0.008      0.016      0.025      0.033
       0.043      0.052      0.063      0.074      0.086
       0.099      0.112      0.126      0.142      0.160
       0.180      0.205      0.255      0.345      0.437
       0.530      0.603      0.633      0.660      0.684
       0.705      0.724      0.742      0.759      0.775
       0.790      0.804      0.818      0.831      0.844
       0.856      0.868      0.879      0.890      0.900
       0.910      0.920      0.930      0.939      0.948
       0.957      0.966      0.975      0.983      0.992
       1.000


 24 HOUR TYPE II RAINFALL DISTRIBUTION
 IDENTIFICATION NAME IS TYPE2  GIVEN DURATION =  24.0 HRS

       0.000      0.001      0.002      0.003      0.004
       0.005      0.006      0.007      0.008      0.009
       0.010      0.012      0.013      0.014      0.015
       0.016      0.017      0.018      0.020      0.021
       0.022      0.023      0.024      0.026      0.027
       0.028      0.029      0.031      0.032      0.033
       0.034      0.036      0.037      0.038      0.040
       0.041      0.042      0.044      0.045      0.047
       0.048      0.049      0.051      0.052      0.054
       0.055      0.057      0.058      0.060      0.061
       0.063      0.065      0.066      0.068      0.070
```

```
       0.071      0.073      0.075      0.076      0.078
       0.080      0.082      0.084      0.085      0.087
       0.089      0.091      0.093      0.095      0.097
       0.099      0.101      0.103      0.105      0.107
       0.109      0.111      0.113      0.116      0.118
       0.120      0.122      0.125      0.127      0.130
       0.132      0.135      0.138      0.141      0.144
       0.147      0.150      0.153      0.157      0.160
       0.163      0.166      0.170      0.173      0.177
       0.181      0.185      0.189      0.194      0.199
       0.204      0.209      0.215      0.221      0.228
       0.235      0.243      0.251      0.261      0.271
       0.283      0.307      0.354      0.431      0.568
       0.663      0.682      0.699      0.713      0.725
       0.735      0.743      0.751      0.759      0.766
       0.772      0.778      0.784      0.789      0.794
       0.799      0.804      0.808      0.812      0.816
       0.820      0.824      0.827      0.831      0.834
       0.838      0.841      0.844      0.847      0.850
       0.854      0.856      0.859      0.862      0.865
       0.868      0.870      0.873      0.875      0.878
       0.880      0.882      0.885      0.887      0.889
       0.891      0.893      0.895      0.898      0.900
       0.902      0.904      0.906      0.908      0.910
       0.912      0.914      0.915      0.917      0.919
       0.921      0.923      0.925      0.926      0.928
       0.930      0.931      0.933      0.935      0.936
       0.938      0.939      0.941      0.942      0.944
       0.945      0.947      0.948      0.949      0.951
       0.952      0.953      0.955      0.956      0.957
       0.958      0.960      0.961      0.962      0.964
       0.965      0.966      0.967      0.968      0.970
       0.971      0.972      0.973      0.975      0.976
       0.977      0.978      0.979      0.981      0.982
       0.983      0.984      0.985      0.986      0.988
       0.989      0.990      0.991      0.992      0.993
       0.994      0.996      0.997      0.998      0.999
       1.000


1SITES ------------------------------------------------------------------------
 XEQ 08/20/2020                    COV RES                       WSID= COVRES
 VER 2005.1.8                        Cove Res                      SUBW= CR
 TIME 06:12:11           SITE = STR1             PASS=    1     PART=   2

MESSAGE ---- Climatic Index changed from 0.0 to 1.0 for this run.

 CREST PS       5545.50 FT    6055.0 ACFT      0.00 AC     126.3 CFS

 SED ACCUM      5545.50 FT    6055.0 ACFT      0.00 AC     126.3 CFS

 START ELEV     5545.50 FT    6055.0 ACFT      0.00 AC       0.0 CFS

 INFLOW HYDROGRAPH PROVIDED IN LOCATION  1,  PEAK=    850.00 CFS, AT 120.00 HRS.
 TITLE = Principal Spillway


 CREST PS       5545.50 FT    6055.0 ACFT      0.00 AC     126.3 CFS

 SED ACCUM      5545.50 FT    6055.0 ACFT      0.00 AC     126.3 CFS

 START ELEV     5545.50 FT    6055.0 ACFT      0.00 AC       0.0 CFS


 NRCS-PSH  RAINFALL   1-DAY =   0.00 IN    10-DAY =   0.00 IN    DA =   4.74 SM
           RUNOFF     1-DAY =   0.00 IN    10-DAY =   0.00 IN

      CLIMATIC INDEX = 1.00    CN 10-DAY =  0.    CN 1-DAY =   0.

      PEAK =       850.0 CFS, AT  120.0 HRS.


 ROUTED RESULT - HYD TYPE      EMAX         VOL-MAX        AMAX         QMAX
                 NRCS-PSH   5547.76 FT    6496.1 ACFT      0.00 AC     40.0 CFS

      PS STORAGE     441.0 ACFT,  BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

 DRAWDOWN (DDT) TEST       5545.84 FT    6121.2 ACFT      4.35 CFS
      CONTROL IS 0.150 DETENTION STORAGE

      TIME LIMIT REACHED = 10.00 DAYS. FLOW WAS     9.73 CFS,  ELEV =  5546.26
      (ELEVATION TO START ROUTING SDH AND/OR FBH HAS BEEN RAISED.)

      TIME TO DDT TEST DISCHARGE IS 15.79 DAYS - DRAWDOWN STOPPED.

 ***** NOTE - CREST OF AUX. RAISED TO HOLD   148.03 ACFT NOT EVACUATED IN
             DRAWDOWN TIME LIMIT.  TOTAL STORAGE REQUIRED =  6644.08 ACFT,
             NEW ELEVATION OF AUXILIARY SPILLWAY CREST    =  5548.51 FT.

 PLOT OF PRINCIPAL SPILLWAY HYDROGRAPH,  1 INCH=     200. CFS
                                                  0.      200.      400.      600.      800.     1000.     1200.     1400.
  Time    Qin  Qout   Elev    Vol   Area  ExtVel  I         I         I         I         I         I         I         I
```

0.00	0.0	0.0	5545.5	6055.5	0.0	.
1.00	11.0	0.0	5545.5	6055.5	0.0	.I
2.00	14.0	0.1	5545.5	6056.5	0.0	.I
3.00	15.0	0.2	5545.5	6057.7	0.0	.I
4.00	15.0	0.3	5545.5	6058.9	0.0	.I
5.00	15.0	0.3	5545.5	6060.1	0.0	.I
6.00	15.0	0.4	5545.5	6061.3	0.0	.I
7.00	15.0	0.5	5545.5	6062.5	0.0	.I
8.00	15.0	0.6	5545.5	6063.7	0.0	.I
9.00	15.0	0.7	5545.6	6064.9	0.0	.I
10.00	15.0	0.7	5545.6	6066.1	0.0	.I
11.00	16.0	0.8	5545.6	6067.3	0.0	.I
12.00	16.0	0.9	5545.6	6068.6	0.0	.I
13.00	16.0	1.0	5545.6	6069.8	0.0	.I
14.00	16.0	1.1	5545.6	6071.1	0.0	.I
15.00	16.0	1.1	5545.6	6072.3	0.0	.I
16.00	16.0	1.2	5545.6	6073.5	0.0	.I
17.00	16.0	1.3	5545.6	6074.7	0.0	.I
18.00	16.0	1.4	5545.6	6076.0	0.0	.I
19.00	16.0	1.5	5545.6	6077.2	0.0	.I
20.00	16.0	1.5	5545.6	6078.4	0.0	.I
21.00	17.0	1.6	5545.6	6079.6	0.0	.I
22.00	17.0	1.7	5545.6	6080.9	0.0	.I
23.00	17.0	1.8	5545.6	6082.1	0.0	.I
24.00	17.0	1.9	5545.6	6083.4	0.0	.I
25.00	17.0	1.9	5545.7	6084.6	0.0	.I
26.00	17.0	2.0	5545.7	6085.9	0.0	.I
27.00	17.0	2.1	5545.7	6087.1	0.0	.I
28.00	17.0	2.2	5545.7	6088.3	0.0	.I
29.00	17.0	2.3	5545.7	6089.5	0.0	.I
30.00	17.0	2.3	5545.7	6090.8	0.0	.I
31.00	18.0	2.4	5545.7	6092.0	0.0	.I
32.00	18.0	2.5	5545.7	6093.3	0.0	.I
33.00	18.0	2.6	5545.7	6094.6	0.0	.I
34.00	18.0	2.7	5545.7	6095.8	0.0	.I
35.00	18.0	2.8	5545.7	6097.1	0.0	.I
36.00	18.0	2.8	5545.7	6098.4	0.0	.I
37.00	18.0	2.9	5545.7	6099.6	0.0	.I
38.00	18.0	3.0	5545.7	6100.8	0.0	.I
39.00	19.0	3.1	5545.7	6102.1	0.0	.I
40.00	19.0	3.2	5545.7	6103.4	0.0	.I
41.00	19.0	3.3	5545.8	6104.7	0.0	.I
42.00	19.0	3.4	5545.8	6106.0	0.0	.I
43.00	19.0	3.4	5545.8	6107.3	0.0	.I
44.00	19.0	3.5	5545.8	6108.6	0.0	.I
45.00	20.0	3.6	5545.8	6109.9	0.0	.I
46.00	20.0	3.7	5545.8	6111.3	0.0	.I
47.00	20.0	3.8	5545.8	6112.6	0.0	.I
48.00	20.0	3.9	5545.8	6114.0	0.0	.I
49.00	20.0	4.0	5545.8	6115.3	0.0	.I
50.00	20.0	4.0	5545.8	6116.6	0.0	.I
51.00	21.0	4.1	5545.8	6118.0	0.0	.I
52.00	21.0	4.2	5545.8	6119.4	0.0	.I
53.00	21.0	4.3	5545.8	6120.7	0.0	.I
54.00	21.0	4.4	5545.8	6122.1	0.0	.I
55.00	21.0	4.5	5545.9	6123.5	0.0	.I
56.00	21.0	4.6	5545.9	6124.8	0.0	.I
57.00	22.0	4.7	5545.9	6126.2	0.0	.I
58.00	22.0	4.8	5545.9	6127.7	0.0	.I
59.00	22.0	4.9	5545.9	6129.1	0.0	.I
60.00	22.0	5.0	5545.9	6130.5	0.0	.I
61.00	23.0	5.1	5545.9	6131.9	0.0	.I
62.00	23.0	5.2	5545.9	6133.4	0.0	.I
63.00	23.0	5.2	5545.9	6134.9	0.0	.I
64.00	23.0	5.3	5545.9	6136.4	0.0	.I
65.00	24.0	5.4	5545.9	6137.8	0.0	.I
66.00	24.0	5.5	5545.9	6139.4	0.0	.I
67.00	24.0	5.6	5545.9	6140.9	0.0	.I
68.00	24.0	5.7	5545.9	6142.4	0.0	.I
69.00	25.0	5.8	5546.0	6144.0	0.0	.I
70.00	25.0	5.9	5546.0	6145.5	0.0	.I
71.00	25.0	6.1	5546.0	6147.1	0.0	.I
72.00	26.0	6.2	5546.0	6148.7	0.0	.I
73.00	26.0	6.3	5546.0	6150.3	0.0	.I
74.00	26.0	6.4	5546.0	6152.0	0.0	.I
75.00	27.0	6.5	5546.0	6153.6	0.0	.I
76.00	27.0	6.6	5546.0	6155.3	0.0	.I
77.00	27.0	6.7	5546.0	6157.0	0.0	.I
78.00	28.0	6.8	5546.0	6158.7	0.0	.I
79.00	28.0	6.9	5546.0	6160.5	0.0	.I
80.00	29.0	7.0	5546.0	6162.2	0.0	.I
81.00	29.0	7.2	5546.1	6164.1	0.0	.I
82.00	29.0	7.3	5546.1	6165.9	0.0	.I
83.00	30.0	7.4	5546.1	6167.7	0.0	. I
84.00	30.0	7.5	5546.1	6169.5	0.0	. I
85.00	31.0	7.7	5546.1	6171.4	0.0	. I
86.00	31.0	7.8	5546.1	6173.4	0.0	. I
87.00	32.0	7.9	5546.1	6175.3	0.0	. I
88.00	33.0	8.0	5546.1	6177.3	0.0	. I
89.00	33.0	8.2	5546.1	6179.4	0.0	. I
90.00	34.0	8.3	5546.1	6181.5	0.0	. I
91.00	35.0	8.5	5546.2	6183.6	0.0	. I

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 92.00  35.0   8.6 5546.2  6185.8   0.0         . I
 93.00  36.0   8.7 5546.2  6188.1   0.0         . I
 94.00  37.0   8.9 5546.2  6190.3   0.0         . I
 95.00  38.0   9.0 5546.2  6192.7   0.0         . I
 96.00  39.0   9.2 5546.2  6195.1   0.0         . I
 97.00  40.0   9.4 5546.2  6197.6   0.0         . I
 98.00  41.0   9.5 5546.2  6200.2   0.0         . I
 99.00  42.0   9.7 5546.3  6202.8   0.0         . I
100.00  43.0   9.9 5546.3  6205.5   0.0         . I
101.00  45.0  10.1 5546.3  6208.3   0.0         .PI
102.00  46.0  10.3 5546.3  6211.3   0.0         .PI
103.00  48.0  10.5 5546.3  6214.3   0.0         .PI
104.00  49.0  10.7 5546.3  6217.4   0.0         .PI
105.00  51.0  10.9 5546.3  6220.7   0.0         .P I
106.00  53.0  11.1 5546.4  6224.0   0.0         .P I
107.00  56.0  11.3 5546.4  6227.6   0.0         .P I
108.00  58.0  11.6 5546.4  6231.4   0.0         .P I
109.00  61.0  11.9 5546.4  6235.3   0.0         .P I
110.00  65.0  12.1 5546.4  6239.5   0.0         .P I
111.00  69.0  12.4 5546.5  6244.1   0.0         .P I
112.00  74.0  12.7 5546.5  6248.9   0.0         .P  I
113.00  80.0  13.1 5546.5  6254.2   0.0         .P  I
114.00  87.0  13.5 5546.5  6260.0   0.0         .P  I
115.00  96.0  13.9 5546.6  6266.5   0.0         .P   I
116.00 109.0  14.4 5546.6  6273.8   0.0         .P   I
117.00 127.0  14.9 5546.7  6282.3   0.0         .P    I
118.00 157.0  15.6 5546.7  6292.8   0.0         .P      I
119.00 219.0  17.3 5546.8  6307.0   0.0         .P        I
120.00 850.0  22.4 5547.0  6349.5   0.0         .P                                      X
121.00 479.0  28.7 5547.3  6402.3   0.0         .P                    I
122.00 259.0  32.1 5547.4  6430.3   0.0         . P         I
123.00 172.0  33.9 5547.5  6445.4   0.0         . P      I
124.00 132.0  35.1 5547.5  6455.1   0.0         . P    I
125.00 111.0  35.9 5547.6  6462.2   0.0         . P   I
126.00  98.0  36.6 5547.6  6467.8   0.0         . P  I
127.00  88.0  37.2 5547.6  6472.5   0.0         . P I
128.00  81.0  37.6 5547.7  6476.4   0.0         . P I
129.00  75.0  38.0 5547.7  6479.7   0.0         . P I
130.00  70.0  38.4 5547.7  6482.5   0.0         . P I
131.00  65.0  38.7 5547.7  6484.9   0.0         . PI
132.00  62.0  38.9 5547.7  6487.0   0.0         . PI
133.00  59.0  39.1 5547.7  6488.7   0.0         . PI
134.00  56.0  39.3 5547.7  6490.2   0.0         . PI
135.00  54.0  39.4 5547.7  6491.5   0.0         . PI
136.00  51.0  39.6 5547.7  6492.6   0.0         . PI
137.00  50.0  39.7 5547.7  6493.5   0.0         . PI
138.00  48.0  39.8 5547.7  6494.3   0.0         . P
139.00  46.0  39.8 5547.7  6494.9   0.0         . P
140.00  45.0  39.9 5547.8  6495.3   0.0         . P
141.00  43.0  39.9 5547.8  6495.7   0.0         . P
142.00  42.0  40.0 5547.8  6495.9   0.0         . P
143.00  41.0  40.0 5547.8  6496.0   0.0         . P
144.00  40.0  40.0 5547.8  6496.1   0.0         . X
145.00  39.0  40.0 5547.8  6496.0   0.0         . P
146.00  38.0  40.0 5547.8  6495.9   0.0         . P
147.00  37.0  39.9 5547.8  6495.7   0.0         . P
148.00  36.0  39.9 5547.8  6495.4   0.0         . P
149.00  35.0  39.9 5547.8  6495.0   0.0         . P
150.00  35.0  39.8 5547.7  6494.6   0.0         . P
151.00  34.0  39.8 5547.7  6494.2   0.0         . P
152.00  33.0  39.7 5547.7  6493.7   0.0         . P
153.00  33.0  39.6 5547.7  6493.1   0.0         . P
154.00  32.0  39.6 5547.7  6492.6   0.0         . P
155.00  32.0  39.5 5547.7  6491.9   0.0         . P
156.00  31.0  39.4 5547.7  6491.3   0.0         . P
157.00  30.0  39.3 5547.7  6490.5   0.0         . P
158.00  30.0  39.2 5547.7  6489.8   0.0         . P
159.00  29.0  39.1 5547.7  6489.0   0.0         .IP
160.00  29.0  39.0 5547.7  6488.1   0.0         .IP
161.00  29.0  38.9 5547.7  6487.3   0.0         .IP
162.00  28.0  38.8 5547.7  6486.5   0.0         .IP
163.00  28.0  38.7 5547.7  6485.6   0.0         .IP
164.00  27.0  38.6 5547.7  6484.6   0.0         .IP
165.00  27.0  38.5 5547.7  6483.7   0.0         .IP
166.00  27.0  38.4 5547.7  6482.7   0.0         .IP
167.00  26.0  38.3 5547.7  6481.8   0.0         .IP
168.00  26.0  38.1 5547.7  6480.8   0.0         .IP
169.00  26.0  38.0 5547.7  6479.8   0.0         .IP
170.00  25.0  37.9 5547.7  6478.7   0.0         .IP
171.00  25.0  37.8 5547.7  6477.7   0.0         .IP
172.00  25.0  37.7 5547.7  6476.6   0.0         .IP
173.00  24.0  37.5 5547.7  6475.5   0.0         .IP
174.00  24.0  37.4 5547.6  6474.4   0.0         .IP
175.00  24.0  37.3 5547.6  6473.3   0.0         .IP
176.00  24.0  37.1 5547.6  6472.2   0.0         .IP
177.00  23.0  37.0 5547.6  6471.1   0.0         .IP
178.00  23.0  36.9 5547.6  6470.0   0.0         .IP
179.00  23.0  36.7 5547.6  6468.8   0.0         .IP
180.00  23.0  36.6 5547.6  6467.7   0.0         .IP
181.00  22.0  36.4 5547.6  6466.5   0.0         .IP
182.00  22.0  36.3 5547.6  6465.3   0.0         .IP
183.00  22.0  36.2 5547.6  6464.2   0.0         .IP
```

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184.00  22.0  36.0 5547.6  6463.0   0.0          .IP
185.00  22.0  35.9 5547.6  6461.8   0.0          .IP
186.00  21.0  35.7 5547.6  6460.7   0.0          .IP
187.00  21.0  35.6 5547.6  6459.5   0.0          .IP
188.00  21.0  35.4 5547.6  6458.3   0.0          .IP
189.00  21.0  35.3 5547.6  6457.1   0.0          .IP
190.00  21.0  35.2 5547.6  6455.9   0.0          .IP
191.00  20.0  35.0 5547.5  6454.7   0.0          .IP
192.00  20.0  34.9 5547.5  6453.4   0.0          .IP
193.00  20.0  34.7 5547.5  6452.2   0.0          .IP
194.00  20.0  34.6 5547.5  6451.0   0.0          .IP
195.00  20.0  34.4 5547.5  6449.8   0.0          .IP
196.00  20.0  34.3 5547.5  6448.6   0.0          .IP
197.00  19.0  34.1 5547.5  6447.4   0.0          .IP
198.00  19.0  34.0 5547.5  6446.2   0.0          .IP
199.00  19.0  33.8 5547.5  6444.9   0.0          .IP
200.00  19.0  33.7 5547.5  6443.7   0.0          .IP
201.00  19.0  33.6 5547.5  6442.5   0.0          .IP
202.00  19.0  33.4 5547.5  6441.3   0.0          .IP
203.00  19.0  33.3 5547.5  6440.1   0.0          .IP
204.00  18.0  33.1 5547.5  6438.9   0.0          .IP
205.00  18.0  33.0 5547.5  6437.7   0.0          .IP
206.00  18.0  32.8 5547.5  6436.4   0.0          .IP
207.00  18.0  32.7 5547.4  6435.2   0.0          .IP
208.00  18.0  32.5 5547.4  6434.0   0.0          .IP
209.00  18.0  32.4 5547.4  6432.8   0.0          .IP
210.00  18.0  32.2 5547.4  6431.6   0.0          .IP
211.00  17.0  32.1 5547.4  6430.4   0.0          .IP
212.00  17.0  32.0 5547.4  6429.2   0.0          .IP
213.00  17.0  31.8 5547.4  6427.9   0.0          .IP
214.00  17.0  31.7 5547.4  6426.7   0.0          .IP
215.00  17.0  31.5 5547.4  6425.5   0.0          .IP
216.00  17.0  31.4 5547.4  6424.3   0.0          .IP
217.00  17.0  31.2 5547.4  6423.1   0.0          .IP
218.00  17.0  31.1 5547.4  6422.0   0.0          .IP
219.00  17.0  30.9 5547.4  6420.8   0.0          .IP
220.00  17.0  30.8 5547.4  6419.7   0.0          .IP
221.00  16.0  30.7 5547.4  6418.5   0.0          .IP
222.00  16.0  30.5 5547.4  6417.3   0.0          .IP
223.00  16.0  30.4 5547.3  6416.1   0.0          .IP
224.00  16.0  30.2 5547.3  6414.9   0.0          .IP
225.00  16.0  30.1 5547.3  6413.7   0.0          .IP
226.00  16.0  30.0 5547.3  6412.6   0.0          .P
227.00  16.0  29.8 5547.3  6411.4   0.0          .P
228.00  16.0  29.7 5547.3  6410.3   0.0          .P
229.00  16.0  29.5 5547.3  6409.2   0.0          .P
230.00  16.0  29.4 5547.3  6408.1   0.0          .P
231.00  15.0  29.3 5547.3  6406.9   0.0          .P
232.00  15.0  29.1 5547.3  6405.7   0.0          .P
233.00  15.0  29.0 5547.3  6404.6   0.0          .P
234.00  15.0  28.9 5547.3  6403.4   0.0          .P
235.00  15.0  28.7 5547.3  6402.3   0.0          .P
236.00  15.0  28.6 5547.3  6401.2   0.0          .P
237.00  15.0  28.5 5547.3  6400.0   0.0          .P
238.00  15.0  28.3 5547.3  6398.9   0.0          .P
239.00  15.0  28.2 5547.3  6397.8   0.0          .P
 Time    Qin  Qout   Elev    Vol   Area  ExtVel  I         I         I         I         I         I         I         I
                                                 0.      200.      400.      600.      800.     1000.     1200.     1400.
       END NRCS-PSH   PLOT


*********************************************************************************
RATING TABLE DEVELOPED, SITE = STR1 :
 BY PROGRAM FOR PS AND AUX. SPILLWAYS
 AUX. RATING USED WSPVRT METHOD.


RATING TABLE NUMBER  1
       ELEV.    Q-TOTAL    Q-PS     Q-AUX.    VOLUME     AREA
       FEET       CFS       CFS       CFS      AC-FT     ACRE
  1  5545.50      0.00      0.00      0.00   6055.03      0.00
  2  5546.72     15.71     15.71      0.00   6294.00      0.00
  3  5547.94     44.43     44.43      0.00   6532.97      0.00
  4  5549.17     81.62     81.62      0.00   6771.95      0.00
                                         FULL CONDUIT FLOW, ELEV = 5550.39 FT
  5  5550.39    125.65    125.65      0.00   7015.04      0.00
  6  5550.65    125.84    125.84      0.00   7069.39      0.00
  7  5550.92    126.01    126.01      0.00   7123.74      0.00
  8  5551.18    126.17    126.17      0.00   7178.09      0.00
  9  5551.44    126.34    126.34      0.00   7232.44      0.00
 10  5551.71    126.50    126.50      0.00   7286.79      0.00
 11  5551.97    126.67    126.67      0.00   7341.14      0.00
 12  5552.23    126.83    126.83      0.00   7395.49      0.00
 13  5552.50    126.99    126.99      0.00   7449.85      0.00

INFLOW HYDROGRAPH PROVIDED IN LOCATION  3,  PEAK=   2180.00 CFS, AT   3.30 HRS.
TITLE = Auxiliary Spillway (Local)


INFLOW HYDROGRAPH PROVIDED IN LOCATION  5,  PEAK=   6395.00 CFS, AT   3.00 HRS.
TITLE = Freeboard (Local)
```

```
1SITES ------------------------------------------------------------------------
 XEQ 08/20/2020                    COV RES                        WSID= COVRES
 VER 2005.1.8                        Cove Res                       SUBW= CR
 TIME 06:12:11            SITE = STR1              PASS=    1     PART=   3


 AUX. CREST     5548.51 FT    6644.1 ACFT      0.00 AC      61.7 CFS

      PS STORAGE    589.1 ACFT,  BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

 START ELEV     5546.26 FT    6203.0 ACFT      0.00 AC       9.7 CFS

 ***** WARNING - AUXILIARY CREST LOWER THAN LOW POINT IN SITE.

 NRCS-SDH   INFLOW HYDROGRAPH INPUT, DA =    4.74 SQUARE MILES

      PEAK =      2180.0 CFS, AT    3.3 HRS.

 NRCS-FBH   INFLOW HYDROGRAPH INPUT, DA =    4.74 SQUARE MILES

      PEAK =      6395.0 CFS, AT    3.0 HRS.

 ***** WARNING - MAXIMUM AUX. SURFACE PROFILE ELEVATION ( 5549.20) AND AUXILIARY
                 CREST ( 5548.51) ELEVATION Do NOT MATCH.  MAXIMUM AUX. SURFACE
                 PROFILE ELEVATION USED IN WSPVRT PROCEDURE.


 ***** MESSAGE - INPUT(5549.14) TO INTERPOLATION ROUTINE IS BELOW
                 ARRAY LIMIT(5549.20).


 ****************************************************************************
 RATING TABLE DEVELOPED, SITE = STR1 :
  BY PROGRAM FOR PS AND AUX. SPILLWAYS
  AUX. RATING USED WSPVRT METHOD.


 RATING TABLE NUMBER  2
        ELEV.    Q-TOTAL    Q-PS     Q-AUX.    VOLUME     AREA
        FEET       CFS       CFS       CFS      AC-FT     ACRE
   1  5545.50      0.00      0.00      0.00   6055.03      0.00
   2  5545.83      2.25      2.25      0.00   6120.52      0.00
   3  5546.17      6.37      6.37      0.00   6186.02      0.00
   4  5546.50     11.71     11.71      0.00   6251.52      0.00
   5  5546.84     18.03     18.03      0.00   6317.01      0.00
   6  5547.17     25.20     25.20      0.00   6382.51      0.00
   7  5547.51     33.12     33.12      0.00   6448.00      0.00
   8  5547.84     41.74     41.74      0.00   6513.50      0.00
   9  5548.18     50.99     50.99      0.00   6578.99      0.00
  10  5548.51     60.85     60.85      0.00   6644.49      0.00
  11  5549.14     80.67     80.67      0.00   6766.41      0.00
  12  5549.76    126.50    102.35     24.15   6888.71      0.00
                                           FULL CONDUIT FLOW, ELEV = 5550.39 FT
  13  5550.39    223.05    125.67     97.38   7015.14      0.00
  14  5550.49    237.89    125.75    112.14   7036.88      0.00
  15  5550.60    255.98    125.81    130.16   7058.62      0.00
  16  5550.79    290.40    125.93    164.47   7097.77      0.00
  17  5551.02    332.53    126.08    206.45   7145.68      0.00
  18  5551.44    422.70    126.34    296.36   7232.64      0.00
  19  5551.97    551.57    126.67    424.90   7341.44      0.00
  20  5552.50    697.75    126.99    570.75   7450.25      0.00
  ****************************************************************************

 SUMMARY OF AUXILIARY SPILLWAY SURFACE CONDITIONS USED IN COMPUTATIONS BY REACH

 REACH  FROM     TO   SLOPE  RETARDANCE  VEGETAL  MAINT. ROOTING  REACH
        STA     STA           CURVE      COVER    CODE   DEPTH  LOCATION
        (ft)    (ft)   (%)    INDEX      FACTOR     +    (ft)     *
 -----  ----    ----  ------ ----------  -------  -----  ------- --------
   1      0.     75.  -25.6     1.000       **       **     **    INLET
   2     75.    155.    0.0     1.000       **       **     **    CREST
   3    155.    237.   38.5     1.000     0.00       1            EXIT !
   4    237.    600.    9.9     1.000     0.00       1            EXIT
   5    600.   1049.    6.3     1.000     0.00       1            EXIT
   6   1049.   1170.   15.1     1.000     0.00       1            EXIT

  + The minimum maintenance code value of 2 is used in INTEGRITY computations
      (the program changes values of 1 to 2 during computation).
  * Upper case indicates a reach of constructed spillway channel.
 ** The program does not use vegetal cover factor, maintenance code, and
      rooting depth for inlet and crest reaches in computations.
  ! Reach   3 used in computing exit channel velocities.
  ****************************************************************************

 ROUTED       BTM WIDTH  MAX ELEV   VOL-MAX  AREA-MAX   AUX.-HP   VOL-AUX.
 RESULTS          FT        FT       ACFT      AC         FT       ACFT
 NRCS-SDH          30.0   5548.67    6675.5       0.0      0.16      31.0

           PEAK - CFS        Q-PS     Q-AUX.    Q-TOT.
           DISCHARGE  =      65.7       0.2      65.9
```

	CRITICAL DEPTH	CRITICAL VELOCITY	CRITICAL SLOPE-Sc	25% OF Q Sc
	FT	FT/SEC	FT/FT	FT/FT
AUXILIARY SPILLWAY ---	0.01	0.57	0.148	0.308

AUXILIARY SPILLWAY DURATION FLOW = 8.7 HOURS

PLOT NRCS-SDH 1 IN = 500. CFS EXIT SLOPE = 0.385

Time	Qin	Qout	Elev	Vol	Area	ExtVel
1.50	0	8	5546.3	6203.0	0.0	0.00
1.80	6	8	5546.3	6203.0	0.0	0.00
2.10	39	8	5546.3	6203.4	0.0	0.00
2.40	194	8	5546.3	6206.1	0.0	0.00
2.70	687	9	5546.3	6216.8	0.0	0.00
3.00	1365	11	5546.5	6242.0	0.0	0.00
3.30	2027	15	5546.7	6283.7	0.0	0.00
3.60	2180	20	5546.9	6335.4	0.0	0.00
3.90	1955	26	5547.2	6386.1	0.0	0.00
4.20	1683	31	5547.4	6430.5	0.0	0.00
4.50	1441	36	5547.6	6468.4	0.0	0.00
4.80	1248	40	5547.8	6500.8	0.0	0.00
5.10	1107	44	5547.9	6528.9	0.0	0.00
5.40	1001	47	5548.1	6553.9	0.0	0.00
5.70	924	51	5548.2	6576.6	0.0	0.00
6.00	874	54	5548.3	6597.6	0.0	0.00
6.30	833	57	5548.4	6617.4	0.0	0.00
6.60	748	60	5548.5	6635.5	0.0	0.00
6.90	589	62	5548.5	6650.6	0.0	0.00
7.20	423	64	5548.6	6661.6	0.0	0.00
7.50	283	65	5548.6	6668.8	0.0	0.00
7.80	180	65	5548.7	6672.9	0.0	0.00
8.10	112	66	5548.7	6674.9	0.0	0.00
8.40	73	66	5548.7	6675.5	0.0	0.00
8.70	47	66	5548.7	6675.4	0.0	0.00
9.00	28	66	5548.7	6674.7	0.0	0.00
9.30	16	66	5548.7	6673.6	0.0	0.00
9.60	9	65	5548.7	6672.3	0.0	0.00
9.90	5	65	5548.6	6670.8	0.0	0.00
10.20	3	65	5548.6	6669.3	0.0	0.00
10.50	1	65	5548.6	6667.8	0.0	0.00
10.80	1	64	5548.6	6666.2	0.0	0.00
11.10	0	64	5548.6	6664.6	0.0	0.00
11.40	0	64	5548.6	6663.1	0.0	0.00
11.70	0	64	5548.6	6661.5	0.0	0.00
12.00	0	63	5548.6	6660.0	0.0	0.00
12.30	0	63	5548.6	6658.4	0.0	0.00
12.60	0	63	5548.6	6656.9	0.0	0.00
12.90	0	63	5548.6	6655.4	0.0	0.00
13.20	0	62	5548.6	6653.8	0.0	0.00
13.50	0	62	5548.6	6652.3	0.0	0.00
13.80	0	62	5548.5	6650.8	0.0	0.00
14.10	0	62	5548.5	6649.3	0.0	0.00
14.40	0	61	5548.5	6647.8	0.0	0.00
14.70	0	61	5548.5	6646.3	0.0	0.00
15.00	0	61	5548.5	6644.8	0.0	0.00
15.30	0	61	5548.5	6643.3	0.0	0.00
15.60	0	60	5548.5	6641.9	0.0	0.00
15.90	0	60	5548.5	6640.4	0.0	0.00
16.20	0	60	5548.5	6638.9	0.0	0.00
16.50	0	60	5548.5	6637.5	0.0	0.00
16.80	0	60	5548.5	6636.0	0.0	0.00
17.10	0	59	5548.5	6634.5	0.0	0.00
17.40	0	59	5548.5	6633.1	0.0	0.00
17.70	0	59	5548.4	6631.7	0.0	0.00
18.00	0	59	5548.4	6630.2	0.0	0.00
18.30	0	58	5548.4	6628.8	0.0	0.00
18.60	0	58	5548.4	6627.4	0.0	0.00
18.90	0	58	5548.4	6626.0	0.0	0.00
19.20	0	58	5548.4	6624.6	0.0	0.00
19.50	0	58	5548.4	6623.1	0.0	0.00
19.80	0	57	5548.4	6621.7	0.0	0.00
20.10	0	57	5548.4	6620.3	0.0	0.00
20.40	0	57	5548.4	6619.0	0.0	0.00
20.70	0	57	5548.4	6617.6	0.0	0.00
21.00	0	57	5548.4	6616.2	0.0	0.00
21.30	0	56	5548.4	6614.8	0.0	0.00
21.60	0	56	5548.4	6613.4	0.0	0.00
21.90	0	56	5548.3	6612.1	0.0	0.00
22.20	0	56	5548.3	6610.7	0.0	0.00
22.50	0	56	5548.3	6609.4	0.0	0.00
22.80	0	55	5548.3	6608.0	0.0	0.00
23.10	0	55	5548.3	6606.7	0.0	0.00
23.40	0	55	5548.3	6605.3	0.0	0.00
23.70	0	55	5548.3	6604.0	0.0	0.00
24.00	0	55	5548.3	6602.7	0.0	0.00
24.30	0	54	5548.3	6601.3	0.0	0.00
24.60	0	54	5548.3	6600.0	0.0	0.00
24.90	0	54	5548.3	6598.7	0.0	0.00
25.20	0	54	5548.3	6597.4	0.0	0.00
25.50	0	54	5548.3	6596.1	0.0	0.00

```
25.80     0    53 5548.3  6594.8   0.0   0.00   .P
26.10     0    53 5548.3  6593.5   0.0   0.00   .P
26.40     0    53 5548.2  6592.2   0.0   0.00   .P
26.70     0    53 5548.2  6590.9   0.0   0.00   .P
27.00     0    53 5548.2  6589.6   0.0   0.00   .P
27.30     0    52 5548.2  6588.4   0.0   0.00   .P
27.60     0    52 5548.2  6587.1   0.0   0.00   .P
27.90     0    52 5548.2  6585.8   0.0   0.00   .P
28.20     0    52 5548.2  6584.5   0.0   0.00   .P
28.50     0    52 5548.2  6583.3   0.0   0.00   .P
28.80     0    51 5548.2  6582.0   0.0   0.00   .P
29.10     0    51 5548.2  6580.8   0.0   0.00   .P
29.40     0    51 5548.2  6579.5   0.0   0.00   .P
29.70     0    51 5548.2  6578.3   0.0   0.00   .P
30.00     0    51 5548.2  6577.1   0.0   0.00   .P
30.30     0    51 5548.2  6575.8   0.0   0.00   .P
30.60     0    50 5548.2  6574.6   0.0   0.00   .P
30.90     0    50 5548.2  6573.4   0.0   0.00   .P
31.20     0    50 5548.1  6572.2   0.0   0.00   .P
31.50     0    50 5548.1  6571.0   0.0   0.00   .P
31.80     0    50 5548.1  6569.8   0.0   0.00   .P
32.10     0    50 5548.1  6568.5   0.0   0.00   .P
32.40     0    49 5548.1  6567.3   0.0   0.00   .P
32.70     0    49 5548.1  6566.1   0.0   0.00   .P
33.00     0    49 5548.1  6565.0   0.0   0.00   .P
33.30     0    49 5548.1  6563.8   0.0   0.00   .P
33.60     0    49 5548.1  6562.6   0.0   0.00   .P
33.90     0    49 5548.1  6561.4   0.0   0.00   .P
34.20     0    48 5548.1  6560.2   0.0   0.00   .P
34.50     0    48 5548.1  6559.1   0.0   0.00   .P
34.80     0    48 5548.1  6557.9   0.0   0.00   .P
35.10     0    48 5548.1  6556.7   0.0   0.00   .P
35.40     0    48 5548.1  6555.6   0.0   0.00   .P
35.70     0    48 5548.1  6554.4   0.0   0.00   .P
36.00     0    47 5548.0  6553.3   0.0   0.00   .P
36.30     0    47 5548.0  6552.1   0.0   0.00   .P
36.60     0    47 5548.0  6551.0   0.0   0.00   .P
36.90     0    47 5548.0  6549.8   0.0   0.00   .P
37.20     0    47 5548.0  6548.7   0.0   0.00   .P
37.50     0    47 5548.0  6547.6   0.0   0.00   .P
37.80     0    46 5548.0  6546.4   0.0   0.00   .P
38.10     0    46 5548.0  6545.3   0.0   0.00   .P
38.40     0    46 5548.0  6544.2   0.0   0.00   .P
38.70     0    46 5548.0  6543.1   0.0   0.00   .P
39.00     0    46 5548.0  6542.0   0.0   0.00   .P
39.30     0    46 5548.0  6540.9   0.0   0.00   .P
39.60     0    45 5548.0  6539.8   0.0   0.00   .P
39.90     0    45 5548.0  6538.7   0.0   0.00   .P
40.20     0    45 5548.0  6537.6   0.0   0.00   .P
40.50     0    45 5548.0  6536.5   0.0   0.00   .P
40.80     0    45 5548.0  6535.4   0.0   0.00   .P
41.10     0    45 5548.0  6534.3   0.0   0.00   .P
41.40     0    45 5547.9  6533.2   0.0   0.00   .P
41.70     0    44 5547.9  6532.1   0.0   0.00   .P
42.00     0    44 5547.9  6531.1   0.0   0.00   .P
42.30     0    44 5547.9  6530.0   0.0   0.00   .P
42.60     0    44 5547.9  6528.9   0.0   0.00   .P
42.90     0    44 5547.9  6527.9   0.0   0.00   .P
43.20     0    44 5547.9  6526.8   0.0   0.00   .P
43.50     0    43 5547.9  6525.7   0.0   0.00   .P
43.80     0    43 5547.9  6524.7   0.0   0.00   .P
44.10     0    43 5547.9  6523.6   0.0   0.00   .P
44.40     0    43 5547.9  6522.6   0.0   0.00   .P
44.70     0    43 5547.9  6521.6   0.0   0.00   .P
45.00     0    43 5547.9  6520.5   0.0   0.00   .P
45.30     0    43 5547.9  6519.5   0.0   0.00   .P
45.60     0    42 5547.9  6518.5   0.0   0.00   .P
45.90     0    42 5547.9  6517.4   0.0   0.00   .P
46.20     0    42 5547.9  6516.4   0.0   0.00   .P
46.50     0    42 5547.9  6515.4   0.0   0.00   .P
46.80     0    42 5547.8  6514.4   0.0   0.00   .P
47.10     0    42 5547.8  6513.4   0.0   0.00   .P
47.40     0    42 5547.8  6512.4   0.0   0.00   .P
47.70     0    41 5547.8  6511.4   0.0   0.00   .P
48.00     0    41 5547.8  6510.4   0.0   0.00   .P
48.30     0    41 5547.8  6509.4   0.0   0.00   .P
48.60     0    41 5547.8  6508.4   0.0   0.00   .P
48.90     0    41 5547.8  6507.4   0.0   0.00   .P
49.20     0    41 5547.8  6506.4   0.0   0.00   .P
49.50     0    41 5547.8  6505.4   0.0   0.00   .P
49.80     0    41 5547.8  6504.4   0.0   0.00   .P
50.10     0    40 5547.8  6503.4   0.0   0.00   .P
50.40     0    40 5547.8  6502.5   0.0   0.00   .P
50.70     0    40 5547.8  6501.5   0.0   0.00   .P
51.00     0    40 5547.8  6500.5   0.0   0.00   .P
51.30     0    40 5547.8  6499.6   0.0   0.00   .P
51.60     0    40 5547.8  6498.6   0.0   0.00   .P
51.90     0    40 5547.8  6497.6   0.0   0.00   .P
52.20     0    40 5547.8  6496.7   0.0   0.00   .P
52.50     0    39 5547.8  6495.7   0.0   0.00   .P
52.80     0    39 5547.7  6494.8   0.0   0.00   .P
53.10     0    39 5547.7  6493.8   0.0   0.00   .P
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53.40     0    39 5547.7  6492.9   0.0   0.00   .P
53.70     0    39 5547.7  6491.9   0.0   0.00   .P
54.00     0    39 5547.7  6491.0   0.0   0.00   .P
54.30     0    39 5547.7  6490.1   0.0   0.00   .P
54.60     0    39 5547.7  6489.1   0.0   0.00   .P
54.90     0    38 5547.7  6488.2   0.0   0.00   .P
55.20     0    38 5547.7  6487.3   0.0   0.00   .P
55.50     0    38 5547.7  6486.4   0.0   0.00   .P
55.80     0    38 5547.7  6485.4   0.0   0.00   .P
56.10     0    38 5547.7  6484.5   0.0   0.00   .P
56.40     0    38 5547.7  6483.6   0.0   0.00   .P
56.70     0    38 5547.7  6482.7   0.0   0.00   .P
57.00     0    38 5547.7  6481.8   0.0   0.00   .P
57.30     0    37 5547.7  6480.9   0.0   0.00   .P
57.60     0    37 5547.7  6480.0   0.0   0.00   .P
57.90     0    37 5547.7  6479.1   0.0   0.00   .P
58.20     0    37 5547.7  6478.2   0.0   0.00   .P
58.50     0    37 5547.7  6477.3   0.0   0.00   .P
58.80     0    37 5547.7  6476.4   0.0   0.00   .P
59.10     0    37 5547.7  6475.5   0.0   0.00   .P
59.40     0    37 5547.6  6474.6   0.0   0.00   .P
59.70     0    37 5547.6  6473.7   0.0   0.00   .P
60.00     0    36 5547.6  6472.9   0.0   0.00   .P
60.30     0    36 5547.6  6472.0   0.0   0.00   .P
60.60     0    36 5547.6  6471.1   0.0   0.00   .P
60.90     0    36 5547.6  6470.2   0.0   0.00   .P
61.20     0    36 5547.6  6469.4   0.0   0.00   .P
61.50     0    36 5547.6  6468.5   0.0   0.00   .P
61.80     0    36 5547.6  6467.7   0.0   0.00   .P
62.10     0    36 5547.6  6466.8   0.0   0.00   .P
62.40     0    35 5547.6  6465.9   0.0   0.00   .P
62.70     0    35 5547.6  6465.1   0.0   0.00   .P
63.00     0    35 5547.6  6464.2   0.0   0.00   .P
63.30     0    35 5547.6  6463.4   0.0   0.00   .P
63.60     0    35 5547.6  6462.5   0.0   0.00   .P
63.90     0    35 5547.6  6461.7   0.0   0.00   .P
64.20     0    35 5547.6  6460.9   0.0   0.00   .P
64.50     0    35 5547.6  6460.0   0.0   0.00   .P
64.80     0    35 5547.6  6459.2   0.0   0.00   .P
65.10     0    34 5547.6  6458.4   0.0   0.00   .P
65.40     0    34 5547.6  6457.5   0.0   0.00   .P
65.70     0    34 5547.6  6456.7   0.0   0.00   .P
66.00     0    34 5547.5  6455.9   0.0   0.00   .P
66.30     0    34 5547.5  6455.1   0.0   0.00   .P
66.60     0    34 5547.5  6454.2   0.0   0.00   .P
66.90     0    34 5547.5  6453.4   0.0   0.00   .P
67.20     0    34 5547.5  6452.6   0.0   0.00   .P
67.50     0    34 5547.5  6451.8   0.0   0.00   .P
67.80     0    34 5547.5  6451.0   0.0   0.00   .P
68.10     0    33 5547.5  6450.2   0.0   0.00   .P
68.40     0    33 5547.5  6449.4   0.0   0.00   .P
68.70     0    33 5547.5  6448.6   0.0   0.00   .P
69.00     0    33 5547.5  6447.8   0.0   0.00   .P
69.30     0    33 5547.5  6447.0   0.0   0.00   .P
69.60     0    33 5547.5  6446.2   0.0   0.00   .P
69.90     0    33 5547.5  6445.4   0.0   0.00   .P
70.20     0    33 5547.5  6444.6   0.0   0.00   .P
70.50     0    33 5547.5  6443.8   0.0   0.00   .P
70.80     0    33 5547.5  6443.1   0.0   0.00   .P
71.10     0    32 5547.5  6442.3   0.0   0.00   .P
71.40     0    32 5547.5  6441.5   0.0   0.00   .P
71.70     0    32 5547.5  6440.7   0.0   0.00   .P
72.00     0    32 5547.5  6439.9   0.0   0.00   .P
72.30     0    32 5547.5  6439.2   0.0   0.00   .P
72.60     0    32 5547.5  6438.4   0.0   0.00   .P
72.90     0    32 5547.5  6437.6   0.0   0.00   .P
73.20     0    32 5547.5  6436.9   0.0   0.00   .P
73.50     0    32 5547.4  6436.1   0.0   0.00   .P
73.80     0    32 5547.4  6435.4   0.0   0.00   .P
74.10     0    31 5547.4  6434.6   0.0   0.00   .P
74.40     0    31 5547.4  6433.8   0.0   0.00   .P
74.70     0    31 5547.4  6433.1   0.0   0.00   .P
75.00     0    31 5547.4  6432.3   0.0   0.00   .P
75.30     0    31 5547.4  6431.6   0.0   0.00   .P
75.60     0    31 5547.4  6430.8   0.0   0.00   .P
75.90     0    31 5547.4  6430.1   0.0   0.00   .P
76.20     0    31 5547.4  6429.4   0.0   0.00   .P
76.50     0    31 5547.4  6428.6   0.0   0.00   .P
76.80     0    31 5547.4  6427.9   0.0   0.00   .P
77.10     0    31 5547.4  6427.1   0.0   0.00   .P
77.40     0    31 5547.4  6426.4   0.0   0.00   .P
77.70     0    30 5547.4  6425.7   0.0   0.00   .P
78.00     0    30 5547.4  6425.0   0.0   0.00   .P
78.30     0    30 5547.4  6424.2   0.0   0.00   .P
78.60     0    30 5547.4  6423.5   0.0   0.00   .P
78.90     0    30 5547.4  6422.8   0.0   0.00   .P
79.20     0    30 5547.4  6422.1   0.0   0.00   .P
79.50     0    30 5547.4  6421.3   0.0   0.00   .P
79.80     0    30 5547.4  6420.6   0.0   0.00   .P
80.10     0    30 5547.4  6419.9   0.0   0.00   .P
80.40     0    30 5547.4  6419.2   0.0   0.00   .P
80.70     0    30 5547.4  6418.5   0.0   0.00   .P
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 81.00     0    29 5547.4  6417.8   0.0   0.00   .P
 81.30     0    29 5547.4  6417.1   0.0   0.00   .P
 81.60     0    29 5547.3  6416.4   0.0   0.00   .P
 81.90     0    29 5547.3  6415.7   0.0   0.00   .P
 82.20     0    29 5547.3  6415.0   0.0   0.00   .P
 82.50     0    29 5547.3  6414.3   0.0   0.00   .P
 82.80     0    29 5547.3  6413.6   0.0   0.00   .P
 83.10     0    29 5547.3  6412.9   0.0   0.00   .P
 83.40     0    29 5547.3  6412.2   0.0   0.00   .P
 83.70     0    29 5547.3  6411.5   0.0   0.00   .P
 84.00     0    29 5547.3  6410.8   0.0   0.00   .P
 84.30     0    29 5547.3  6410.2   0.0   0.00   .P
 84.60     0    28 5547.3  6409.5   0.0   0.00   .P
 84.90     0    28 5547.3  6408.8   0.0   0.00   .P
 85.20     0    28 5547.3  6408.1   0.0   0.00   .P
 85.50     0    28 5547.3  6407.4   0.0   0.00   .P
 85.80     0    28 5547.3  6406.8   0.0   0.00   .P
 86.10     0    28 5547.3  6406.1   0.0   0.00   .P
 86.40     0    28 5547.3  6405.4   0.0   0.00   .P
 86.70     0    28 5547.3  6404.8   0.0   0.00   .P
 87.00     0    28 5547.3  6404.1   0.0   0.00   .P
 87.30     0    28 5547.3  6403.4   0.0   0.00   .P
 87.60     0    28 5547.3  6402.8   0.0   0.00   .P
 87.90     0    28 5547.3  6402.1   0.0   0.00   .P
 88.20     0    27 5547.3  6401.4   0.0   0.00   .P
 88.50     0    27 5547.3  6400.8   0.0   0.00   .P
 88.80     0    27 5547.3  6400.1   0.0   0.00   .P
 89.10     0    27 5547.3  6399.5   0.0   0.00   .P
 89.40     0    27 5547.3  6398.8   0.0   0.00   .P
 89.70     0    27 5547.3  6398.2   0.0   0.00   .P
 90.00     0    27 5547.3  6397.5   0.0   0.00   .P
 90.30     0    27 5547.2  6396.9   0.0   0.00   .P
 90.60     0    27 5547.2  6396.3   0.0   0.00   .P
 90.90     0    27 5547.2  6395.6   0.0   0.00   .P
 91.20     0    27 5547.2  6395.0   0.0   0.00   .P
 91.50     0    27 5547.2  6394.3   0.0   0.00   .P
 91.80     0    27 5547.2  6393.7   0.0   0.00   .P
 92.10     0    26 5547.2  6393.1   0.0   0.00   .P
 92.40     0    26 5547.2  6392.4   0.0   0.00   .P
 92.70     0    26 5547.2  6391.8   0.0   0.00   .P
 93.00     0    26 5547.2  6391.2   0.0   0.00   .P
 93.30     0    26 5547.2  6390.6   0.0   0.00   .P
 93.60     0    26 5547.2  6389.9   0.0   0.00   .P
 93.90     0    26 5547.2  6389.3   0.0   0.00   .P
 94.20     0    26 5547.2  6388.7   0.0   0.00   .P
 94.50     0    26 5547.2  6388.1   0.0   0.00   .P
 94.80     0    26 5547.2  6387.5   0.0   0.00   .P
 95.10     0    26 5547.2  6386.9   0.0   0.00   .P
 95.40     0    26 5547.2  6386.2   0.0   0.00   .P
 95.70     0    26 5547.2  6385.6   0.0   0.00   .P
 96.00     0    26 5547.2  6385.0   0.0   0.00   .P
 96.30     0    25 5547.2  6384.4   0.0   0.00   .P
 96.60     0    25 5547.2  6383.8   0.0   0.00   .P
 96.90     0    25 5547.2  6383.2   0.0   0.00   .P
 97.20     0    25 5547.2  6382.6   0.0   0.00   .P
 Time    Qin  Qout   Elev    Vol   Area  ExtVel  I         I         I         I         I         I         I         I
                                                 0.      500.     1000.     1500.     2000.     2500.     3000.     3500.
        END NRCS-SDH   PLOT

ROUTED       BTM WIDTH  MAX ELEV   VOL-MAX  AREA-MAX   AUX.-HP   VOL-AUX.
RESULTS          FT        FT        ACFT      AC         FT       ACFT
NRCS-FBH          30.0   5552.00    7347.2       0.0      3.49     702.7

          PEAK - CFS        Q-PS     Q-AUX.    Q-TOT.
          DISCHARGE  =     126.7     432.6     559.2

                        CRITICAL  CRITICAL   CRITICAL  25% OF Q
                          DEPTH   VELOCITY   SLOPE-Sc     Sc
          AUXILIARY         FT      FT/SEC     FT/FT     FT/FT
          SPILLWAY ---     1.79      7.21     0.008     0.011

          INTEGRITY ANALYSIS - REACH SURFACE PERFORMANCE SUMMARY
           (The auxiliary spillway began flow at time =    3.3 hours
            and peaked at time =    7.5 hours.)


            REACH   3: FROM STATION    155. TO    237. ON   38.5% SLOPE.
               Non-vegetated conditions implied: flow concentration
                assumed with minimal flow: Time =    4.2 hours.


            REACH   4: FROM STATION    237. TO    600. ON    9.9% SLOPE.
               Non-vegetated conditions implied: flow concentration
                assumed with minimal flow: Time =    4.2 hours.


            REACH   5: FROM STATION    600. TO   1049. ON    6.3% SLOPE.
               Non-vegetated conditions implied: flow concentration
                assumed with minimal flow: Time =    4.2 hours.


            REACH   6: FROM STATION   1049. TO   1170. ON   15.1% SLOPE.
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Non-vegetated conditions implied: flow concentration
assumed with minimal flow: Time = 4.2 hours.

INTEGRITY ANALYSIS - HEADCUT EROSION DAMAGE SUMMARY

The most upstream headcut began at station 155.
and progressed upstream to station 153.
The final height of the headcut was 6.9 ft.

The deepest headcut is also the furthest upstream.

THE HYDROGRAPH WAS NOT ADJUSTED FOR THE EFFECTS OF EROSION.

	DURATION FLOW HRS	ATTACK OE/B ACFT/FT	DIST. FROM MOST U/S HEADCUT TO U/S EDGE AUX. CREST, FT
AUXILIARY SPILLWAY ---	61.5	12.1	78.

EXIT CHANNEL FLOW SUPERCRITICAL: MAX VELOCITY= 24.1 FT/SEC
EXIT SLOPE = 0.385 FT/FT
FLOW DEPTH = 0.6 FT

>>>>> MINIMUM FLOW IN AUXILIARY SPILLWAY FROM TR60 (510. CFS).

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
MIN. AUX.	30.0	5552.28	7405.2	0.0	3.77	760.7

	PEAK - CFS Q-PS	Q-AUX.	Q-TOT.
DISCHARGE =	126.9	510.4	637.3

	CRITICAL DEPTH FT	CRITICAL VELOCITY FT/SEC	CRITICAL SLOPE-Sc FT/FT	25% OF Q Sc FT/FT
AUXILIARY SPILLWAY ---	1.99	7.57	0.008	0.011

PLOT NRCS-FBH 1 IN = 1000. CFS EXIT SLOPE = 0.385

Time	Qin	Qout	Elev	Vol	Area	ExtVel	0.	1000.	2000.	3000.	4000.	5000.	6000.	7000.
0.90	0	8	5546.3	6203.0	0.0	0.00	I	I	I	I	I	I	I	I
1.20	8	8	5546.3	6203.0	0.0	0.00	.							
1.50	43	8	5546.3	6203.5	0.0	0.00	.							
1.80	129	8	5546.3	6205.4	0.0	0.00	.I							
2.10	306	8	5546.3	6210.6	0.0	0.00	. I							
2.40	824	9	5546.4	6224.4	0.0	0.00	. I							
2.70	2325	13	5546.6	6263.1	0.0	0.00	. I							
3.00	4867	22	5547.0	6351.9	0.0	0.00	. I							
3.30	6395	39	5547.7	6490.7	0.0	0.00	. X							
3.60	6123	61	5548.5	6644.7	0.0	0.00	.A I							
3.90	5053	86	5549.2	6781.4	0.0	3.25	.A I							
4.20	4063	129	5549.8	6891.7	0.0	8.04	.A I							
4.50	3364	196	5550.2	6979.8	0.0	12.35	. A I							
4.80	2855	250	5550.6	7051.3	0.0	14.90	. A I							
5.10	2500	302	5550.9	7110.9	0.0	17.07	. A I							
5.40	2228	349	5551.1	7161.4	0.0	18.71	. A I							
5.70	2039	394	5551.3	7205.1	0.0	20.09	. A I							
6.00	1913	436	5551.5	7243.8	0.0	21.24	. A I							
6.30	1819	477	5551.7	7278.8	0.0	22.29	. A I							
6.60	1614	513	5551.8	7309.0	0.0	23.13	. A I							
6.90	1240	540	5551.9	7331.4	0.0	23.72	. A I							
7.20	851	555	5552.0	7343.7	0.0	24.05	. A I							
7.50	540	559	5552.0	7347.2	0.0	24.15	. IX							
7.80	332	555	5552.0	7344.1	0.0	24.06	. I A							
8.10	201	546	5552.0	7337.1	0.0	23.87	. I A							
8.40	113	535	5551.9	7327.6	0.0	23.62	.I A							
8.70	62	522	5551.9	7316.6	0.0	23.34	.I A							
9.00	34	508	5551.8	7305.1	0.0	23.02	. A							
9.30	18	495	5551.7	7293.3	0.0	22.70	. A							
9.60	9	481	5551.7	7281.5	0.0	22.37	. A							
9.90	5	467	5551.6	7269.9	0.0	22.03	. A							
10.20	2	453	5551.6	7258.6	0.0	21.70	. A							
10.50	1	440	5551.5	7247.6	0.0	21.36	. A							
10.80	0	428	5551.5	7236.8	0.0	21.02	. A							
11.10	0	416	5551.4	7226.4	0.0	20.71	. A							
11.40	0	406	5551.4	7216.2	0.0	20.42	. A							
11.70	0	395	5551.3	7206.3	0.0	20.13	. A							
12.00	0	385	5551.3	7196.7	0.0	19.84	. A							
12.30	0	376	5551.2	7187.3	0.0	19.55	. A							
12.60	0	366	5551.2	7178.1	0.0	19.26	. A							
12.90	0	357	5551.1	7169.2	0.0	18.97	. A							
13.20	0	348	5551.1	7160.4	0.0	18.68	. A							
13.50	0	339	5551.1	7152.0	0.0	18.39	. A							
13.80	0	331	5551.0	7143.7	0.0	18.11	. A							
14.10	0	324	5551.0	7135.6	0.0	17.86	. A							
14.40	0	317	5550.9	7127.7	0.0	17.62	. A							
14.70	0	310	5550.9	7119.9	0.0	17.37	. A							
15.00	0	303	5550.9	7112.4	0.0	17.12	. A							
15.30	0	297	5550.8	7104.9	0.0	16.88	. A							
15.60	0	290	5550.8	7097.7	0.0	16.63	. A							
15.90	0	284	5550.8	7090.6	0.0	16.38	. A							

16.20	0	278	5550.7	7083.7	0.0	16.13	. A
16.50	0	272	5550.7	7076.9	0.0	15.88	. A
16.80	0	266	5550.7	7070.2	0.0	15.63	. A
17.10	0	260	5550.6	7063.7	0.0	15.38	. A
17.40	0	255	5550.6	7057.3	0.0	15.13	. A
17.70	0	250	5550.6	7051.1	0.0	14.89	. A
18.00	0	245	5550.5	7045.0	0.0	14.65	. A
18.30	0	240	5550.5	7039.0	0.0	14.41	. A
18.60	0	235	5550.5	7033.2	0.0	14.20	. A
18.90	0	231	5550.4	7027.4	0.0	14.00	. A
19.20	0	228	5550.4	7021.7	0.0	13.79	. A
19.50	0	224	5550.4	7016.2	0.0	13.59	. A
19.80	0	220	5550.4	7010.7	0.0	13.41	. A
20.10	0	216	5550.3	7005.3	0.0	13.24	. A
20.40	0	212	5550.3	7000.1	0.0	13.06	. A
20.70	0	208	5550.3	6994.9	0.0	12.89	. A
21.00	0	204	5550.3	6989.8	0.0	12.71	. A
21.30	0	200	5550.2	6984.8	0.0	12.54	. A
21.60	0	196	5550.2	6979.9	0.0	12.36	. A
21.90	0	193	5550.2	6975.2	0.0	12.18	. A
22.20	0	189	5550.2	6970.5	0.0	12.01	. A
22.50	0	185	5550.1	6965.8	0.0	11.83	. A
22.80	0	182	5550.1	6961.3	0.0	11.65	. A
23.10	0	179	5550.1	6956.9	0.0	11.46	. A
23.40	0	175	5550.1	6952.5	0.0	11.28	. A
23.70	0	172	5550.1	6948.2	0.0	11.10	. A
24.00	0	169	5550.0	6944.0	0.0	10.91	. A
24.30	0	166	5550.0	6939.9	0.0	10.73	. A
24.60	0	163	5550.0	6935.9	0.0	10.54	. A
24.90	0	159	5550.0	6931.9	0.0	10.35	. A
25.20	0	157	5550.0	6928.0	0.0	10.16	. A
25.50	0	154	5549.9	6924.2	0.0	9.97	. A
25.80	0	151	5549.9	6920.4	0.0	9.78	. A
26.10	0	148	5549.9	6916.8	0.0	9.58	.A
26.40	0	145	5549.9	6913.1	0.0	9.38	.A
26.70	0	142	5549.9	6909.6	0.0	9.18	.A
27.00	0	140	5549.9	6906.1	0.0	8.98	.A
27.30	0	137	5549.8	6902.7	0.0	8.77	.A
27.60	0	135	5549.8	6899.4	0.0	8.56	.A
27.90	0	132	5549.8	6896.1	0.0	8.34	.A
28.20	0	130	5549.8	6892.9	0.0	8.12	.A
28.50	0	127	5549.8	6889.7	0.0	7.89	.A
28.80	0	126	5549.8	6886.6	0.0	7.77	.A
29.10	0	125	5549.7	6883.5	0.0	7.69	.A
29.40	0	123	5549.7	6880.5	0.0	7.61	.A
29.70	0	122	5549.7	6877.5	0.0	7.53	.A
30.00	0	121	5549.7	6874.5	0.0	7.46	.A
30.30	0	120	5549.7	6871.5	0.0	7.38	.A
30.60	0	119	5549.7	6868.6	0.0	7.30	.A
30.90	0	118	5549.6	6865.7	0.0	7.22	.A
31.20	0	117	5549.6	6862.8	0.0	7.13	.A
31.50	0	116	5549.6	6859.9	0.0	7.05	.A
31.80	0	115	5549.6	6857.1	0.0	6.97	.A
32.10	0	114	5549.6	6854.3	0.0	6.88	.A
32.40	0	113	5549.6	6851.5	0.0	6.80	.A
32.70	0	112	5549.6	6848.7	0.0	6.71	.A
33.00	0	110	5549.5	6846.0	0.0	6.62	.A
33.30	0	109	5549.5	6843.3	0.0	6.54	.A
33.60	0	108	5549.5	6840.6	0.0	6.45	.A
33.90	0	107	5549.5	6838.0	0.0	6.36	.A
34.20	0	107	5549.5	6835.4	0.0	6.27	.A
34.50	0	106	5549.5	6832.8	0.0	6.17	.A
34.80	0	105	5549.5	6830.2	0.0	6.08	.A
35.10	0	104	5549.5	6827.6	0.0	5.98	.A
35.40	0	103	5549.4	6825.1	0.0	5.88	.A
35.70	0	102	5549.4	6822.6	0.0	5.78	.A
36.00	0	101	5549.4	6820.1	0.0	5.68	.A
36.30	0	100	5549.4	6817.6	0.0	5.58	.A
36.60	0	99	5549.4	6815.2	0.0	5.47	.A
36.90	0	98	5549.4	6812.8	0.0	5.36	.A
37.20	0	97	5549.4	6810.4	0.0	5.25	.A
37.50	0	96	5549.4	6808.0	0.0	5.14	.A
37.80	0	95	5549.3	6805.7	0.0	5.02	.A
38.10	0	95	5549.3	6803.3	0.0	4.90	.A
38.40	0	94	5549.3	6801.0	0.0	4.78	.A
38.70	0	93	5549.3	6798.7	0.0	4.65	.A
39.00	0	92	5549.3	6796.5	0.0	4.52	.A
39.30	0	91	5549.3	6794.2	0.0	4.39	.A
39.60	0	90	5549.3	6792.0	0.0	4.22	.A
39.90	0	89	5549.3	6789.8	0.0	4.04	.A
40.20	0	89	5549.2	6787.6	0.0	3.85	.A
40.50	0	88	5549.2	6785.4	0.0	3.66	.A
40.80	0	87	5549.2	6783.3	0.0	3.45	.A
41.10	0	86	5549.2	6781.2	0.0	3.23	.A
41.40	0	85	5549.2	6779.1	0.0	2.99	.A
41.70	0	85	5549.2	6777.0	0.0	2.74	.A
42.00	0	84	5549.2	6774.9	0.0	2.46	.A
42.30	0	83	5549.2	6772.9	0.0	2.14	.A
42.60	0	82	5549.2	6770.9	0.0	1.77	.A
42.90	0	82	5549.2	6768.9	0.0	1.29	.A
43.20	0	81	5549.1	6766.9	0.0	0.00	.A
43.50	0	80	5549.1	6764.9	0.0	0.00	.A

43.80	0	80	5549.1	6762.9	0.0	0.00	.A
44.10	0	80	5549.1	6761.0	0.0	0.00	.A
44.40	0	79	5549.1	6759.0	0.0	0.00	.A
44.70	0	79	5549.1	6757.1	0.0	0.00	.A
45.00	0	79	5549.1	6755.1	0.0	0.00	.A
45.30	0	79	5549.1	6753.2	0.0	0.00	.A
45.60	0	78	5549.1	6751.3	0.0	0.00	.A
45.90	0	78	5549.1	6749.4	0.0	0.00	.A
46.20	0	78	5549.0	6747.5	0.0	0.00	.A
46.50	0	77	5549.0	6745.6	0.0	0.00	.A
46.80	0	77	5549.0	6743.7	0.0	0.00	.A
47.10	0	77	5549.0	6741.8	0.0	0.00	.A
47.40	0	76	5549.0	6740.0	0.0	0.00	.A
47.70	0	76	5549.0	6738.1	0.0	0.00	.A
48.00	0	76	5549.0	6736.2	0.0	0.00	.A
48.30	0	75	5549.0	6734.4	0.0	0.00	.A
48.60	0	75	5549.0	6732.5	0.0	0.00	.A
48.90	0	75	5549.0	6730.7	0.0	0.00	.A
49.20	0	75	5548.9	6728.9	0.0	0.00	.A
49.50	0	74	5548.9	6727.1	0.0	0.00	.A
49.80	0	74	5548.9	6725.2	0.0	0.00	.A
50.10	0	74	5548.9	6723.4	0.0	0.00	.A
50.40	0	73	5548.9	6721.6	0.0	0.00	.A
50.70	0	73	5548.9	6719.8	0.0	0.00	.A
51.00	0	73	5548.9	6718.1	0.0	0.00	.A
51.30	0	73	5548.9	6716.3	0.0	0.00	.A
51.60	0	72	5548.9	6714.5	0.0	0.00	.A
51.90	0	72	5548.9	6712.8	0.0	0.00	.A
52.20	0	72	5548.9	6711.0	0.0	0.00	.A
52.50	0	71	5548.8	6709.2	0.0	0.00	.A
52.80	0	71	5548.8	6707.5	0.0	0.00	.A
53.10	0	71	5548.8	6705.8	0.0	0.00	.A
53.40	0	71	5548.8	6704.0	0.0	0.00	.A
53.70	0	70	5548.8	6702.3	0.0	0.00	.A
54.00	0	70	5548.8	6700.6	0.0	0.00	.A
54.30	0	70	5548.8	6698.9	0.0	0.00	.A
54.60	0	69	5548.8	6697.2	0.0	0.00	.A
54.90	0	69	5548.8	6695.5	0.0	0.00	.A
55.20	0	69	5548.8	6693.8	0.0	0.00	.A
55.50	0	69	5548.8	6692.1	0.0	0.00	.A
55.80	0	68	5548.8	6690.5	0.0	0.00	.A
56.10	0	68	5548.7	6688.8	0.0	0.00	.A
56.40	0	68	5548.7	6687.1	0.0	0.00	.A
56.70	0	68	5548.7	6685.5	0.0	0.00	.A
57.00	0	67	5548.7	6683.9	0.0	0.00	.A
57.30	0	67	5548.7	6682.2	0.0	0.00	.A
57.60	0	67	5548.7	6680.6	0.0	0.00	.A
57.90	0	66	5548.7	6679.0	0.0	0.00	.A
58.20	0	66	5548.7	6677.3	0.0	0.00	.A
58.50	0	66	5548.7	6675.7	0.0	0.00	.A
58.80	0	66	5548.7	6674.1	0.0	0.00	.A
59.10	0	65	5548.7	6672.5	0.0	0.00	.A
59.40	0	65	5548.6	6670.9	0.0	0.00	.A
59.70	0	65	5548.6	6669.3	0.0	0.00	.A
60.00	0	65	5548.6	6667.8	0.0	0.00	.A
60.30	0	64	5548.6	6666.2	0.0	0.00	.A
60.60	0	64	5548.6	6664.6	0.0	0.00	.A
60.90	0	64	5548.6	6663.0	0.0	0.00	.A
61.20	0	64	5548.6	6661.5	0.0	0.00	.A
61.50	0	63	5548.6	6659.9	0.0	0.00	.A
61.80	0	63	5548.6	6658.4	0.0	0.00	.A
62.10	0	63	5548.6	6656.9	0.0	0.00	.A
62.40	0	63	5548.6	6655.3	0.0	0.00	.A
62.70	0	62	5548.6	6653.8	0.0	0.00	.A
63.00	0	62	5548.6	6652.3	0.0	0.00	.A
63.30	0	62	5548.5	6650.8	0.0	0.00	.A
63.60	0	62	5548.5	6649.3	0.0	0.00	.A
63.90	0	61	5548.5	6647.8	0.0	0.00	.A
64.20	0	61	5548.5	6646.3	0.0	0.00	.A
64.50	0	61	5548.5	6644.8	0.0	0.00	.A
64.80	0	61	5548.5	6643.3	0.0	0.00	.P
65.10	0	60	5548.5	6641.8	0.0	0.00	.P
65.40	0	60	5548.5	6640.4	0.0	0.00	.P
65.70	0	60	5548.5	6638.9	0.0	0.00	.P
66.00	0	60	5548.5	6637.4	0.0	0.00	.P
66.30	0	60	5548.5	6636.0	0.0	0.00	.P
66.60	0	59	5548.5	6634.5	0.0	0.00	.P
66.90	0	59	5548.5	6633.1	0.0	0.00	.P
67.20	0	59	5548.4	6631.6	0.0	0.00	.P
67.50	0	59	5548.4	6630.2	0.0	0.00	.P
67.80	0	58	5548.4	6628.8	0.0	0.00	.P
68.10	0	58	5548.4	6627.4	0.0	0.00	.P
68.40	0	58	5548.4	6625.9	0.0	0.00	.P
68.70	0	58	5548.4	6624.5	0.0	0.00	.P
69.00	0	58	5548.4	6623.1	0.0	0.00	.P
69.30	0	57	5548.4	6621.7	0.0	0.00	.P
69.60	0	57	5548.4	6620.3	0.0	0.00	.P
69.90	0	57	5548.4	6618.9	0.0	0.00	.P
70.20	0	57	5548.4	6617.6	0.0	0.00	.P
70.50	0	57	5548.4	6616.2	0.0	0.00	.P
70.80	0	56	5548.4	6614.8	0.0	0.00	.P
71.10	0	56	5548.4	6613.4	0.0	0.00	.P

```
 71.40     0    56 5548.3  6612.1   0.0   0.00   .P
 71.70     0    56 5548.3  6610.7   0.0   0.00   .P
 Time    Qin  Qout   Elev    Vol   Area  ExtVel  I         I         I         I         I         I         I         I
                                                 0.     1000.     2000.     3000.     4000.     5000.     6000.     7000.
        END NRCS-FBH   PLOT
 ------------------------------------------------------------------------------

 Inflow Hyd 1 PSH-Peak =         39.99 CFS  at  143.00 hrs.,  Location Point

 Inflow Hyd 1 SDH-Peak =         65.90 CFS  at    8.10 hrs.,  Location Point

 Inflow Hyd 1 FBH-Peak =        559.24 CFS  at    7.20 hrs.,  Location Point
HYDOUT   1     STR1

1SITES....JOB NO.  1 COMPLETE.
 ------------------------------------------------------------------------------

 COVRES        COV RES

       0 SUBWATERSHED(S) ANALYZED.

       1 STRUCTURE(S) ANALYZED.

       3 HYDROGRAPHS ROUTED AT LOWEST SITE.

       0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

 ******************************************************************************



 SITES.....COMPUTATIONS COMPLETE


                              SUMMARY TABLE  1          SITES VERSION 2005.1.8
                             ----------------               DATED 01/01/2005


 WATERSHED ID                       RUN DATE                          RUN TIME
 ------------                       --------                          --------
 COVRES                           08/20/2020                          06:12:11

 >>>   SITE   SUBWS   SUBWS DA   CURVE    TC   TOTAL DA   TYPE    STRUC    <<<
        ID      ID     (SQ MI)    NO.    (HRS)  (SQ MI)  DESIGN   CLASS
       -----   ----   --------   -----   ----   -------   -----   -----
       STR1     CR        4.74      0.   0.00      4.74    TR60     C

 PASS  DIA./  AUX.CREST  BTM.  MAX.    MAX.    EMB.  INTEGR.*  EXIT*    TYPE
  NO.  WIDTH    ELEV    WIDTH   HP     ELEV    VOL.   DIST.     VEL.     HYD
      (IN/FT)   (FT)     (FT)  (FT)    (FT)    (CY)   (FT)   (FT/SEC)
 ----  -----  -------  ------  ----  -------  -------  -----  ------  ---------
    1   30.0   5548.5    30.0   3.8   5552.3       0.    78.    24.1  MIN. AUX.


 *  INTEGRITY DIST. AND EXIT VEL. ARE BASED ON THE ROUTED HYDROGRAPH
    AND WILL NOT RELATE TO THE MAX. ELEV. (TOP OF DAM),
    WHICH IS SET BY MINIMUM DESIGN CRITERIA.



 SITES.......SUMMARY TABLE 1 COMPLETED.


                   NRCS  SITES    VERSION 2005.1.8  ,01/01/2005
                           COVRES   FILES

INPUT  = c:\USDA\SITES\080620-PSH-ASHL-FBHL.d2c
OUTPUT = c:\USDA\SITES\080620-PSH-ASHL-FBHL.OUT
         DATED 08/20/2020 06:12:11

                         GRAPHICS FILES GENERATED

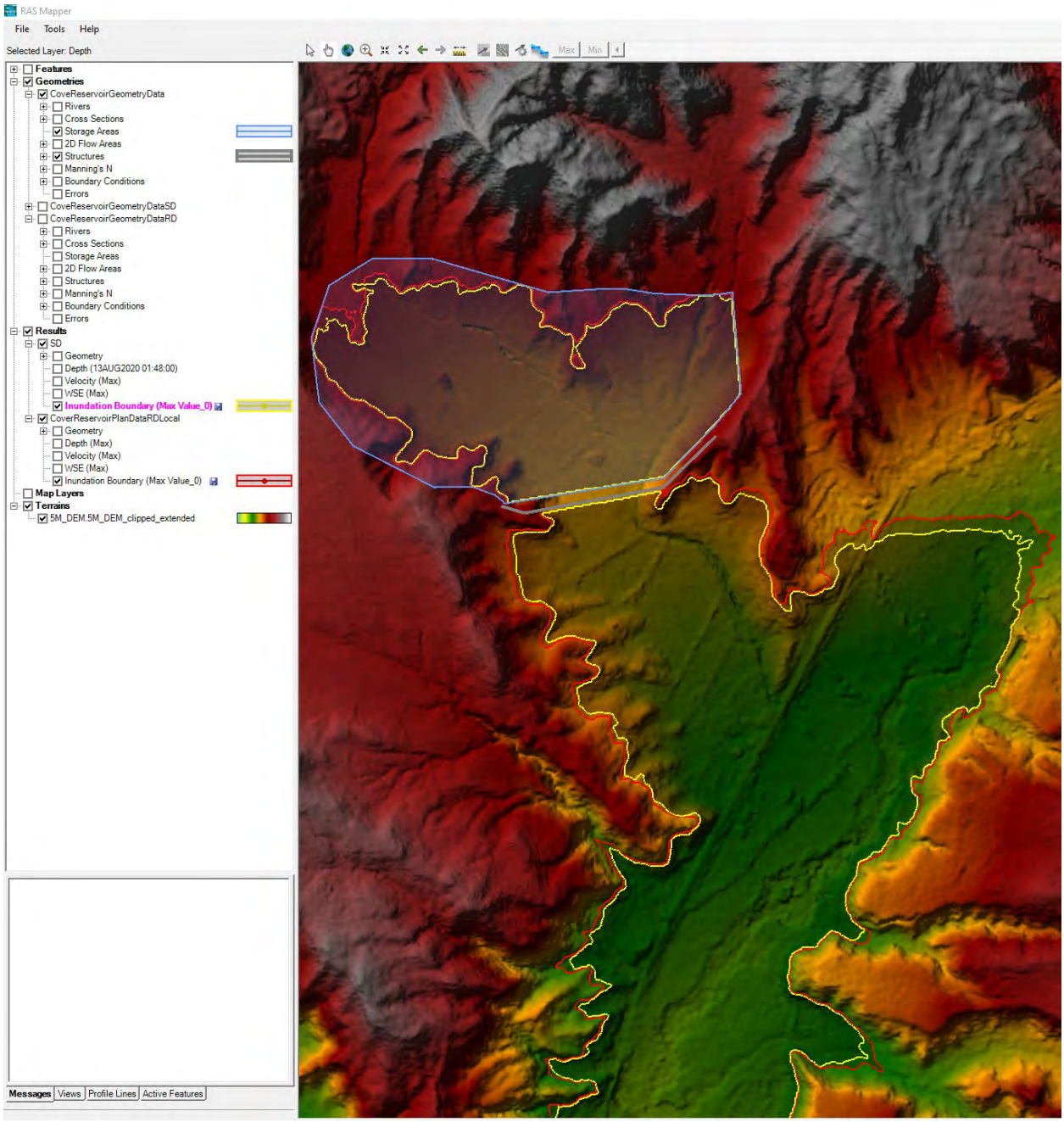
OPTION "L"  = c:\USDA\SITES\080620-PSH-ASHL-FBHL.DRG DATED 08/20/2020 06:12:11

OPTION "P"  = c:\USDA\SITES\080620-PSH-ASHL-FBHL.DHY DATED 08/20/2020 06:12:11

OPTION "E"  = c:\USDA\SITES\080620-PSH-ASHL-FBHL.DEM DATED 08/20/2020 06:12:11

AUX.GRAPHICS = c:\USDA\SITES\080620-PSH-ASHL-FBHL.DG* DATED 08/20/2020 06:12:11
```

Breach Analysis



HEC-RAS Graphical Output with Inundation Boundaries - Sunny Day (yellow) and Rainy Day (red)

Sunny Day

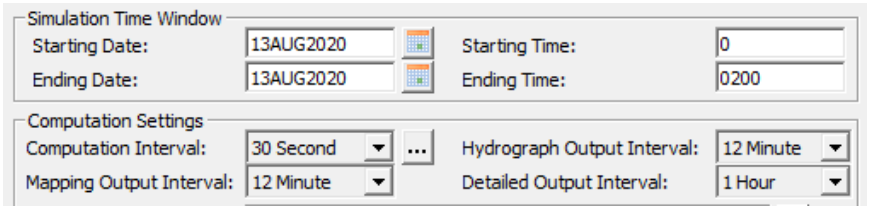
Unsteady Flow Data

Storage/2D Flow Areas		Boundary Condition
1	CoveReservoir BCLine: USBoundaryCondition	Flow Hydrograph
2	Downstream2D BCLine: DSBoundaryCondition	Normal Depth

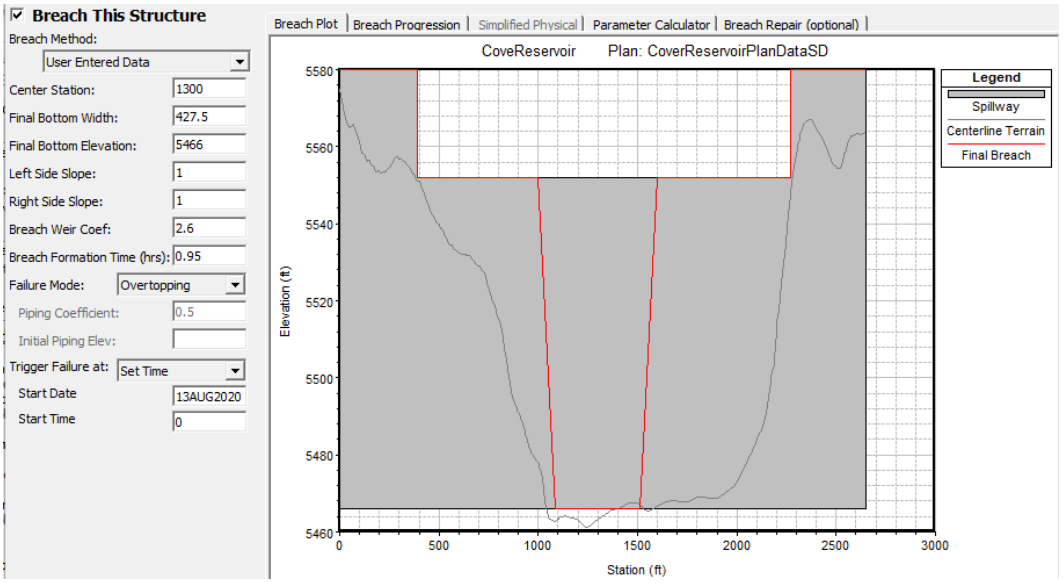
Flow Hydrograph = No Storm

	Storage Area/2D Flow Area	Initial Elevation
1	SA: CoveReservoir	5549
2	2D: Downstream2D	

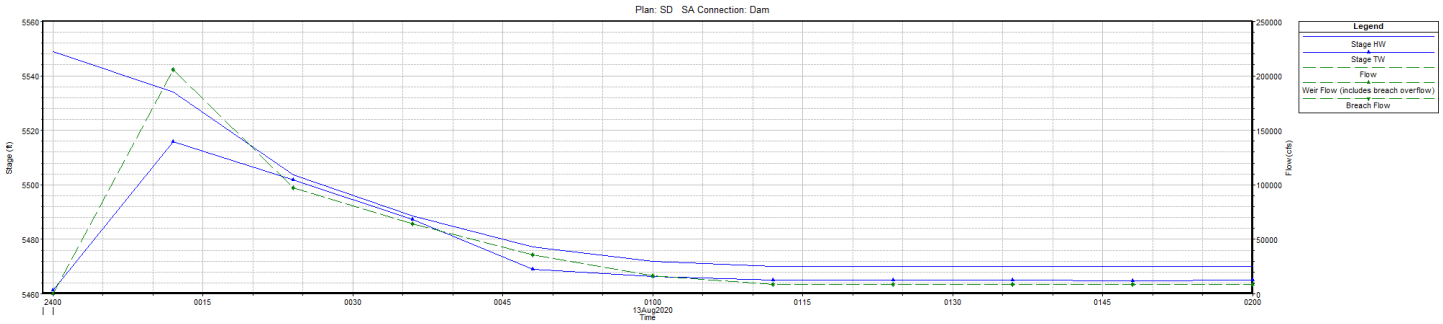
Unsteady Flow Analysis



Storage Area Connection Breach Data



Stage and Flow Hydrograph



Rainy Day

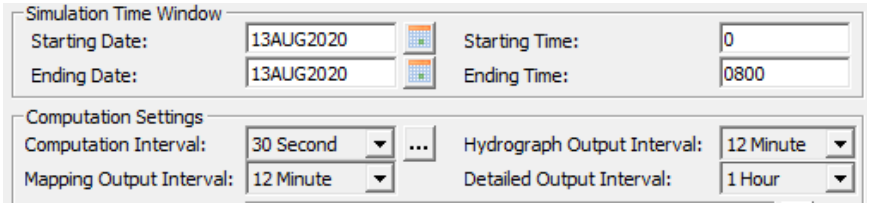
Unsteady Flow Data

Storage/2D Flow Areas		Boundary Condition
1	CoveReservoir BCLine: USBoundaryCondition	Flow Hydrograph
2	Downstream2D BCLine: DSBoundaryCondition	Normal Depth

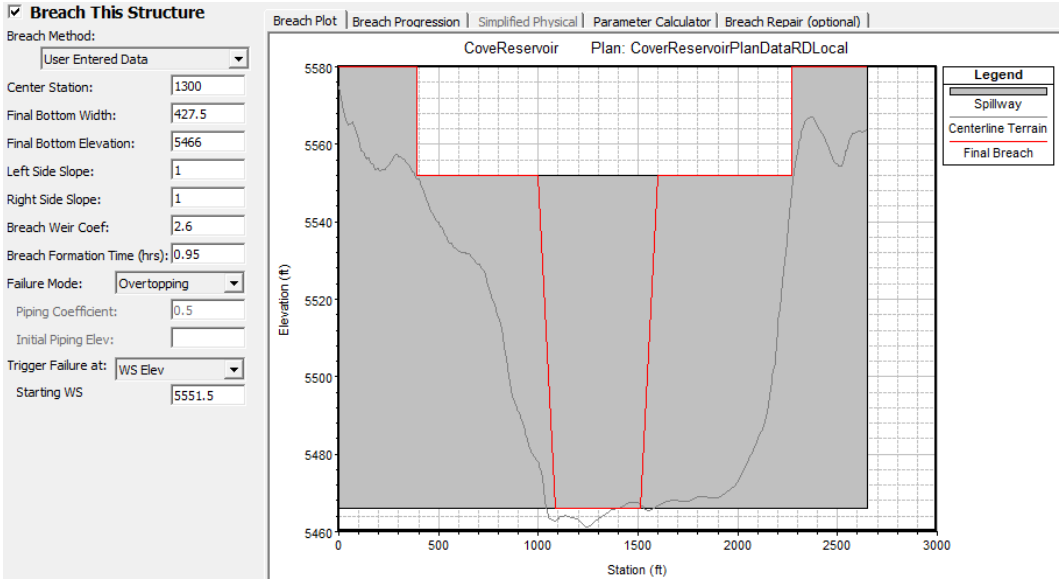
Flow Hydrograph = FBH-L

	Storage Area/2D Flow Area	Initial Elevation
1	SA: CoveReservoir	5549
2	2D: Downstream2D	

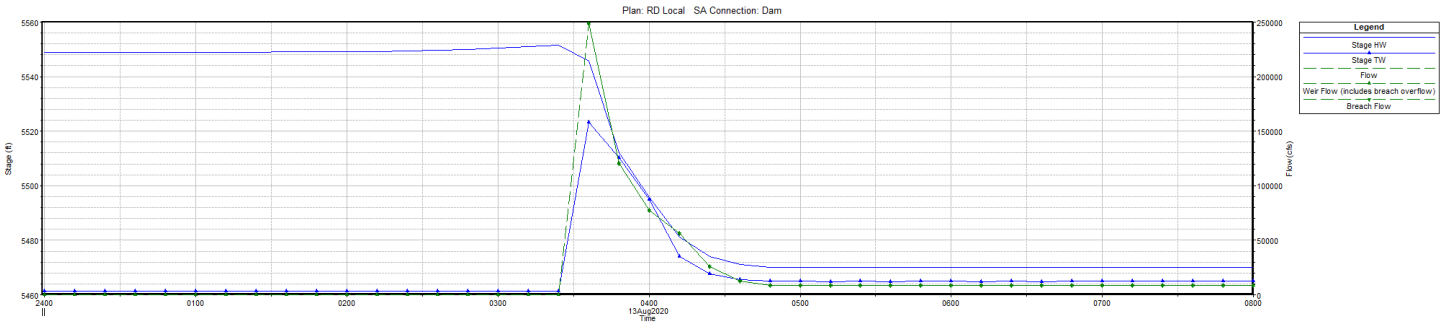
Unsteady Flow Analysis



Storage Area Connection Breach Data



Stage and Flow Hydrograph



Attachment 3 Cove Dam Feasibility Study

DIVISION OF WATER RESOURCES
Engineering Geology Section
1594 West North Temple, Suite 310
Box 145201
Salt Lake City, Utah 84114-6201

M E M O R A N D U M

October 6, 1997

Post-it® Fax Note 7671	Date 10/10/97	# of pages ▶ 15
To Brad Price	From Dan Aubrey	
Co./Dept. RB46	Co. Water Resources	
Phone #	Phone # 538-7283	
Fax # 801-374-5773	Fax #	

TO: Ben Everitt
Chief Geologist
FROM: Dan Aubrey
Engineering Geologist
SUBJECT: Test Pits At Cove Dam Site Near Orderville, Kane County, Utah.

Introduction and Location

On Wednesday, June 4th at the request of Kane County Water Conservancy District I supervised the digging of a number of test pits along the proposed alignments for two offstream damsites in the lower reaches of Cove Canyon. The lower alignment, including both abutments is located in the SW¼ of Sec.5, T41S, R7W, SLB&M. The right abutment of the upper alignment is located in the SE¼ of Sec. 6, while the left abutment is located in the NW¼ of Sec. 5, T41S, R7W, SLB&M (see Figure 1). A total of nine test pits were located and logged, six pertaining to the upper alignment and three along the lower alignment (see Figure 1).

These sites had been identified during a reconnaissance level inventory of Virgin River damsites during the mid- to late 1980's. Not until 1996 did this location receive any further attention concerning its viability as a potential damsite(s). Franson-Nobel & Associates, Inc., in June of 1996, completed a reconnaissance level evaluation, in part, to help in the preparation of preliminary cost estimates. Continued interest in the site by both the Kane County Water Conservancy District and the Washington County Water Conservancy District resulted in this first review of the site from a geology and geotechnical point of view.

Given a storage of 6,700 acre-feet, a dam at the lower alignment would have to be approximately 98 feet high and at the upper alignment a dam would have to be about 103 feet high to store this amount of water. A dam of this height at the upper site may require the placement of a dike in the saddle just upstream of the right abutment.

Geologic Setting

The proposed Cove damsites are located in an alluvial valley, tributary to Long Valley and the East Fork Virgin River, that has been cut into a sequence of Cretaceous and Tertiary sedimentary rocks consisting mostly of sandstone and shale. Based on a review of pertinent geologic maps and literature the bedrock exposed in the abutments and underlying the alluvium in the reservoir basins is of the Cretaceous aged Tropic Shale Formation. The shale is predominantly gray, carbonaceous, calcareous, and includes bentonitic horizons and thin lenticular sandstones. The residual soil is a silty to sandy clay (CL to CH). Capping abutment ridges is a thin light brown deposit of gravel containing pebbles and cobbles of gray and red

quartzite, grey to black chert, and grey limestone. Alluvium which covers the flat valley floor of the Cove is predominantly light to medium brown, fine to very fine grained sand with silt, and clay.

Based on research of water well logs, depth to bedrock in Long Valley (underlying the East Fork Virgin River) is approximately 50 feet. Making the assumption that tributaries are graded to the main valley results in projected depth to bedrock under the lower alignment of about 40-45 feet, and under the upper alignment of about 35-40 feet. The valley is approximately 1,000 feet wide at the lower alignment and about 1,500 feet wide at the upper alignment.

Discussion of Test Pits and Geotechnical Considerations

Figure 2 is a graphic representation of the materials encountered in the test pits. In general the materials encountered were very fine grained sand to silt and clay (SM, ML, & CL). The two test pits (#'s 2 & 7) located at the base of the right abutment, at each damsite, encountered some gravel. The gravel is contributed from the colluvial slopes of the abutment. Test pit #5 which was located in the drainage near the left abutment of the upper alignment encountered the most granular material. Here 6.5 feet of poorly graded sandy gravel contains cobbles to 14" diameter. Calcite (calcium carbonate) stringers are moderately abundant to very abundant in the test pits below 6 or 7 feet, in most of the test pits. Restricted access prevented us from placing test pits on or near the left abutments of either alignment.

Based on the test pits it appears that there is an abundance of cohesive material available for dam construction, however, the test pits did not identify an adequate source of granular material. At this level of investigation (considering only the geology and geotechnical aspects) it does not appear that one alignment has any advantage over the other.

Geologic Hazards

Following digging of the test pits, I performed a preliminary geologic hazards review of the sites. The summary of geologic hazards (see Table 1) accompanies this report. While most of the hazards listed in the summary, rate in the unlikely hazards category there are two geologic hazards which fall into the probable category and five which rate as possible hazards. These are identified as follows:

Probable Hazards -- 1. Ground shaking due to an earthquake centered on the nearby Sevier Fault, and 2. Expansive clays which occur in the Tropic Formation throughout southern Utah.

Possible Hazards -- 1. Liquefaction, 2. Tectonic subsidence, and 3. Slope failure are all related to proximity of the Sevier Fault. 4. Collapsible soils and 5. Pipable/Erodible hazards are related to the identification in the test pits of very fine grained sand and non-cohesive silt.

Further study will be necessary to determine what impact these seven hazards might have on a dam constructed at either of these sites.

Conclusions and Recommendations

Based on information from the test pits and geologic hazards evaluation the following conclusions can be reached:

1. There is an abundance of cohesive material available, including some bentonite outcroppings in the Tropic Shale.

2. Only a very limited amount of granular material is available, and nothing that is suitable as rip rap was identified.
3. At this level of investigation one site does not seem to have any substantial advantage over the other.
4. Either site is capable of storing 6,700 acre-feet of water.
5. Proximity of these sites to the Sevier Fault and the presence of expansive clays and very fine grained non-cohesive soils are geologic hazards.
6. As part of a preliminary design, additional studies should address specific hazards.

The following recommendations are suggested:

1. A seismic hazards evaluation of the Sevier Fault will be needed to determine what impact this hazard might have on these damsites.
2. Laboratory testing of soil samples is necessary to determine if a soils/foundation hazard exists.
3. A careful cost estimate ought to be prepared for these sites so a benefit /cost ratio can be developed.
4. From a geologic and geotechnical view the next step would be to pursue investigation of the subsurface conditions by drilling, sampling and testing (permeability, blow counts, etc.) along the proposed alignment.

TABLE # 1

SUMMARY OF GEOLOGIC HAZARDS

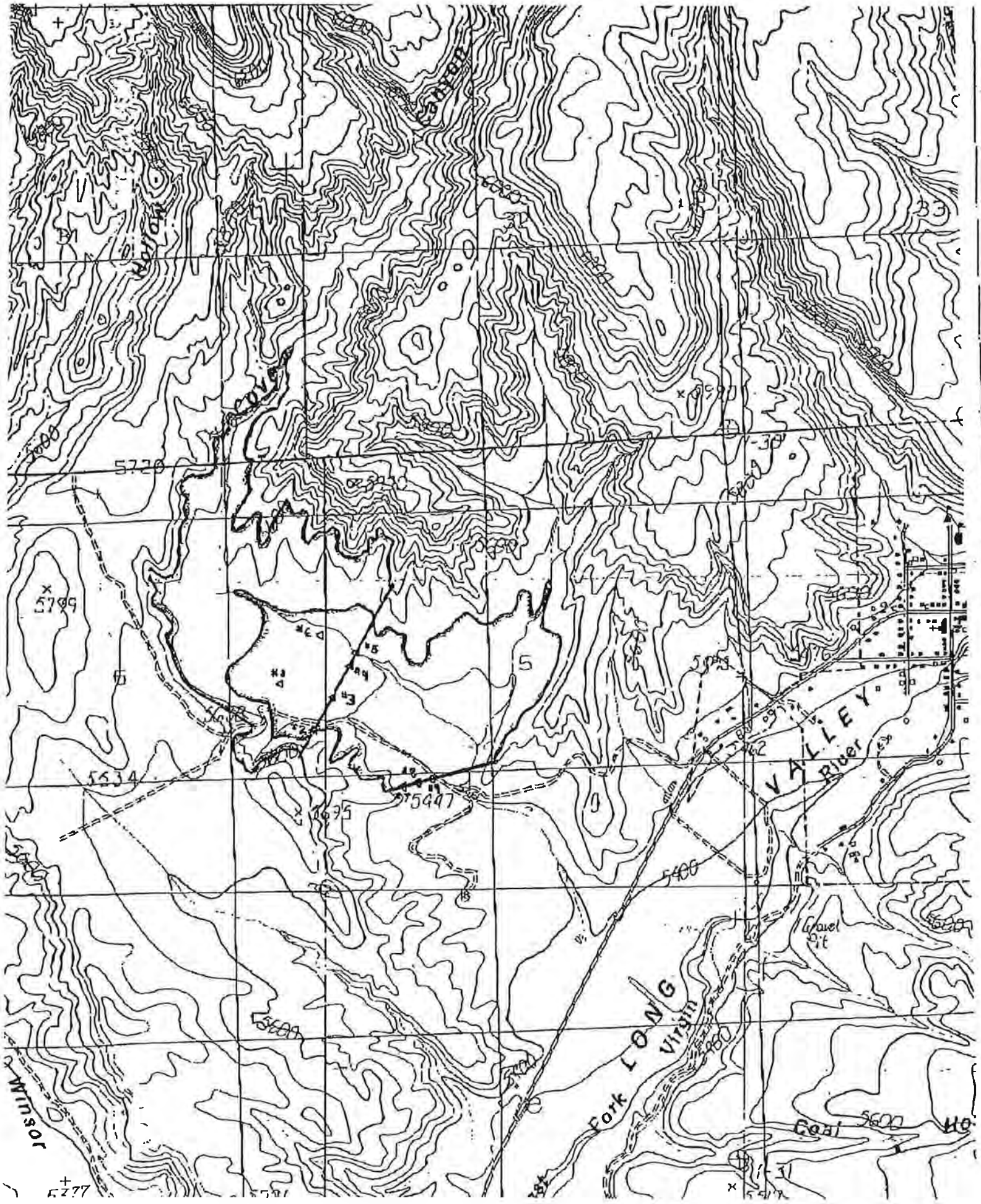
COVE DAMSITES

	Hazard Rating*			Further Study Recommended**
	Probable Hazard	Possible Hazard	Unlikely Hazard	
Earthquake				
Ground shaking	E,F			G
Liquefaction		AF		S
Surface faulting			X	
Tectonic deformation		E,RB		G
Slope failure		A,RB		G
Seiche			X	
Slope Failure (Non-seis)				
Rock fall			X	
Landslide			X	
Debris flow			X	
Found/Embank Problems				
Collapsible soils		AF		S
Expansive clays	F,A			S
Sensitive clays			X	
Organic soils			X	
Soluble salts			X	
Erodable/Erodible		E		S
Karst			X	
Differential settlement			X	
Non-engineered fill			X	
Hydrologic				
Shallow ground-water			X	
Springs/Seeps			X	
Flooding				
Stream/Lake			X	
Upstream dam failure			X	
Spillway capacity			X	
Dam overtopping			X	

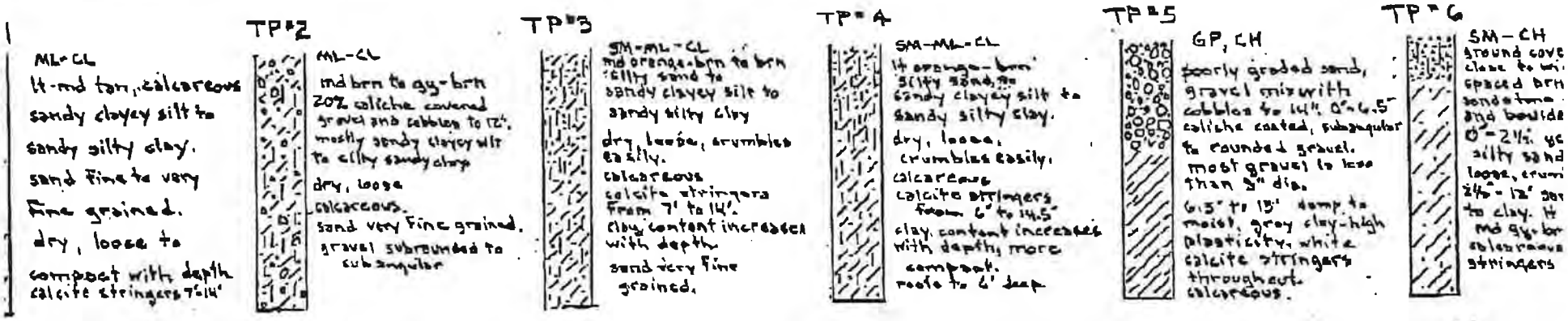
*Hazard Rating - Probable-evidence is strong that the hazard exists and mitigation measures should be taken. Possible-hazard may exist, but evidence is uncertain and further study is recommended. Unlikely-no evidence was found to indicate that the hazard is present.

Abbreviations; E = embankment, F = foundation, AF = alluvial foundation, BF = bedrock foundation, A = abutments, RB = reservoir basin, SL = shore line, DST = down stream toe, UST = up stream toe, DSF = down stream face, USF = up stream face, SP = spillway, & NA = Not applicable.

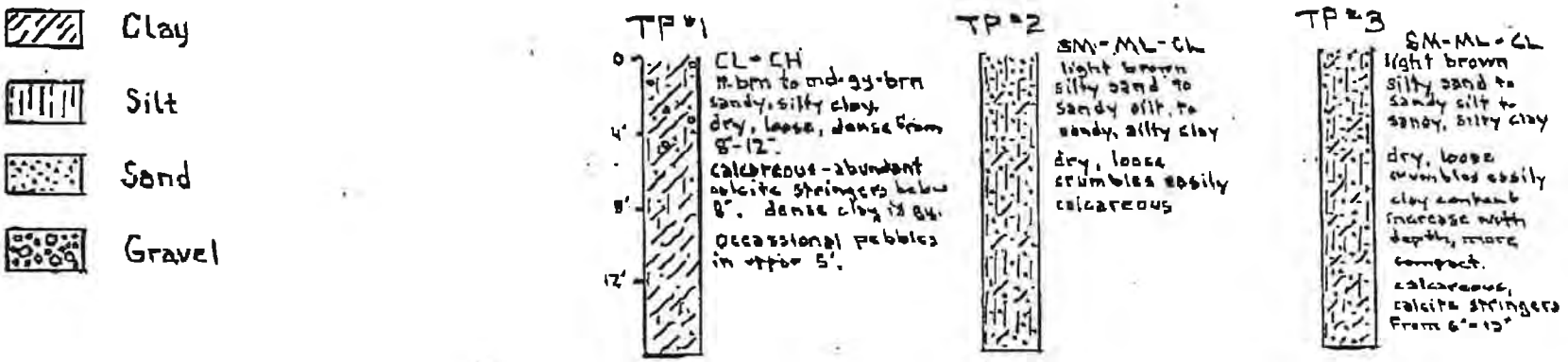
**Further Study (S-soil/foundation, G-geotecnical/engineering, H-hydrologic, SIP-study in progress, MIP-mitigation measures in progress) is recommended to address the hazard (see Conclusions and Recommendations).


Canyon
Coyote
5720
5709
5634
5447
5400
5600
VALLEY
River
Gravel Pit
Fork LONG
Virgin
Coal
Wilson

Upper Alignment



Lower Alignment



See Map for Test Pit Locatic

Figure #2

AMERICAN 22-144 200 SHEETS

Proposed Cove Canyon Dam and Reservoir Near Orderville, Utah
Reconnaissance-Level Evaluation
June 1996

Introduction

This study was performed at the request of the Kane County Water Conservancy District. The objective of the study is to determine the feasibility of constructing a dam and reservoir at the Cove Canyon site near Orderville. The study was performed at reconnaissance level and all results are preliminary in nature. This study included the following elements: 1) evaluation of irrigation diversion requirements in the Glendale-Orderville-Mt. Carmel area; 2) development of a computer operation model which simulates operation of the existing river diversions and the proposed reservoir; 3) preparation of preliminary cost estimates; and 4) performing preliminary financial analyses.

Irrigation Diversion Requirements

Because of the controversy surrounding the State Engineer's proposed determination of water rights and the associated irrigation duty in the Virgin River drainage basin, a re-examination of the consumptive use of crops grown in the Glendale-Orderville-Mt. Carmel area was performed. Table 1 summarizes the net crop consumptive use and the diversion requirement per acre for the study area. Consumptive use values shown in the table were derived from the report entitled "Consumptive Use of Irrigated Crops in Utah, Research Report 145." This report was prepared by the Utah Agricultural Experiment Station, Utah State University in October 1994. The Utah Division of Water Rights was a sponsor of the report. The diversion requirement per acre or duty shown in the table is based on the consumptive use and an irrigation conveyance and application efficiency of 47 percent. This is the same efficiency used in the State Engineer's proposed determination.

Table 1
Net Crop Consumptive Use and Diversion Requirement per Acre for Glendale, Orderville, and Mt. Carmel
(acre-feet per acre)

Crop	Alfalfa	Pasture	Grain	Grass Hay	Corn	Orchard	Weighted Average	Diversion Requirement
Percentage of acres	59.9	25.1	4.6	4.4	0.7	5.2	100	
April	0.00	0.06	0.00	0.08	0.03	0.00	0.02	0.04
May	0.49	0.32	0.30	0.48	0.42	0.50	0.44	0.94
June	0.47	0.41	0.65	0.68	0.47	0.47	0.47	1.00
July	0.66	0.42	0.59	0.56	0.55	0.67	0.59	1.26
August	0.35	0.32	0.00	0.14	0.08	0.37	0.31	0.66
September	0.27	0.21	0.00	0.03	0.00	0.26	0.23	0.49
Total	2.23	1.74	1.54	1.96	1.55	2.28	2.06	4.39

As shown in the table, the calculated diversion requirement is 4.39 acre-feet per acre, which is higher that the State Engineer's proposed duty of 4.00 acre-feet per acre. However, because the

4.39 acre-feet per acre value is based on information developed with the State Engineer's cooperation, it appears that there could be a legitimate appeal of the proposed duty. In evaluating the Cove Reservoir site, 4.39 acre-feet per acre was used as the diversion requirement.

Computer Operation Model

A computer operation model was developed to simulate flows of the East Fork of the Virgin River, irrigation diversions for the Glendale, Orderville, and Mt. Carmel Irrigation Companies, and diversions into and releases from the proposed Cove Canyon Reservoir. The period of study was 1968-95. This period was selected because of the availability of flow records. All river flows at the Glendale Irrigation Company diversion are based on the USGS gage "East Fork Virgin River Near Glendale." The computer model includes two separate studies, a preproject study and a project study. The preproject study uses direct river flows only without storage to determine remaining demands and to quantify storable flows. The preproject study used present water right acreage. Based on the results of the preproject study, there is an average of approximately 8,400 acre-feet per year of storable water at the site. This value takes into account the bypass requirements of the proposed Federal reserved water right settlement.

Preliminary Cost Estimates

Preliminary cost estimates for Cove Canyon Dam, the East Fork Feeder Pipeline, and the East Fork Diversion Dam were prepared using USGS 7.5 minute quadrangle maps. The locations of these features are shown in Figure 1. No geological nor geotechnical investigations have been performed and the study assumes that the proposed sites are geologically feasible. In order to evaluate different dam heights, a cost vs. dam height curve was developed. Supporting cost data used in this study is contained in the appendix.

Financial Analysis

A simple financial analysis was performed to determine amortized costs. These costs are displayed as total amortized capital costs and per-acre-foot amortized costs. Amortization was based on 3 percent interest with a 25-year repayment period. These values are commonly used by the Utah Board of Water Resources for irrigation project loans.

Results

Two alternatives for Cove Canyon Dam and Reservoir were evaluated. Alternative 1 is based on the irrigation requirements of the present water right acreage of the three irrigation companies. Alternative 2 includes additional arable lands as identified in the "Draft Water Resources Master Plan, Phase I & II, April 1996" prepared by Boyle Engineering. Summary results for Alternatives 1 and 2 are provided in Tables 2 and 3, respectively.

As shown in the tables, the total capital cost of Alternative 1 is $6,620,000 and the total capital cost of Alternative 2 is $12,780,000. The total cost for Alternative 2 does not include the cost of acquiring downstream water rights, which would be necessary since the river basin is closed to new appropriations. The annual cost per acre-foot of water delivered is $567 for Alternative 1 and $360 for Alternative 2.

The per acre-foot cost of both alternatives is quite high and cannot be repaid by agricultural interests. The cost per acre-foot is also quite high for M&I use. Other sources of non-reimbursable funding would likely be required to make the project financially feasible.

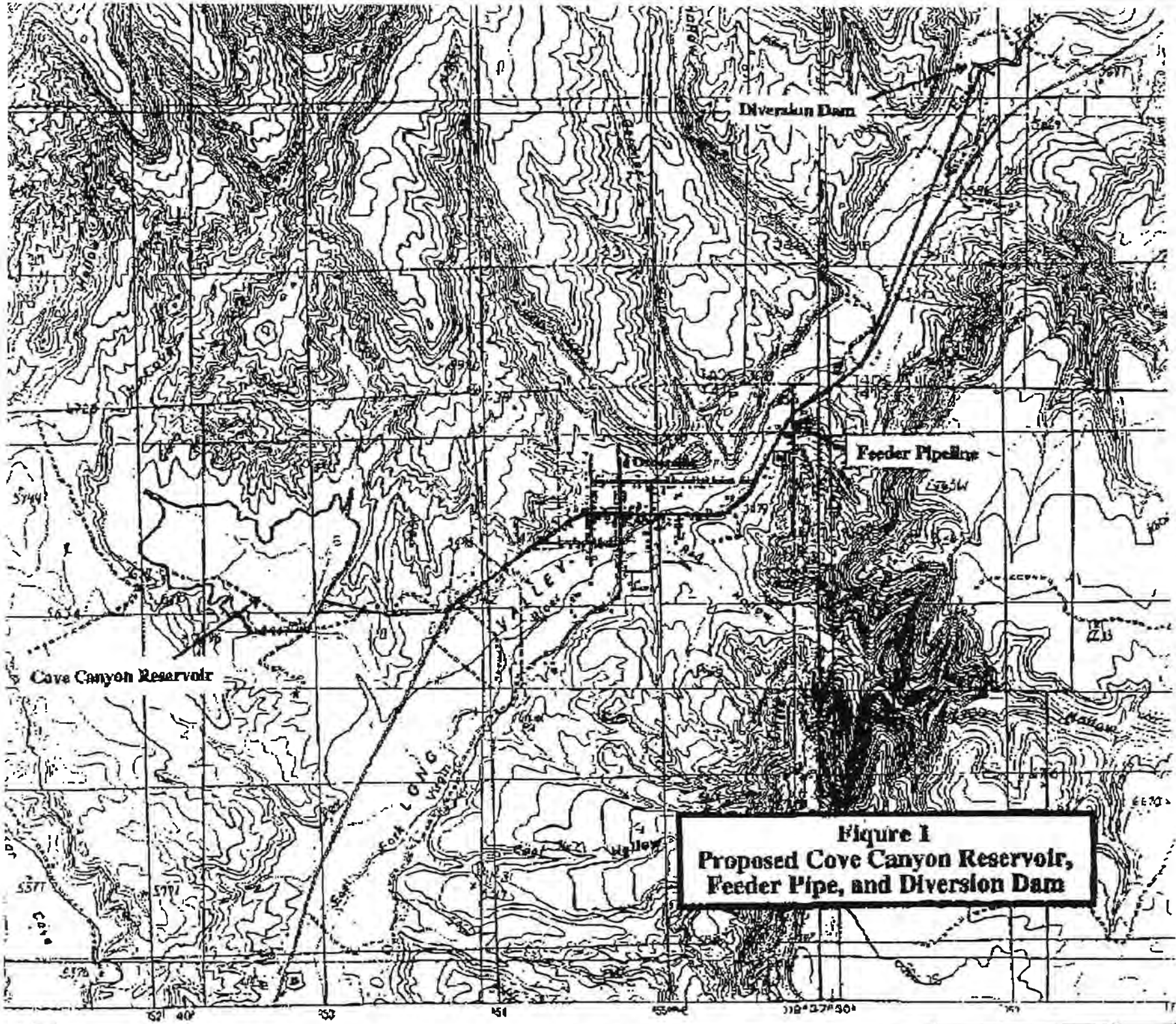


Figure 1
Proposed Cove Canyon Reservoir, Feeder Pipe, and Diversion Dam

Table 2
Alternative 1 Summary Data

Irrigated Area	
Glendale	434 acres
Orderville	286 acres
Mt. Carmel	404 acres
Total	1,124 acres
Diversion requirement	4,929 acre-feet
Present irrigation supply	4,203 acre-feet
Remaining demand	726 acre-feet
Cove Reservoir	
Storage capacity	2,420 acre-feet
Surface area when full	87 acres
Irrigation water supplied by storage	671 acre-feet
Cove Dam	
Crest elevation	5505 feet
Dam height	65 feet
Cost	$6,000,000
Feeder Pipeline	
Capacity	6 cfs
Diameter	15 inches
Length	3.3 miles
Cost	$370,000
Diversion Dam	
Cost	$250,000
Financial Data	
Total capital cost	$6,620,000
Amortized capital cost (25 years, 3 percent interest)	$380,173
Amortized capital cost per acre-foot of water supplied	$567

Table 3
Alternative 2 Summary Data

Irrigated Area	
Glendale	509 acres
Orderville	436 acres
Mt. Carmel	733 acres
Total	1,678 acres
Diversion requirement	7,358 acre-feet
Present irrigation supply	5,171 acre-feet
Remaining demand	2,187 acre-feet
Cove Reservoir	
Storage capacity	6,000 acre-feet
Surface area when full	165 acres
Irrigation water supplied by storage	2,038 acre-feet
Cove Dam	
Crest elevation	5532 feet
Dam height	92 feet
Cost	$12,000,000
Feeder Pipeline	
Capacity	10 cfs
Diameter	21 inches
Length	3.5 miles
Cost	$530,000
Diversion Dam	
Cost	$250,000
Financial Data	
Total capital cost	$12,780,000
Amortized capital cost (25 years, 3 percent interest)	$733,928
Amortized capital cost per acre-foot of water supplied	$360

Cove Canyon Dam
Alternative 3 Summary Data

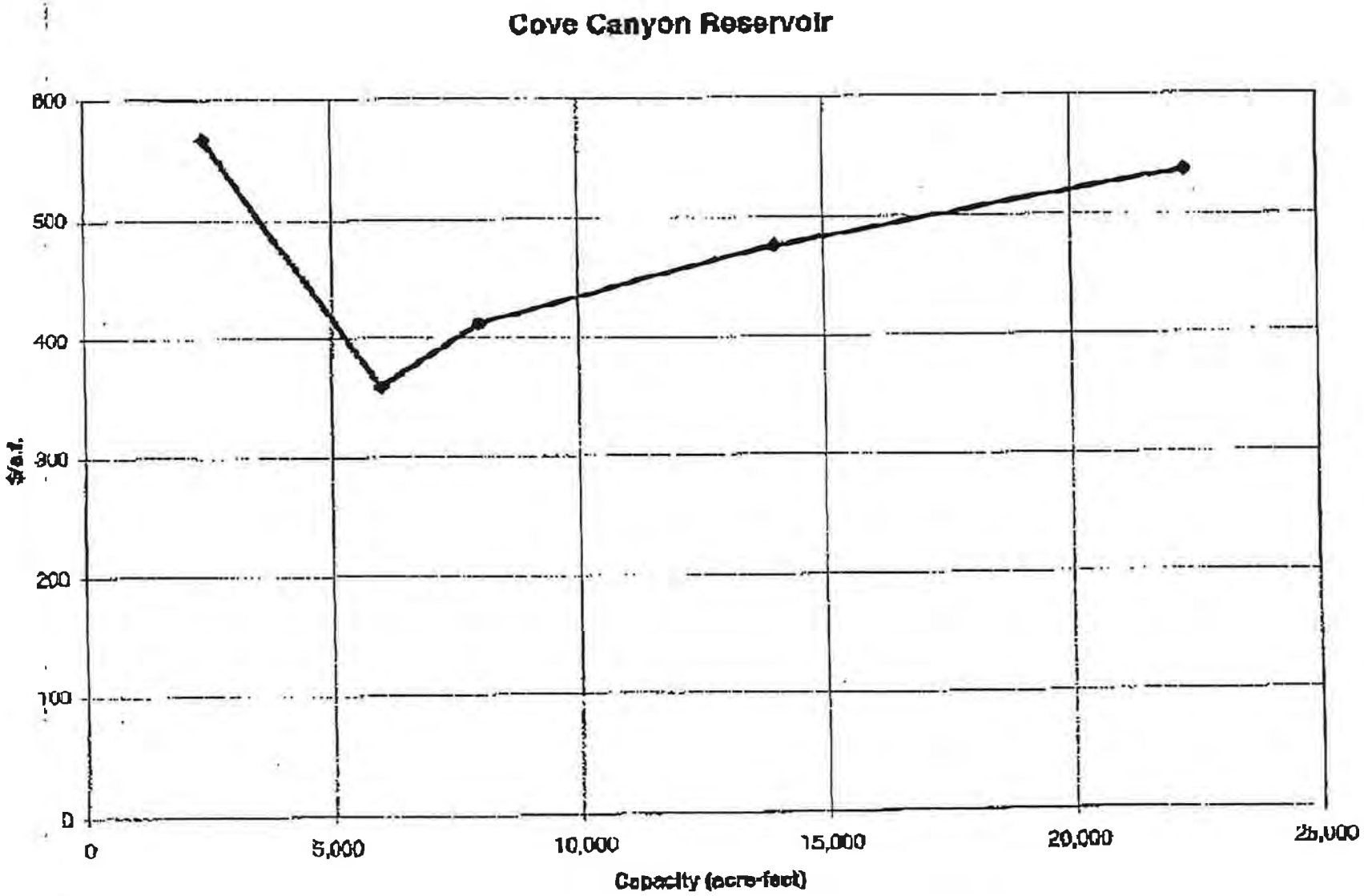
Irrigated Area	
Glendale	509 acres
Orderville	436 acres
Mt. Carmel	733 acres
Total	1,678 acres
Diversion requirement	7,358 acre-feet
Present irrigation supply	5,171 acre-feet
Remaining demand	2,187 acre-feet
Other demand	2,286 acre-feet
Cove Reservoir	
Storage capacity	22,300 acre-feet
Surface area when full	326 acres
Irrigation water supplied by storage	4,309 acre-feet
Cove Dam	
Crest elevation	5600 feet
Dam height	160 feet
Cost	$39,000,000
Feeder Pipeline	
Capacity	20 cfs
Diameter	30 inches
Length	3.5 miles
Cost	$1,060,000
Diversion Dam	
Cost	$250,000
Financial Data	
Total capital cost	$40,310,000
Amortized capital cost (25 years, 3 percent interest)	$2,314,917
Amortized capital cost per acre-foot of water supplied	$537

Cove Canyon Dam
Alternative 4 Summary Data

Irrigated Area	
Glendale	509 acres
Orderville	436 acres
Mt. Carmel	733 acres
Total	1,678 acres
Diversion requirement	7,358 acre-feet
Present irrigation supply	5,171 acre-feet
Remaining demand	2,187 acre-feet
Other demand	984 acre-feet
Cove Reservoir	
Storage capacity	14,000 acre-feet
Surface area when full	269 acres
Irrigation water supplied by storage	3,166 acre-feet
Cove Dam	
Crest elevation	5570 feet
Dam height	130 feet
Cost	$25,000,000
Feeder Pipeline	
Capacity	19 cfs
Diameter	30 inches
Length	3.5 miles
Cost	$1,007,000
Diversion Dam	
Cost	$250,000
Financial Data	
Total capital cost	$26,257,000
Amortized capital cost (25 years, 3 percent interest)	$1,507,883
Amortized capital cost per acre-foot of water supplied	$476

Cove Canyon Dam
Alternative 5 Summary Data

Irrigated Area	
Glendale	509 acres
Orderville	436 acres
Mt. Carmel	733 acres
Total	1,678 acres
Diversion requirement	7,358 acre-feet
Present irrigation supply	5,171 acre-feet
Remaining demand	2,187 acre-feet
Other demand	188 acre-feet
Cove Reservoir	
Storage capacity	8,000 acre-feet
Surface area when full	192 acres
Irrigation water supplied by storage	2,341 acre-feet
Cove Dam	
Crest elevation	5545 feet
Dam height	105 feet
Cost	$16,000,000
Feeder Pipeline	
Capacity	11 cfs
Diameter	21 inches
Length	3.5 miles
Cost	$583,000
Diversion Dam	
Cost	$250,000
Financial Data	
Total capital cost	$16,833,000
Amortized capital cost (25 years, 3 percent interest)	$966,683
Amortized capital cost per acre-foot of water supplied	$413


Cove Canyon Reservoir
600
500
400
300
200
100
0
s.l.
0
5,000
10,000
15,000
20,000
25,000
Capacity (acre-feet)

Attachment 4 Subsurface Investigation Data

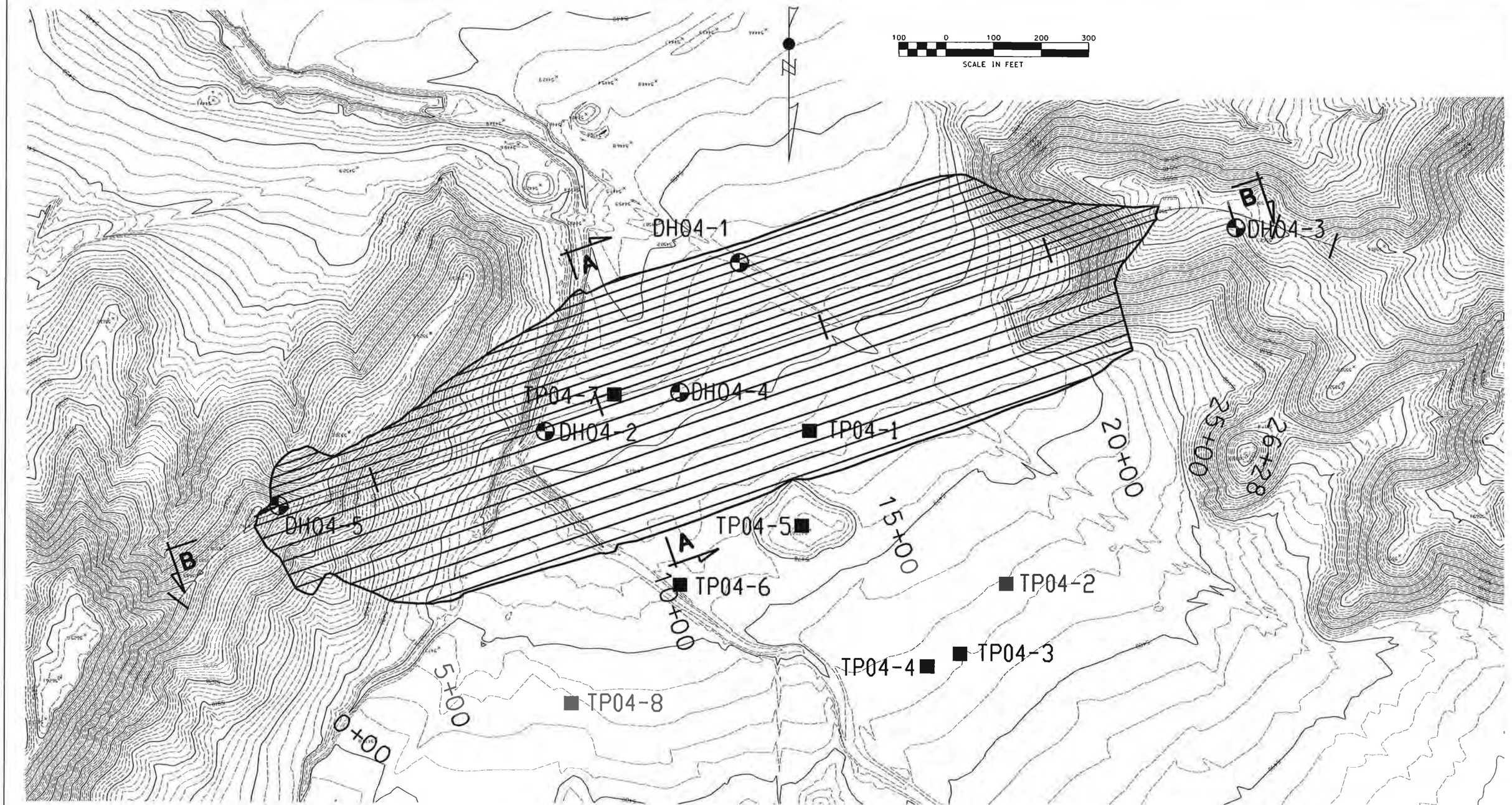
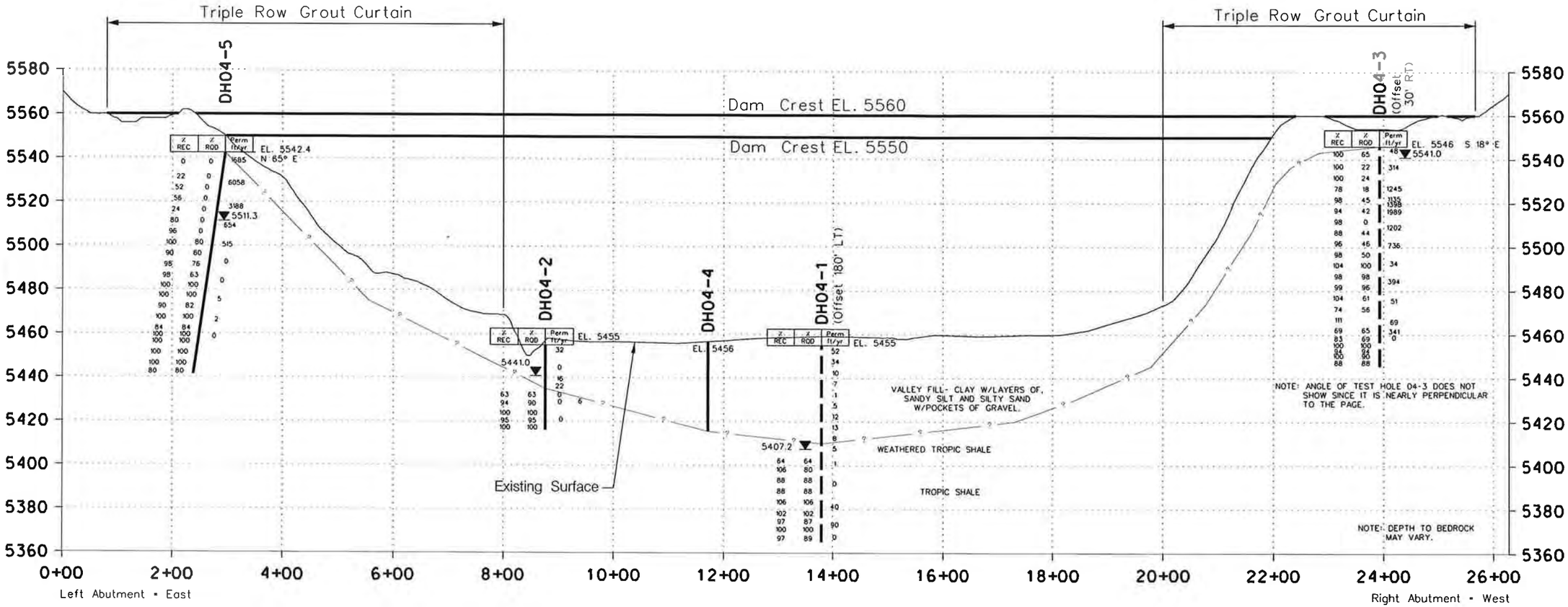


Figure 4

RB&G ENGINEERING INC.
Provo, Utah

Cove Dam
Orderville, Utah

Dam Plan View,
Test Pit and Drill Hole
Locations



GEOLOGIC CROSS-SECTION (PROFILE)

Note: Exaggerated Vertical Scale,
Scale: 1"=50' Vertical
1"=200' Horizontal

Figure 5

RB&G ENGINEERING INC.
Provo, Utah

Cove Dam
Near Orderville, Utah

Geologic Profile

Borings

DRILL HOLE LOG

BORING NO. 04-1

Sheet: 1 of 2

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 4/13/04
LOCATION: SEE SITE PLAN - MAXIMUM SECTION — ELEVATION: ~5454.0'
DRILLER: D. SAMPSON, N. BAILEY — LOGGED BY: M.H., V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.W. CASING TO 51.5'
DEPTH TO WATER - INITIAL: ▽ N.M. AFTER 24 HOURS: ▽ 46.8' 6/3/04

Elev. (Feet)	Depth (Feet)	Lithology	SAMPLE Type	SAMPLE Rec. (In.)	See Legend	USCS	Material Description	Permeability, ft/yr	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
				6	5,3,3	CL-ML	lt. brown, dry, firm — SILTY CLAY W/SAND, calcareous	52								
5450	5			8	Pushed 1.00+	CL-1	lt. brown, dry, hard — LEAN CLAY	34	120.3	9.8	32	14	0	10	90	CT
5445	10			5	7,9,11	CL	lt. brown, dry, very stiff — CLAY W/SAND	10								
5440	15			12	Pushed 1.00+	CL-2	lt. brown, dry, hard — SANDY CLAY	7	119.4	8.7	37	19	0	17	83	CT
5435	20			5	9,12,17	CL,SM	lt. brown, dry, very stiff — SILTY CLAY W/SILTY SAND LENSES & LAYERS	1								
5430	25			12	Pushed 1.00+	CL-2	lt. brown, dry, hard	5	112.4	14.3	34	18	0	6	94	CT
5425	30			6	8,12,13	CL	med. to lt. brown, dry, very stiff, w/white stringers — LEAN CLAY	12								
5420	35			18	Pushed 1.00+	CL-2	med. brown, moist, very stiff	13	105.2	17.5	49	31	0	3	97	CT
5415	40			18	4,6,8 0.72	CL	med. brown, moist to slightly wet, stiff	8								
5410	45			12	Pushed 0.72	CL-2/CH	grayish-med. brown, moist, stiff, w/white stringers — LEAN TO FAT CLAY W/SOME SAND	5	100.7	23.1	50	34	0	6	94	CT
5405	50						TROPIC SHALE FORMATION									

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LEGEND

- 2,3,2 ← Blow Count per 6"
- 0.45 ← Torvane (tsf)
- Disturbed Sample
- Core
- 100,60 ← Rock Quality Designation (RQD)
- Percent Sample Recovery
- Undisturbed Sample
- ▽ ← Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

DRILL HOLE LOG

BORING NO. 04-1

Sheet: 2 of 2

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 4/13/04
LOCATION: SEE SITE PLAN - MAXIMUM SECTION — ELEVATION: ~5454.0'
DRILLER: D. SAMPSON, N. BAILEY — LOGGED BY: M.H., V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.W. CASING TO 51.5'
DEPTH TO WATER - INITIAL: ▽ N.M. AFTER 24 HOURS: ▽ 46.8' 6/3/04

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	Rec. (In.)	See Legend	USCS	Material Description	Permeability, ft/yr	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
				18	18,28,36	CL	dk. gray, moist, hard **SLIGHTLY SHALEY CLAY** very highly weathered bedrock, w/many gypsum stringers	1								
				19	Core 64,64	CH				16.4	80	50	0	0	100	
5400																
	55			64	Core 106,80	-	dk. gray **HIGHLY WEATHERED MUDSTONE** few gypsum stringers									
							dk. gray **LESS WEATHERED MUDSTONE** shells									
5395																
	60			53	Core 88,88	-	dk. gray	0								
5390							**SLIGHTLY WEATHERED MUDSTONE**									
	65			53	Core 88,88	-	dk. gray slickenside									
5385																
	70			64	Core 106,106	-	0.25" clay seam									
						CH	white-gray **BENTONITE W/SAND & LIMESTONE GRAVEL**	40		13.2	70	45	0	0	100	
5380																
	75			61	Core 102,102	-	dk. gray									
5375							**MUDSTONE**									
	80			35	Core 97,87	-	broken zone									
5370				50	Core 100,100	-	dk. gray, some black corbonaceous lenses	90								
	85						white-gray **BENTONITE**									
				44	Core 97,89	-	dk. gray, some black corbonaceous lenses **MUDSTONE**	0								
5365	90															
5360																
	95															
5355																
	100															

06/16/04 10:46:17 AM

LEGEND

- 2,3,2 ← Blow Count per 6"
- 0.45 ← Torvane (tsf)
- Disturbed Sample
- Core 100,60 ← Rock Quality Designation (RQD)
- Percent Sample Recovery
- Undisturbed Sample
- ▽ ← Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

DRILL HOLE LOG

BORING NO. 04-2

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 4/16/04
LOCATION: SEE SITE PLAN - TOE, LEFT ABUTMENT — ELEVATION: ~5458.0'
DRILLER: D. SAMPSON, N. BAILEY — LOGGED BY: M.H., V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.W. CASING TO 21.5' THEN N.Q. CORE
DEPTH TO WATER - INITIAL: ▽ N.M. AFTER 24 HOURS: ▽ 17.0' 6/3/04

Elev. (Feet)	Depth (Feet)	Lithology	Sample Type	Sample Rec. (In.)	Sample See Legend	USCS	Material Description	Permeability, ft/yr	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
				9	2,4,6	CL	lt. brown, dry to moist, firm, w/roots — SILTY CLAY	32								
5455																
	5			14	Pushed 1.00+	CL	dk. brown, slightly moist, hard — LEAN CLAY W/GYPSUM STRINGERS									
				7	14,22,33	CL-2	dk. brown, slightly moist, hard	0		12.2	45	31	0	2		98
5450																
	10			10	15,22,33	CL	dk. brown, moist, hard, some gypsum — LEAN CLAY W/SOME SAND SIZE SANDSTONE FRAGMENTS	16								
5445																
	15			18	Pushed 1.00+	CH	dk. brown, moist, hard — FAT CLAY	22	111.8	19.3	58	34	0	0	100	CT
5440																
	20			18	9,15,33	-	dk. gray — VERY HIGHLY WEATHERED MUDSTONE very high slaking, rapid	6								
				26	Core 63,63	-	LESS WEATHERED MUDSTONE	0								
5435																
	25			56	Core 94,90	CH	dk. gray, dry mech. open 0.2' joint 0.25" clay seam	0		12.5	70	47	0	0	100	
5430																
	30			48	Core 100,100	-	dk. gray, wealky calcareous — MUDSTONE calcareous, high slaking									
5425																
	35			34	Core 95,95	-	a few white silt lenses	0								
				36	Core 100,100	-										
5420																
	40															
5415																
	45															
5410																
	50															

06/16/04 10:46:33 A

LEGEND

- 2,3,2 — Blow Count per 6"
- 0.45 — Torvane (tsf)
- Disturbed Sample
- Core 100,60 — Rock Quality Designation (RQD) / Percent Sample Recovery
- Undisturbed Sample
- Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

DRILL HOLE LOG

BORING NO. 04-3

Sheet: 1 of 2

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 4/26/04
LOCATION: SEE SITE PLAN - RIGHT ABUTMENT — ELEVATION: ~5546.0'
DRILLER: D. SAMPSON, M. BARBOUR — LOGGED BY: M.H., V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.Q. CORE AT 60° FROM HORIZONTAL, TREND S18° E
DEPTH TO WATER - INITIAL: ▽ N.M. AFTER 24 HOURS: ▽ 71.0' 6/3/04

Elev. (Feet)	Depth (Feet)	Lith-ology	Sample Type	Sample Rec. (In.)	See Legend	USCS	Material Description	Permeability, ft/yr	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5545							gray-brown **CLAY/VERY WEATHERED MUDSTONE**	48								
	5		24	Core 100,65	-		gray-brown to brown-gray gypsum									
5540			60	Core 100,22	-		gray-brown	314								
	10															
5535							**SILTY MUDSTONE** calcareous coating, very highly weathered & fractured, multiple angle - haphazard, some gypsum coating on joints, shaley & friable									
	15		61	Core 100,24	CH		gray-brown, dry			13.7	54	33	0	0	100	
5530								1245								
	20		23	Core 78,18	-											
5525								1135								
	25		59	Core 98,45	-		gray-white, some rust staining **BENTONITE**									
							brown **SHALEY MUDSTONE**									
							100% water loss	1398								
5520	30		56	Core 94,42	-		dk. gray w/white bedding **SILTSTONE/MUDSTONE**	1989								
	35		59	Core 98,0	-		interbedded dk. gray & brown, gypsum bedding **SILTY MUDSTONE** calcareous									
5515								1202								
	40		53	Core 88,44	-		interbedded dk. gray & brown w/white stratification									
5510							clay seam									
	45		58	Core 96,46	-		**MUDSTONE**	736								
5505							dk. gray w/brown, some rust stains, some shells, slow slaking									
	50		59	Core 98,50	-											

06/16/04 10:46:49 A

LEGEND

- 2,3,2 ← Blow Count per 6"
- 0.45 ← Torvane (tsf)
- Core ← Disturbed Sample
- 100,60 ← Rock Quality Designation (RQD)
- Percent Sample Recovery
- Undisturbed Sample
- ▽ ← Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

DRILL HOLE LOG

BORING NO. 04-3

Sheet: 2 of 2

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 4/26/04
LOCATION: SEE SITE PLAN - RIGHT ABUTMENT — ELEVATION: ~5546.0'
DRILLER: D. SAMPSON, M. BARBOUR — LOGGED BY: M.H., V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.Q. CORE AT 60° FROM HORIZONTAL, TREND S18° E
DEPTH TO WATER - INITIAL: ▽ N.M. AFTER 24 HOURS: ▽ 71.0' 6/3/04

Elev. (Feet)	Depth (Feet)	Lithology	SAMPLE Type	SAMPLE Rec. (In.)	See Legend	USCS	Material Description	Permeability, ft/yr	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5500	55		Core	62	104,100	-	dk. gray more competent, no bedding, shells, open joint at 53.4' to 53.7', 0.2" clay seam **MUDSTONE**	34								
5495	60		Core	59	98,98	-	dk. gray, some white bedding, trace of gypsum	394								
5490	65		Core	59	99,96	-	rust stain & coating **SILTY MUDSTONE**									
5485	70		Core	62	104,61	-	shells very hard septarian nodule	51								
5480	75		Core	44	74,56	-	gray, high slaking **SHALE** gray **BENTONITE**									
5475	80		Core	62	111,?	-	core is stuck in inner barrel and has not been removed, may contain bentonite 100% water loss	69								
5470	85		Core	41	69,65	-	dk. gray **MUDSTONE** calcareous, some slaking, some lt. gray wavy bedding 40° slickenside	341 0								
			Core	29	83,69	-	0.25" clay seam									
5465	90		Core	60	100,100	-	dk. gray clay seam, not calcareous									
			Core	28	94,94	-										
	95		Core	24	100,100	-	lt. gray **BENTONITE** black & white **LIMESTONE/VOLCANIC ASH BENTONITE**									
5460	100		Core	42	88,88	-	dk. gray **MUDSTONE**									

06/16/04
04:02:52 P

LEGEND

- 2,3,2 ← Blow Count per 6"
- 0.45 ← Torvane (tsf)
- Core ← Disturbed Sample
- 100,60 ← Rock Quality Designation (RQD)
- Percent Sample Recovery
- ← Undisturbed Sample
- ← Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

DRILL HOLE LOG

BORING NO. 04-4

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 4/30/04
LOCATION: SEE SITE PLAN - MAXIMUM SECTION — ELEVATION: ~5458.0'
DRILLER: D. SAMPSON, M. BARBOUR — LOGGED BY: M.H., V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.W. CASING
DEPTH TO WATER - INITIAL: ▽ N.M. AFTER 24 HOURS: ▽ DRY AT 29.3' 6/3/04

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Rec. (In.)	See Legend	USCS	Material Description	Permeability, ft/yr	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5455	0					CL	lt. brown, dry — SANDY LEAN CLAY									
	5															
5450																
	10			7	7,11,14	CL	lt. brown, dry, very stiff — SILTY CLAY									
5445																
	15															
5440																
	20			10	11,14,19	CL	lt. brown, dry, very stiff — SILTY CLAY W/SILTY SAND LENSES									
5435																
	25						gray — harder									
5430																
	30			14	11,15,20	CL/SC	mottled rusty & yellow-brown, slightly moist to dry, hard — SANDY CLAY									
5425																
	35			18	15,32,56	-	brown-gray, slightly moist, hard — VERY HIGHLY WEATHERED MUDSTONE TO VERY HARD CLAY w/gypsum, w/calcite crystals & stringers									
5420																
	40			12	24,66	-	brown-gray, slightly moist, hard — HIGHLY WEATHERED CLAYEY MUDSTONE									
5415							BEDROCK - TROPIC SHALE FORMATION									
	45															
5410																
	50															

06/16/04 10:47:25 AI

LEGEND

- 2,3,2 ← Blow Count per 6"
- 0.45 ← Torvane (tsf)
- Disturbed Sample
- Core
- 100,60 ← Rock Quality Designation (RQD)
- Percent Sample Recovery
- Undisturbed Sample
- Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

DRILL HOLE LOG

BORING NO. 04-5

Sheet: 1 of 2

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 5/4/04
LOCATION: SEE SITE PLAN - LEFT ABUTMENT — ELEVATION: ~5542.4'
DRILLER: D. SAMPSON, M. BARBOUR — LOGGED BY: M.H., V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.Q. CORE AT 60° FROM HORIZONTAL, TREND N65° E
DEPTH TO WATER - INITIAL: ▽ N.M. AFTER 24 HOURS: ▽ 35.0' 6/3/04

Elev. (Feet)	Depth (Feet)	Lithology	Sample Type	Sample Rec. (In.)	See Legend	USCS	Material Description	Permeability, ft/yr	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5540	0							1685								
	5			0	Core 0,0	-	VERY HIGHLY WEATHERED TROPIC SHALE FORMATION									
5535	10			13	Core 22,0	-	brown-gray VERY HIGHLY WEATHERED CLAYEY MUDSTONE TO CLAY W/MUDSTONE FRAGMENTS	6058								
5530	15			31	Core 52,0	-	MUDSTONE RUBBLE W/CLAY MATRIX									
5525	20			34	Core 56,0	-		3188								
	25						MUDSTONE BROKEN TO RUBBLE									
5520				14	Core 24,0	-	brown-gray									
	30			48	Core 80,0	-	brown-gray, calcareous	654								
5515	35			58	Core 96,0	-	MOTTLED & MIXED LAYERS OF DARK GRAY & BROWN MUDSTONE more competent, w/random gypsum stringers, near vertical fractures at 33' to 38', some friable shaley layers 1" to 2" thick									
5510	40			60	Core 100,80	CL-2	brown-gray, dry	515		4.7	43	26	0	9	91	
5505	45			64	Core 90,60	-	w/clay seams, shells									
5500	50					CL-2	dk. gray, dry, shells CALCAREOUS MUDSTONE	0		12.6	47	24	0	2	98	

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LEGEND

- 2,3,2 — Blow Count per 6"
- 0.45 — Torvane (tsf)
- Core — Disturbed Sample
- 100,60 — Rock Quality Designation (RQD)
- Percent Sample Recovery
- Undisturbed Sample
- Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test

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DRILL HOLE LOG

BORING NO. 04-5

Sheet: 2 of 2

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 5/4/04
LOCATION: SEE SITE PLAN - LEFT ABUTMENT — ELEVATION: ~5542.4'
DRILLER: D. SAMPSON, M. BARBOUR — LOGGED BY: M.H., V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.Q. CORE AT 60° FROM HORIZONTAL, TREND N65° E
DEPTH TO WATER - INITIAL: ▽ N.M. AFTER 24 HOURS: ▽ 35.0' 6/3/04

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Rec. (In.)	See Legend	USCS	Material Description	Permeability, ft/yr	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
				59	Core 98,76	-	dk. gray									
5495	55			54	Core 98,63	-	dk. gray	0								
5490	60			53	Core 100,100	-	dk. gray, few shells — SHALEY MUDSTONE, friable, very slow slaking									
	65			60	Core 100,100	-	dk. gray, no gypsum, w/big white shells									
5485								5								
	70			54	Core 90,82	-										
5480							SHALE TO BENTONITE									
	75			60	Core 100,100	-	dk. gray w/few white lenses — CALCAREOUS MUDSTONE	2								
5475							dk. to lt. gray, very soft dk. gray — SHALEY BENTONITE									
	80			50	Core 84,84	-	dk. gray									
5470				12	Core 100,100	-	CALCAREOUS MUDSTONE	0								
	85			60	Core 100,100	-										
5465							very soft — SHALEY BENTONITE									
	90			60	Core 100,100	-	dk. gray — CALCAREOUS MUDSTONE									
5460	95			52	Core 100,100	-										
							LIMESTONE									
5455	100			24	Core 80,80	-	dk. gray — CALCAREOUS MUDSTONE W/SHELLS									

05/16/04 10:49:46 AM

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Provo, Utah

LEGEND

- 2,3,2 ← Blow Count per 6"
- 0.45 ← Torvane (tsf)
- Core ← Disturbed Sample
- 100,60 ← Rock Quality Designation (RQD)
- Percent Sample Recovery
- Undisturbed Sample
- ▽ ← Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test

Top

04-1



Bottom

Depth Cored
51.5 to 90 feet

NQ Core Dia. 1.875 in.
Length of Core Box 2 ft.

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Provo, Utah

Figure Core Photos, Drill Hole # 04-1 *Center Section*
Project *Cove DamSite Feasibility Study*
Location *Orderville, Kane County, Utah*

04-2

Top



Bottom

Depth Cored
21.5 to 39 feet

NQ Core Dia. 1.875 in.
Length of Core Box 2 ft.

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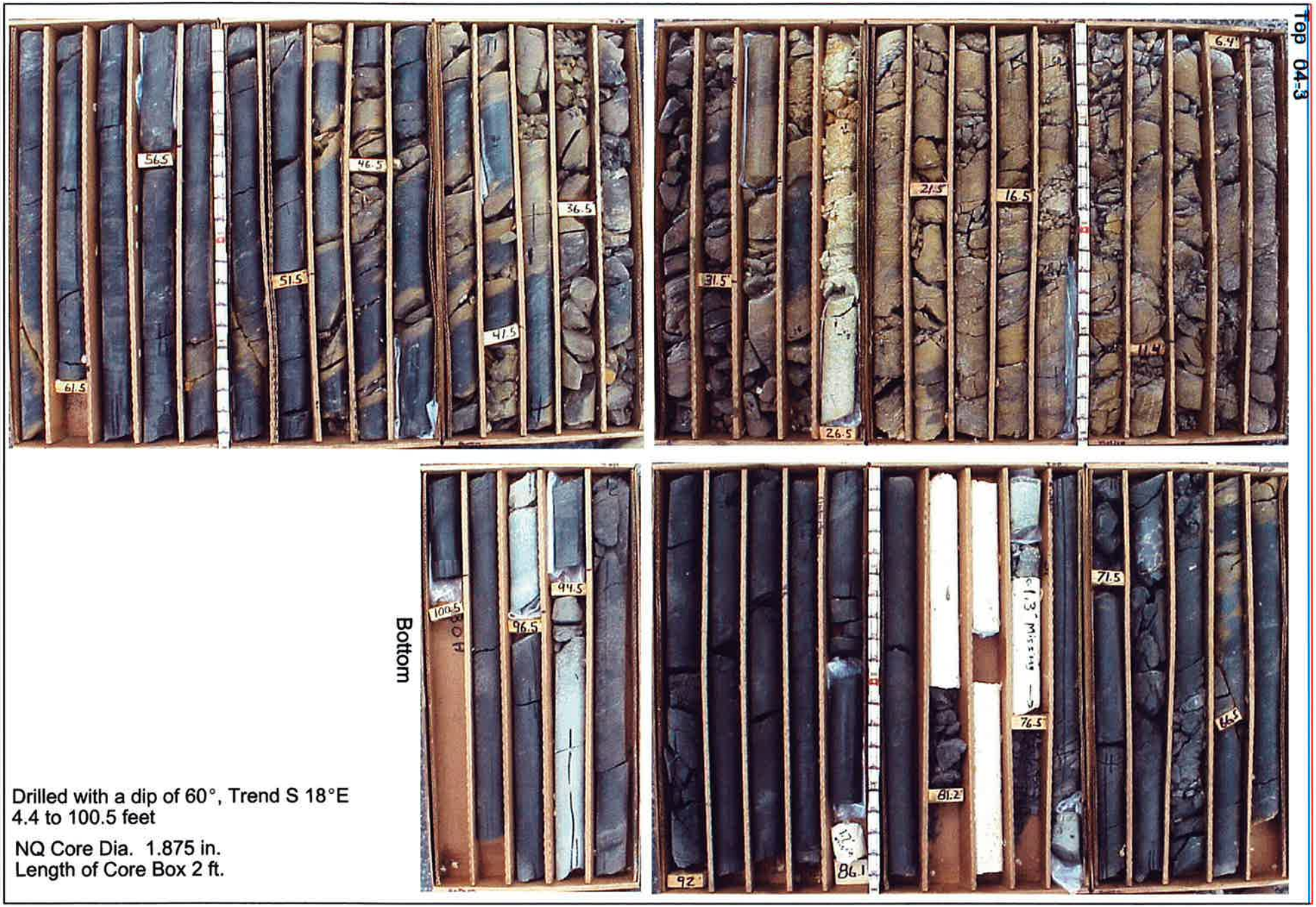
Provo, Utah

Figure Core Photos, Drill Hole # 04-2 ~~Center~~ Max Section
Project *Cove DamSite Feasibility Study*
Location *Orderville, Kane County, Utah*

near toeof slope @ left abutment.



Drilled with a dip of 60°, Trend S 18°E
4.4 to 100.5 feet

NQ Core Dia. 1.875 in.
Length of Core Box 2 ft.

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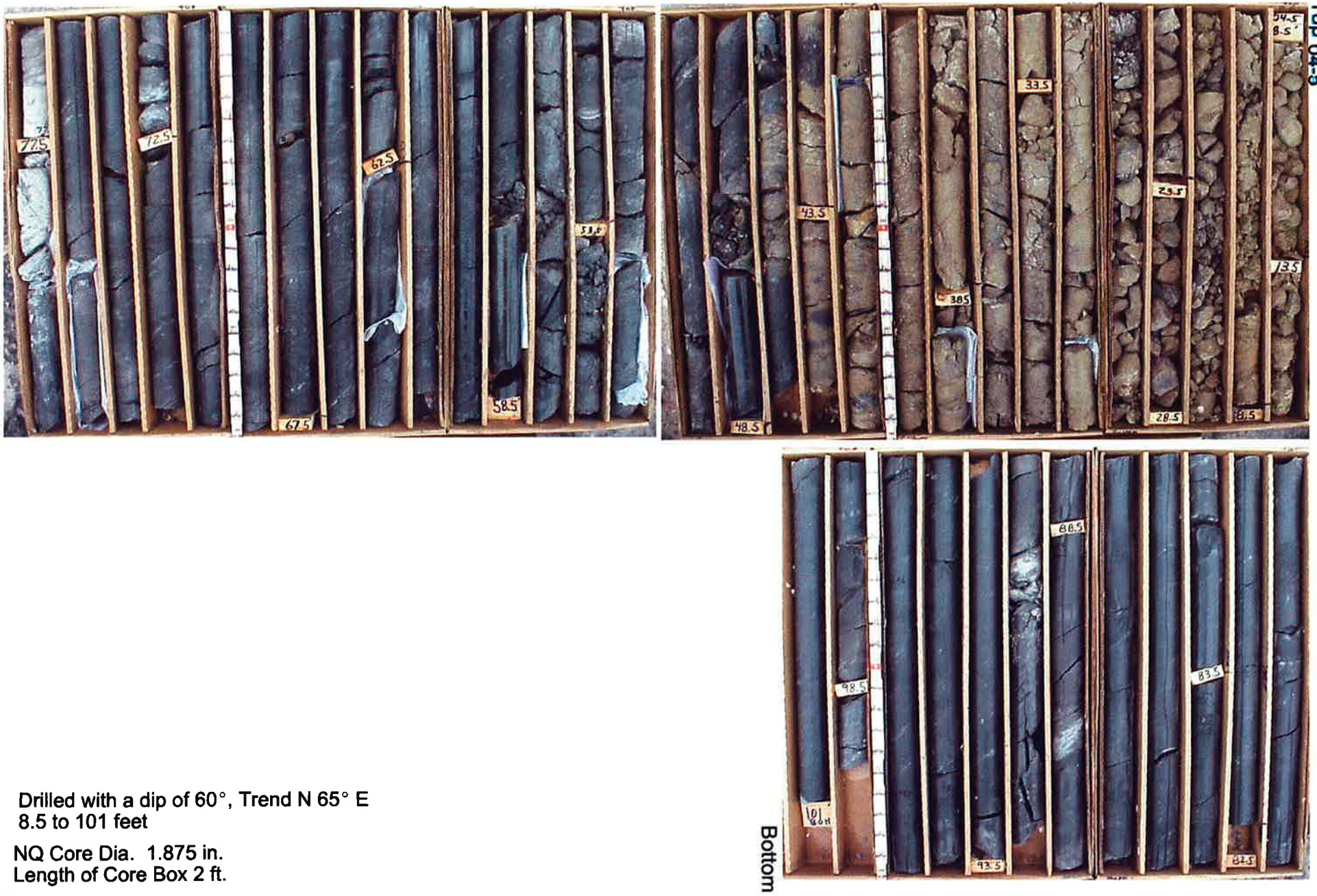
Provo, Utah

Figure Core Photos, Drill Hole # 04-3 *Right Abutment*
Project *Cove Dam Site Feasibility Study*
Location *Orderville, Kane County, Utah*



Drilled with a dip of 60°, Trend N 65° E
8.5 to 101 feet

NQ Core Dia. 1.875 in.
Length of Core Box 2 ft.

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Figure Core Photos, Drill Hole # 04-5 *Left Abutment*
Project *Cove Dam Site Feasibility Study*
Location *Orderville, Kane County, Utah*

Test Pits

TEST PIT LOG

PIT NO. 04–1

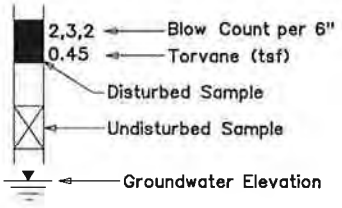
Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 6/1/04
LOCATION: SEE SITE PLAN — ELEVATION: ~5463.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY — AFTER 24 HOURS: ▽ DRY

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	SAMPLE USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5460	0			3 Rings Block Bucket	CL-1	1" fine silty sand layer		4.8	26	12	0	3	97	
	5			Ring Block	CL-2	**LEAN CLAY** lt. brown to brown, dry, hard, some pinhole structure, minor mineral stringers	95.1	6.4	35	16	0	2	98	
5455						1" fine silty sand layer								
	10			Ring Block	CL-2			3.4	31	15	0	26	74	
						1" fine silty sand layer								
				Bag	CL	1" fine silty sand layer								
5450														
	15													
5445														
	20													

06/15/04
11:02:09 AM

LEGEND



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Provo, Utah

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

TEST PIT LOG

PIT NO. 04-2

Sheet: 1 of 1

PROJECT: COVE DAM
PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D.
DATE: 6/2/04
LOCATION: SEE SITE PLAN
ELEVATION: ~5474.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY AFTER 24 HOURS: ▽ DRY

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	SAMPLE USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5470	5			Bag	CL	**LEAN CLAY W/FINE SAND** lt. brown to brown, very dry, hard, sand intermixed throughout entire depth of test pit, some distinct pockets but no continuous layers, some pinhole structure, macro-hole structure in upper 3', trace minerals								
				Bag	CL-2			8.6	40	20	0	2	98	
5465	10			Bag	CL									
				Bag	CL-1			5.8	31	13	0	12	88	
5460	15													
5455	20													

06/11/04
10:58:58 AM

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Provo, Utah

LEGEND

- 2,3,2 ← Blow Count per 6"
- 0.45 ← Torvane (tsf)
- Disturbed Sample
- Undisturbed Sample
- Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

TEST PIT LOG

PIT NO. 04-3

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 6/2/04
LOCATION: SEE SITE PLAN — ELEVATION: ~5476.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY AFTER 24 HOURS: ▽ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lithology	Sample Type	Sample Type	USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5475	0		Bag	SP		**SAND W/GRAVEL** medium grained sand, fine grained gravel					25	73	2	
			Bag	CL										
				SM	2" silty sand layer									
	5													
5470			Bag	CL		**LEAN CLAY W/SAND** lt. brown to brown, dry, hard, intermixed, fine, some pinhole structure, some silt lenses, calcite stringers								
			Bag	CL										
	10			SP-SM	2" sand w/silt layer									
5465				SM	2" silty sand layer									
			Bag	CL										
	15													
5460														
	20													

06/15/04
11:02:30 AM

LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

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Provo, Utah

TEST PIT LOG

PIT NO. 04-4

Sheet: 1 of 1

PROJECT: COVE DAM | PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. | DATE: 6/2/04
LOCATION: SEE SITE PLAN | ELEVATION: ~5475.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY AFTER 24 HOURS: ▼ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	SAMPLE USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
				Bag	CL									
5470	5				SM	2" sand layer at 5.5'					0	82	18	
				Bag	CL	**LEAN CLAY** lt. brown to brown, dry, hard, some small sand pockets, pinhole structure, trace minerals								
				Bag	CL									
5465	10													
5460	15													
	20													

06/15/04
11:02:45 AM

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LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
▼ ← Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test

TEST PIT LOG

PIT NO. 04-5

Sheet: 1 of 1

PROJECT: COVE DAM
PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D.
DATE: 6/2/04
LOCATION: SEE SITE PLAN
ELEVATION: ~5477.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY AFTER 24 HOURS: ▽ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
					CL	**LEAN CLAY**								
5475				Bag	GP	**GRAVEL W/SAND** fairly clean, sub-angular, mostly 0.75" to 3" sizes, a few cobbles up to 12"								
	5			Bag	CH	**HEAVILY WEATHERED MUDSTONE** dk. brown, moist, very hard			58	34				
5470														
				Bag	CH				59	31				
	10													
5465														
	15													
5460														
	20													

06/15/04
11:03:01 AM

RB&G ENGINEERING INC.
Provo, Utah

LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

TEST PIT LOG

PIT NO. 04–6

Sheet: 1 of 1

PROJECT: COVE DAM
CLIENT: K.C.W.C.D.
LOCATION: SEE SITE PLAN
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY AFTER 24 HOURS: ▽ NOT MEASURED

PROJECT NO.: 200401.025
DATE: 6/2/04
ELEVATION: ~5466.0'
LOGGED BY: M. STILSON

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	SAMPLE USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5465	0			Bag	CL	**LEAN CLAY W/FINE SAND** lt. brown to brown, dry, hard, intermixed, some sand pockets, pinhole structure, minerals								
	5													
5460				Bag	CL									
	10			Bag	CL									
5455				Bag	CL									
	15													
5450														
	20													

06/11/04
10:59:49 AM

RB&G ENGINEERING INC.
Provo, Utah

LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
▽ Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

TEST PIT LOG

PIT NO. 04–7

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 6/2/04
LOCATION: SEE SITE PLAN — ELEVATION: ~5456.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY — AFTER 24 HOURS: ▽ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lithology	Sample Type	Sample Type	USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5455	0					**LEAN CLAY** dry, pinhole structure, macro-holes to 3'								
				Ring	CL-1		82.0	9.1	28	11	0	13	87	
				2 Blocks	CL-ML		86.9	6.5	26	6	0	10	90	CT
						SILTY CLAY								
	5													
5450				Block Bucket	CL-2				37	18	0	3	97	DS
						LEAN CLAY lt. brown to brown, dry, hard, pinhole structure								
				Block	CL-2		89.6	9.1	33	15	0	3	97	
	10													
5445														
				Bag	CL									
	15													
5440														
	20													

06/14/04
03:09:18 PM

RB&G ENGINEERING INC.
Provo, Utah

LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test
DS - Direct Shear Test

TEST PIT LOG

PIT NO. 04–8

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 6/2/04
LOCATION: SEE SITE PLAN — ELEVATION: ~5475.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY — AFTER 24 HOURS: ▽ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lithology	Sample Type	Sample Type	USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
						SILTY CLAY W/SAND lt. brown to brown, dry, hard, pinhole structure								
				Bag	CL-1			6.9	33	14	0	6	94	
5470	5													
				Bag	CL	**LEAN CLAY** lt. brown to brown, dry, hard, pinhole structure, minerals								
				Bag	CL-2			6.7	46	25	0	2	98	
5465	10													
				Bag	CL									
5460	15													
	20													

06/11/04
11:00:17 AM

LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
▽ ← Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

TEST PIT LOG

PIT NO. 04-9

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 6/2/04
LOCATION: SEE SITE PLAN — ELEVATION: ~5483.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY AFTER 24 HOURS: ▽ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	SAMPLE USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5480	0													
	5			Bag	CL									
				Bag	CL-2	**LEAN CLAY W/FINE SAND** lt. brown to brown, dry, hard, pinhole structure, trace minerals		7.8	37	21	0	1	99	
5475														
				Bag	CL									
	10													
				Bag	CL-2			6.3	31	15	0	6	94	
5470														
	15													
5465														
	20													

08/11/04
11:00:31 AM

RB&G ENGINEERING INC.
Provo, Utah

LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
▽ ← Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

TEST PIT LOG

PIT NO. 04–10

Sheet: 1 of 1

PROJECT: COVE DAM
CLIENT: K.C.W.C.D.
LOCATION: SEE SITE PLAN
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY AFTER 24 HOURS: ▽ NOT MEASURED

PROJECT NO.: 200401.025
DATE: 6/2/04
ELEVATION: ~5500.0'
LOGGED BY: M. STILSON

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	SAMPLE USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
				Bag	CL-2			6.9	38	20	0	6	94	
5495	5					**LEAN CLAY** lt. brown to brown, dry, hard, trace pinhole structure, more minerals, trace sand at 3'								
				Bag	CL									
				Bag	CL-2			8.5	43	22	0	6	94	
5490	10													
				Bag	CL									
5485	15													
	20													

06/11/04
11:00:46 AM

RB&G ENGINEERING INC.
Provo, Utah

LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
▽ ← Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

TEST PIT LOG

PIT NO. 04–11

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 6/2/04
LOCATION: SEE SITE PLAN — ELEVATION: ~5498.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY — AFTER 24 HOURS: ▽ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5495	0			Bag	CL-ML	**SILTY CLAY W/SAND** lt. brown to brown, dry, hard, pinhole structure, fine sand - intermixed		4.4	20	5	0	43	57	
	5			Bag	CL-ML									
5490														
	10			Bag	CL-2	**LEAN CLAY W/SAND** lt. brown to brown, dry, hard, pinhole structure, fine sand - intermixed		5.7	34	16	0	17	83	
				Bag	CL-ML	**SILTY CLAY W/SAND** lt. brown to brown, dry, hard, pinhole structure, fine sand - intermixed								
5485														
	15													
5480														
	20													

06/11/04
11:01:01 AM

RB&G ENGINEERING INC.
Provo, Utah

LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

TEST PIT LOG

PIT NO. 04–12

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 6/2/04
LOCATION: SEE SITE PLAN — ELEVATION: ~5520.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY — AFTER 24 HOURS: ▽ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
				Bag	CL-ML	**SILTY CLAY W/SAND** lt. brown to brown, dry, hard								
5515	5			Bag/ Block	ML	shows layering **SANDY SILT** lt. brown to brown, dry, hard		4.4		NP	0	47	53	
5510	10			Bag	CL-ML	**SILTY CLAY W/SAND** lt. brown to brown, dry, hard								
				Bag	CL-2	**LEAN CLAY** lt. brown to brown, dry, hard		7.2	36	16	0	2	98	
5505	15													
	20													

06/11/04
11:01:14 AM

LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
▽ Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

TEST PIT LOG

PIT NO. 04–13

Sheet: 1 of 1

PROJECT: COVE DAM
PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D.
DATE: 6/2/04
LOCATION: SEE SITE PLAN
ELEVATION: ~5548.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY AFTER 24 HOURS: ▽ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	SAMPLE USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
						6" clay layer								
				Bag	SM									
						8" clay layer								
5515	5					**SILTY SAND W/CLAY LAYERS**								
				Bag	SM	lt. brown to brown, dry								
						12" clay layer								
				Bag	SM									
5510	10													
				Bag	SM									
5505	15													
	20													

06/11/04
11:01:30 AM

RB&G ENGINEERING INC.
Provo, Utah

LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

Laboratory Testing

Table 1

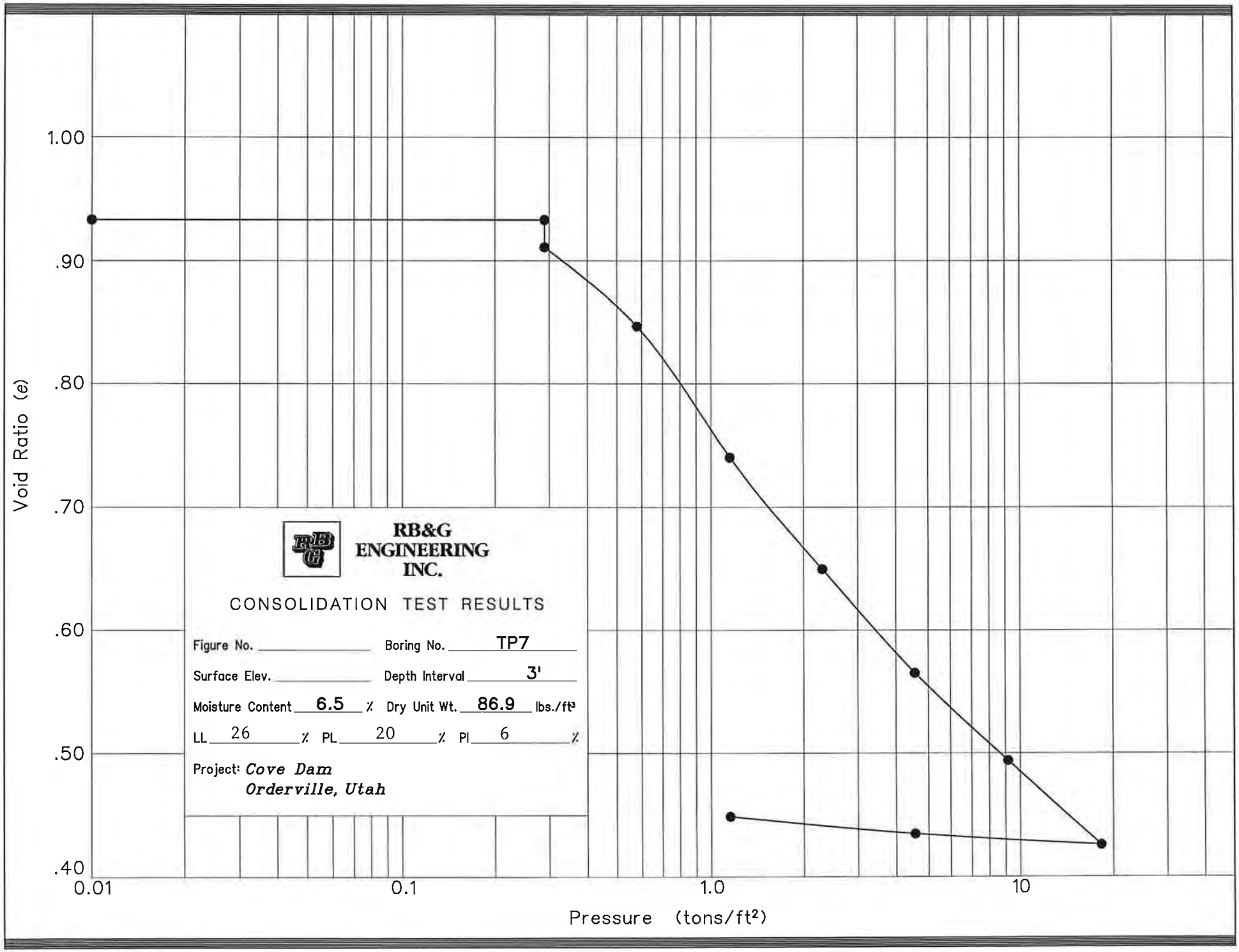
SUMMARY OF TEST DATA

PROJECT Cove Dam
LOCATION Kane County, Utah

PROJECT NO. 200401-025
FEATURE

HOLE NO.	DEPTH BELOW GROUND SURFACE (ft)	MATERIAL	IN-PLACE		PINHOLE TEST RESULTS	ATTERBERG LIMITS			MECHANICAL ANALYSIS			UNIFIED SOIL CLASSIFICATION SYSTEM (modified)
			DRY UNIT WEIGHT (pcf)	MOISTURE (%)		LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT & CLAY	
DH-1	5-6	Soil	120.3	9.8		32	18	14	0	10	90	CL-1
	15-16.5	Soil	119.4	8.7		37	18	19	0	17	83	CL-2
	25-26.5	Soil	112.4	14.3		34	16	18	0	6	94	CL-2
	35-36.5	Soil	105.2	17.5		49	18	31	0	3	97	CL-2
	45-46	Soil	100.7	23.1		50	16	34	0	6	94	CL-2/CH
	53	Bedrock		16.4		82	30	50	0	0	100	CH
	73	Bedrock		13.2		70	25	45	0	0	100	CH
DH-2	6.5-8	Soil		12.2		45	14	31	0	2	98	CL-2
	15-16.5	Soil	111.8	19.3		58	24	34	0	0	100	CH
	26	Bedrock		13.5		70	23	47	0	0	100	CH
DH-3	14	Bedrock		13.7		54	21	33	0	0	100	CH
DH-5	41	Bedrock		4.7		43	17	26	0	9	91	CL-2
	48	Bedrock		12.6		47	23	24	0	2	98	CL-2
TP-1	3-4	Soil		4.8	ND2	26	16	12	0	3	97	CL-1
	6-7	Soil		6.4	ND2	35	19	6	0	2	98	CL-2
	9-10	Soil		3.4	ND3	31	16	15	0	26	74	CL-2
TP-2	6-7	Soil		8.6		40	20	20	0	2	98	CL-2
	12-12.5	Soil		5.8	ND3	31	18	13	0	12	88	CL-1
TP-3	0-1	Soil							25	73	2	SP
TP-4	5.5	Soil							0	82	18	SM
TP-5	6	Bedrock				58	24	34				CH
	9	Bedrock				59	28	31				CH
TP-7	2	Soil	82.0	9.1	ND2	28	17	11	0	13	87	CL-1
	2-3	Soil	86.9	6.5	ND3	26	20	6	0	10	90	CL-ML
	6-7	Soil		4.0	ND2	37	19	18	0	3	97	CL-2
	9-10	Soil	89.6	9.1		33	18	15	0	3	97	CL-2
TP-8	3-4	Soil		6.9	ND3	33	19	14	0	6	94	CL-1
	9-10	Soil		6.7	ND2	46	21	25	0	2	98	CL-2
TP-9	6-7	Soil		7.8		37	16	21	0	1	99	CL-2
	12-12.5	Soil		6.3		31	16	15	0	6	94	CL-2
TP-10	3-4	Soil		6.9		38	18	20	0	6	94	CL-2
	9-10	Soil		8.5		43	21	22	0	6	94	CL-2
TP-11	3-4	Soil		4.4		20	15	5	0	43	57	CL-ML
	9-10	Soil		5.7		34	18	16	0	17	83	CL-2
TP-12	6-7	Soil		4.4				NP	0	47	53	ML
	12-12.5	Soil		7.2		36	20	16	0	2	98	CL-2

NP=Nonplastic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Void Ratio (e)
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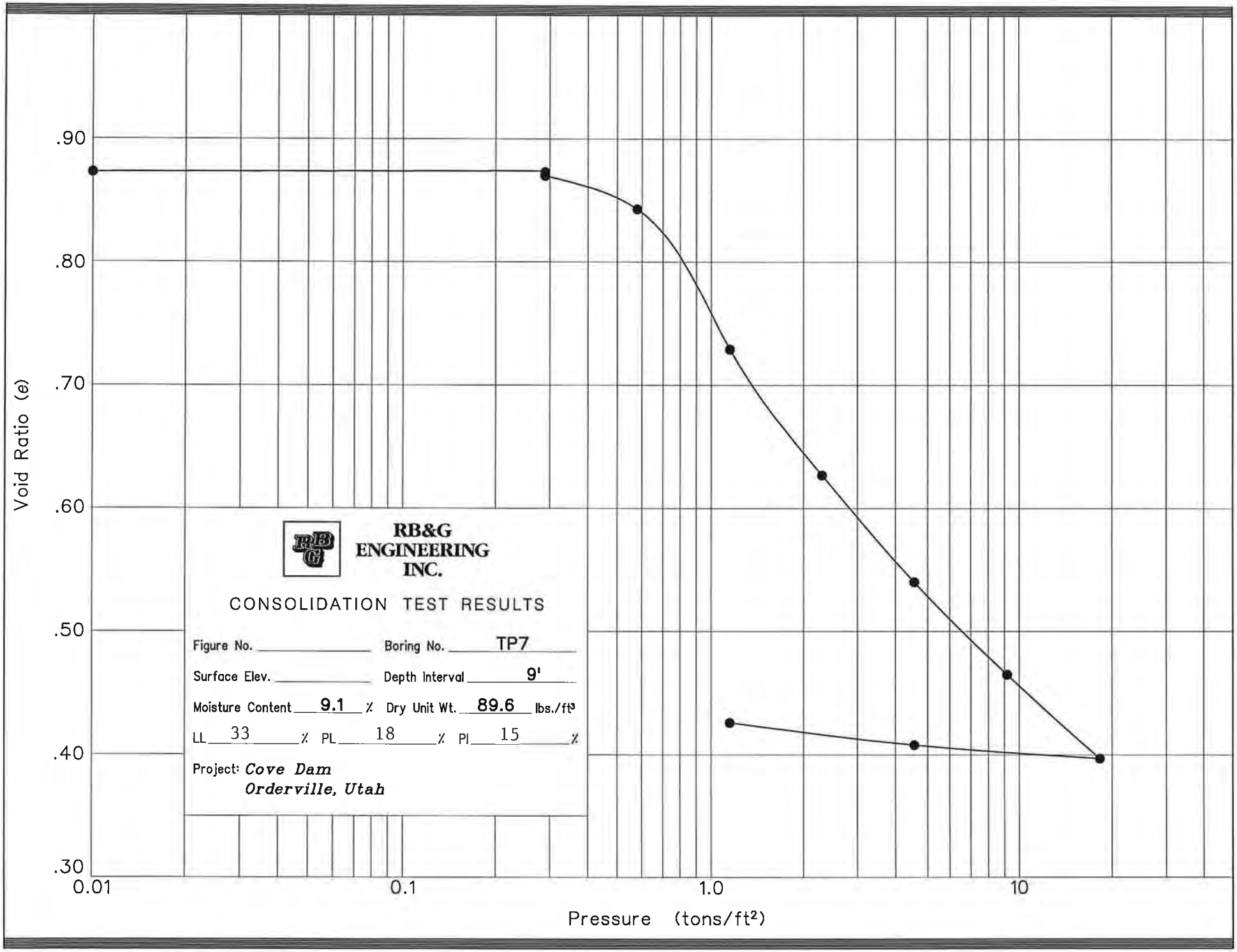
0.1
1.0
10
Pressure (tons/ft²)
RB&G ENGINEERING INC.
CONSOLIDATION TEST RESULTS
Figure No. _____ Boring No. TP7
Surface Elev. _____ Depth Interval 3'
Moisture Content 6.5 % Dry Unit Wt. 86.9 lbs./ft³
LL 26 % PL 20 % PI 6 %
Project: Cove Dam
Orderville, Utah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Void Ratio (e)
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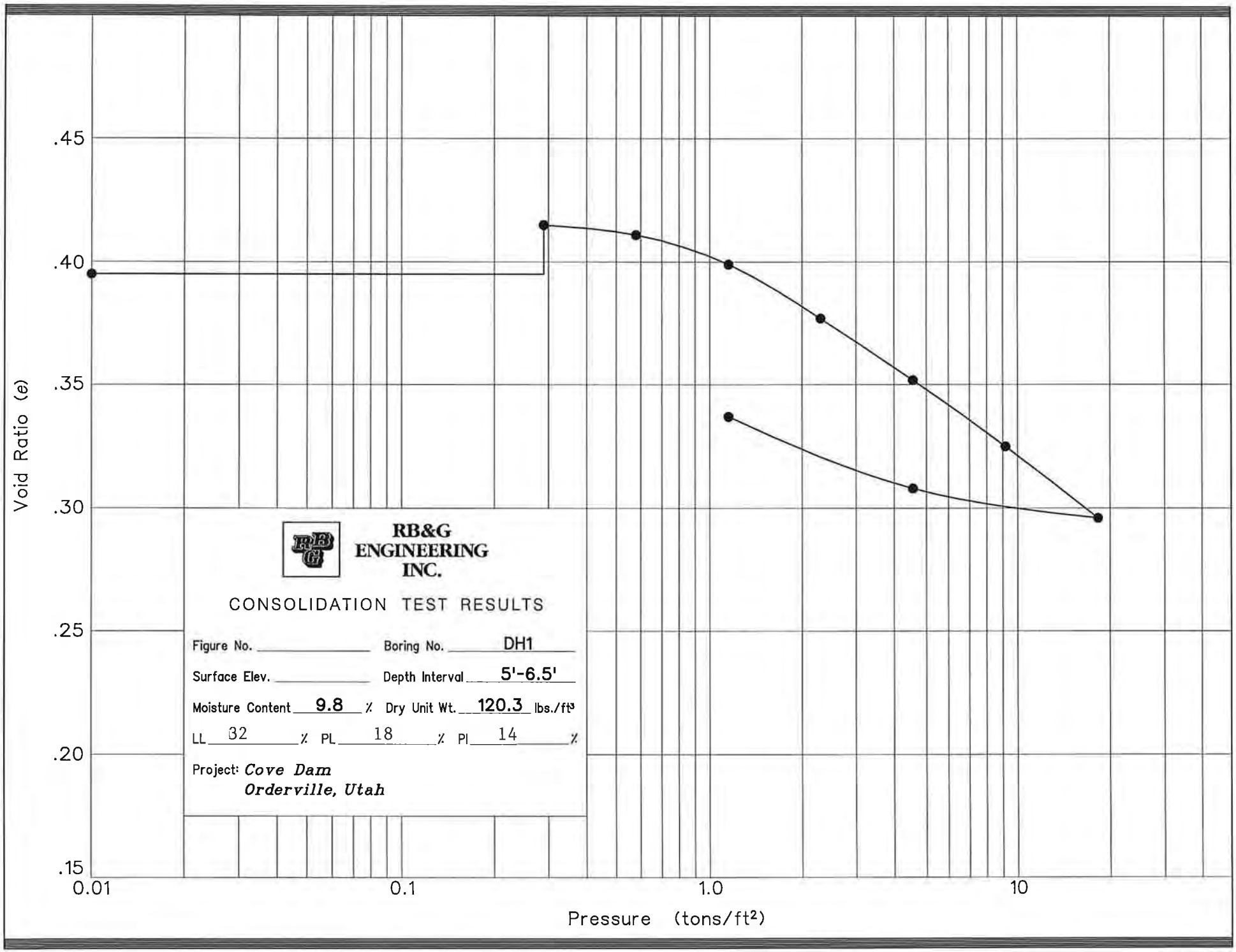
0.1
1.0
10
Pressure (tons/ft²)
RB&G ENGINEERING INC.
CONSOLIDATION TEST RESULTS
Figure No. _____ Boring No. TP7
Surface Elev. _____ Depth Interval 9'
Moisture Content 9.1 % Dry Unit Wt. 89.6 lbs./ft³
LL 33 % PL 18 % PI 15 %
Project: Cove Dam
Orderville, Utah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Void Ratio (e)
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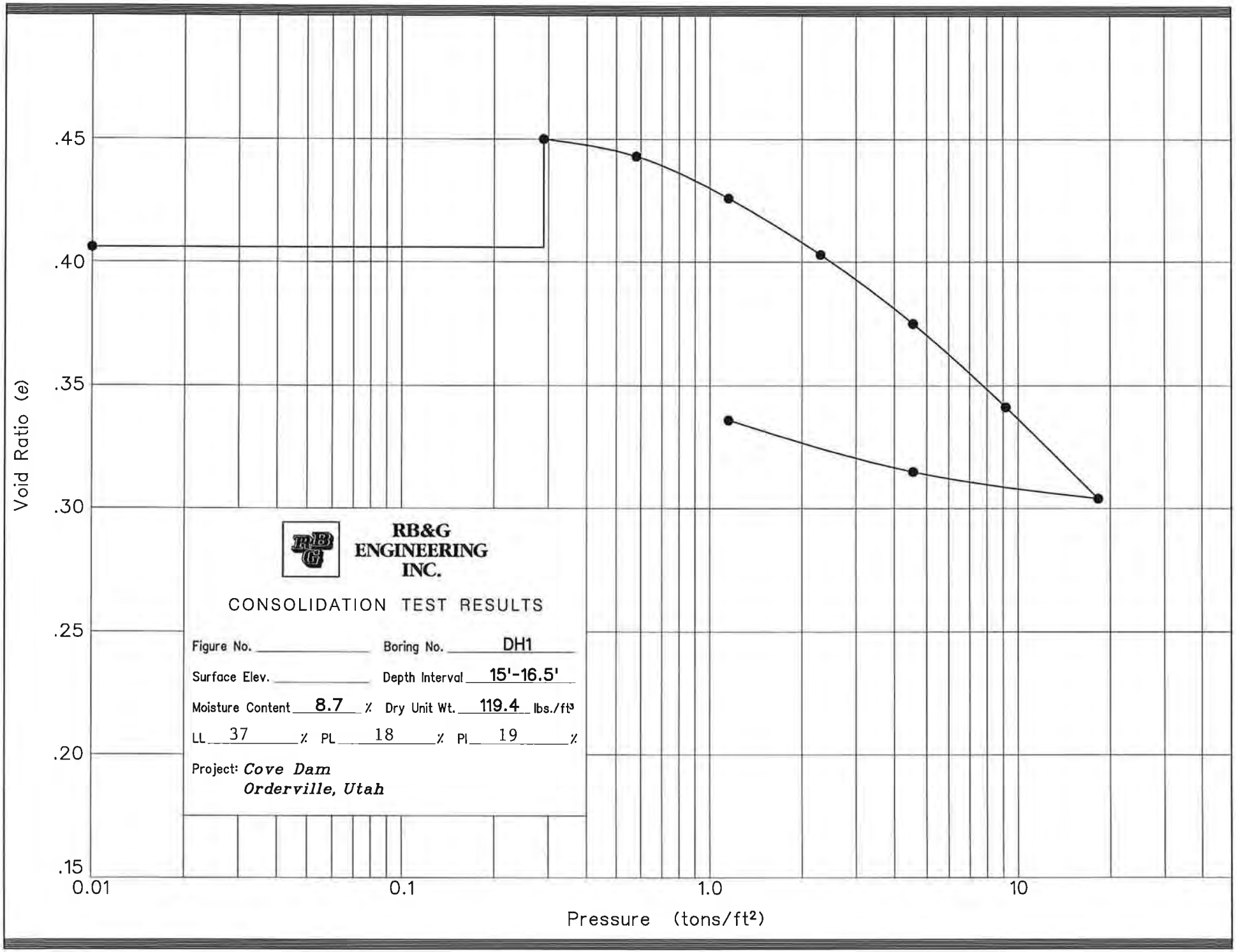
0.1
1.0
10
Pressure (tons/ft²)
RB&G ENGINEERING INC.
CONSOLIDATION TEST RESULTS
Figure No.
Boring No. DH1
Surface Elev.
Depth Interval 5'-6.5'
Moisture Content 9.8 % Dry Unit Wt. 120.3 lbs./ft³
LL 32 % PL 18 % PI 14 %
Project: Cove Dam
Orderville, Utah



RB&G ENGINEERING INC.

CONSOLIDATION TEST RESULTS

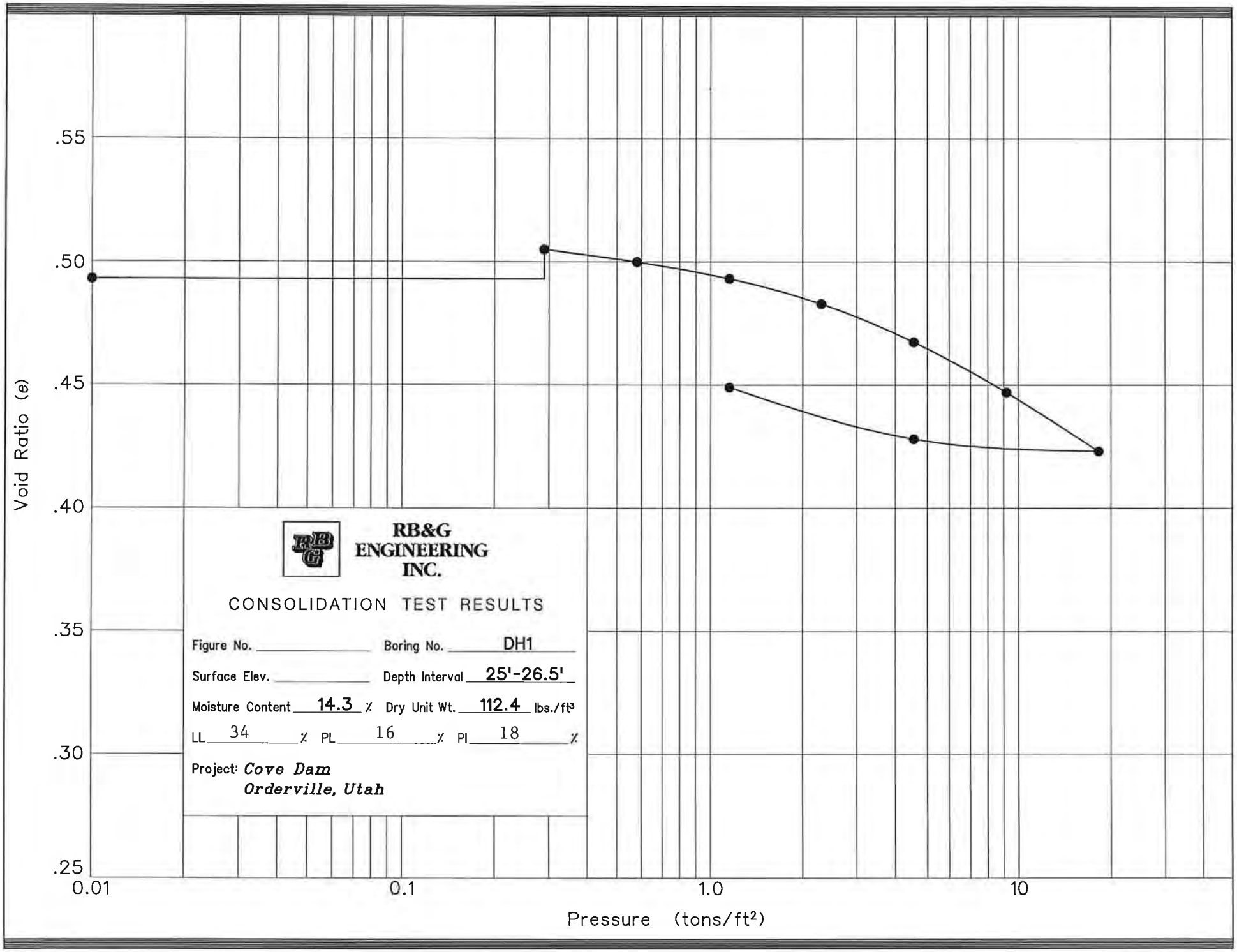
Figure No. _____ Boring No. DH1

Surface Elev. _____ Depth Interval 15'-16.5'

Moisture Content 8.7 % Dry Unit Wt. 119.4 lbs./ft³

LL 37 % PL 18 % PI 19 %

Project: *Cove Dam*
Orderville, Utah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Void Ratio (e)
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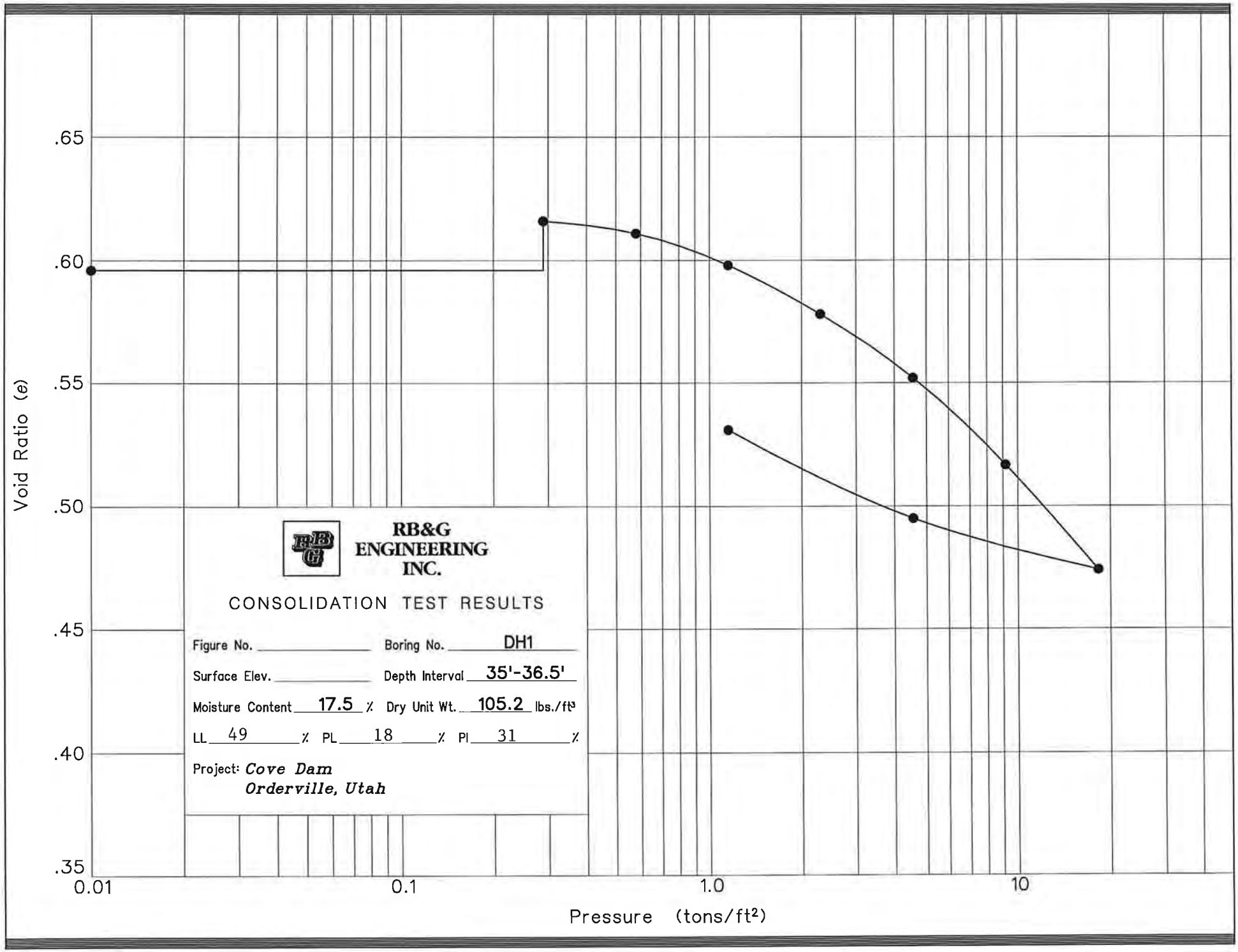
0.1
1.0
10
Pressure (tons/ft²)
RB&G ENGINEERING INC.
CONSOLIDATION TEST RESULTS
Figure No. _____ Boring No. DH1
Surface Elev. _____ Depth Interval 25'-26.5'
Moisture Content 14.3 % Dry Unit Wt. 112.4 lbs./ft³
LL 34 % PL 16 % PI 18 %
Project: Cove Dam
Orderville, Utah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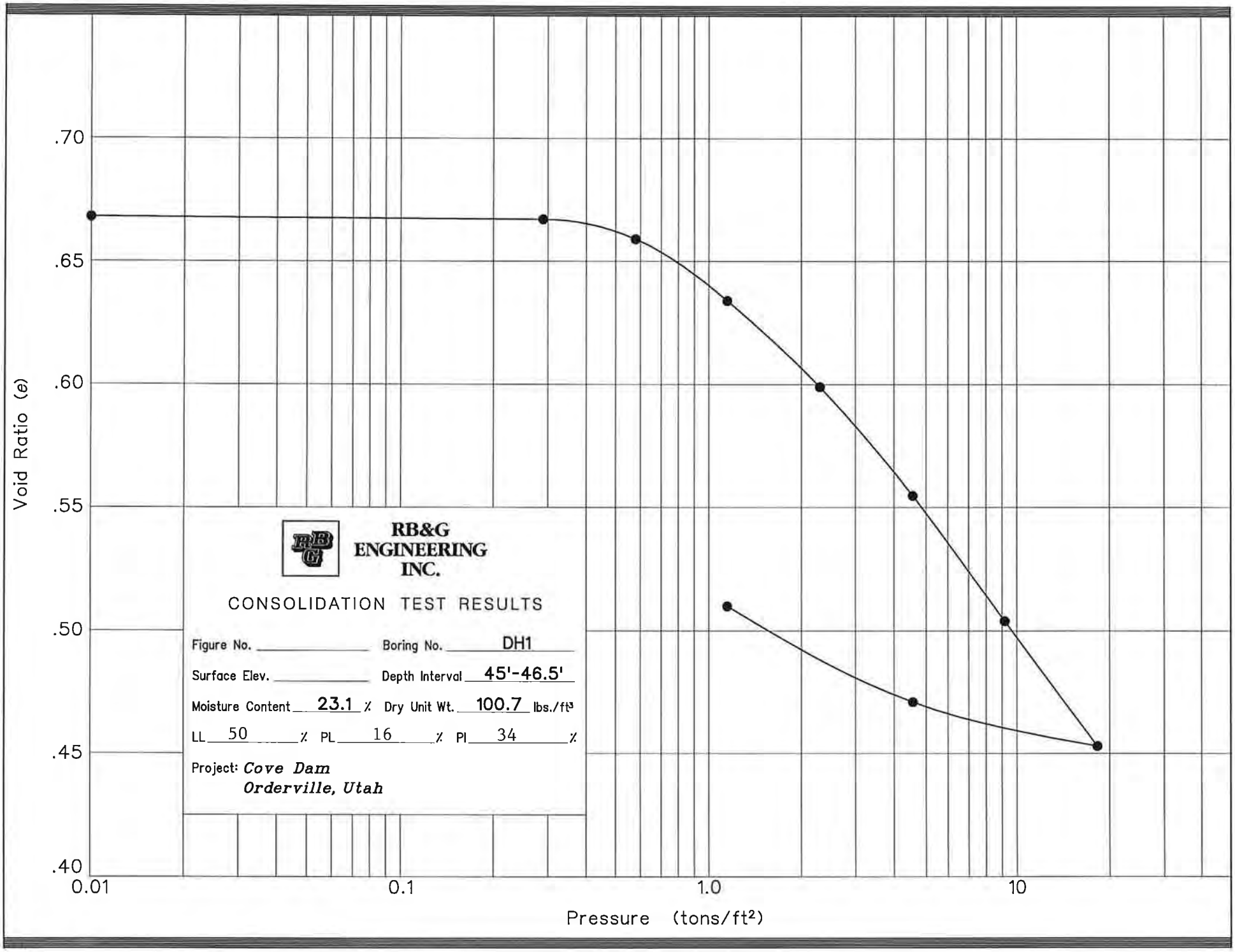
Void Ratio (e)
0.01
0.1
1.0
10
Pressure (tons/ft²)
RB&G ENGINEERING INC.
CONSOLIDATION TEST RESULTS
Figure No.
Boring No. DH1
Surface Elev.
Depth Interval 35'-36.5'
Moisture Content 17.5 % Dry Unit Wt. 105.2 lbs./ft³
LL 49 % PL 18 % PI 31 %
Project: Cove Dam
Orderville, Utah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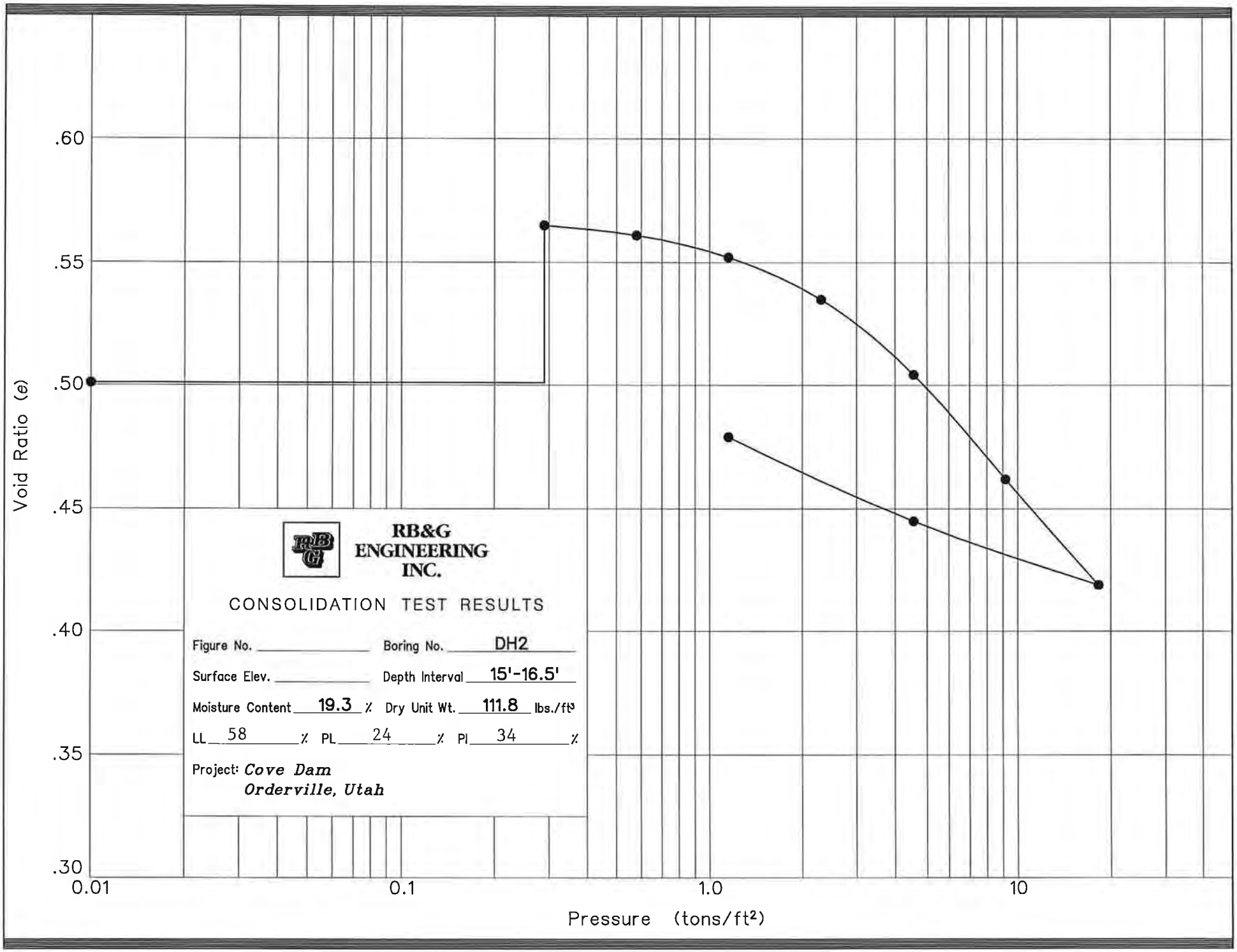
Void Ratio (e)
0.01
0.1
1.0
10
Pressure (tons/ft²)
RB&G ENGINEERING INC.
CONSOLIDATION TEST RESULTS
Figure No. _____ Boring No. DH1
Surface Elev. _____ Depth Interval 45'-46.5'
Moisture Content 23.1 % Dry Unit Wt. 100.7 lbs./ft³
LL 50 % PL 16 % PI 34 %
Project: Cove Dam
Orderville, Utah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Void Ratio (e)
0.01
0.1
1.0
10
Pressure (tons/ft²)
RB&G ENGINEERING INC.
CONSOLIDATION TEST RESULTS
Figure No. _____ Boring No. DH2
Surface Elev. _____ Depth Interval 15'-16.5'
Moisture Content 19.3 % Dry Unit Wt. 111.8 lbs./ft³
LL 58 % PL 24 % PI 34 %
Project: Cove Dam
Orderville, Utah

RB&G ENGINEERING INC.
1435 West 820 North, Provo, Utah 84601
801 374-5771 Provo
801 521-5771 Salt Lake City

PROJECT NO.	200401.025

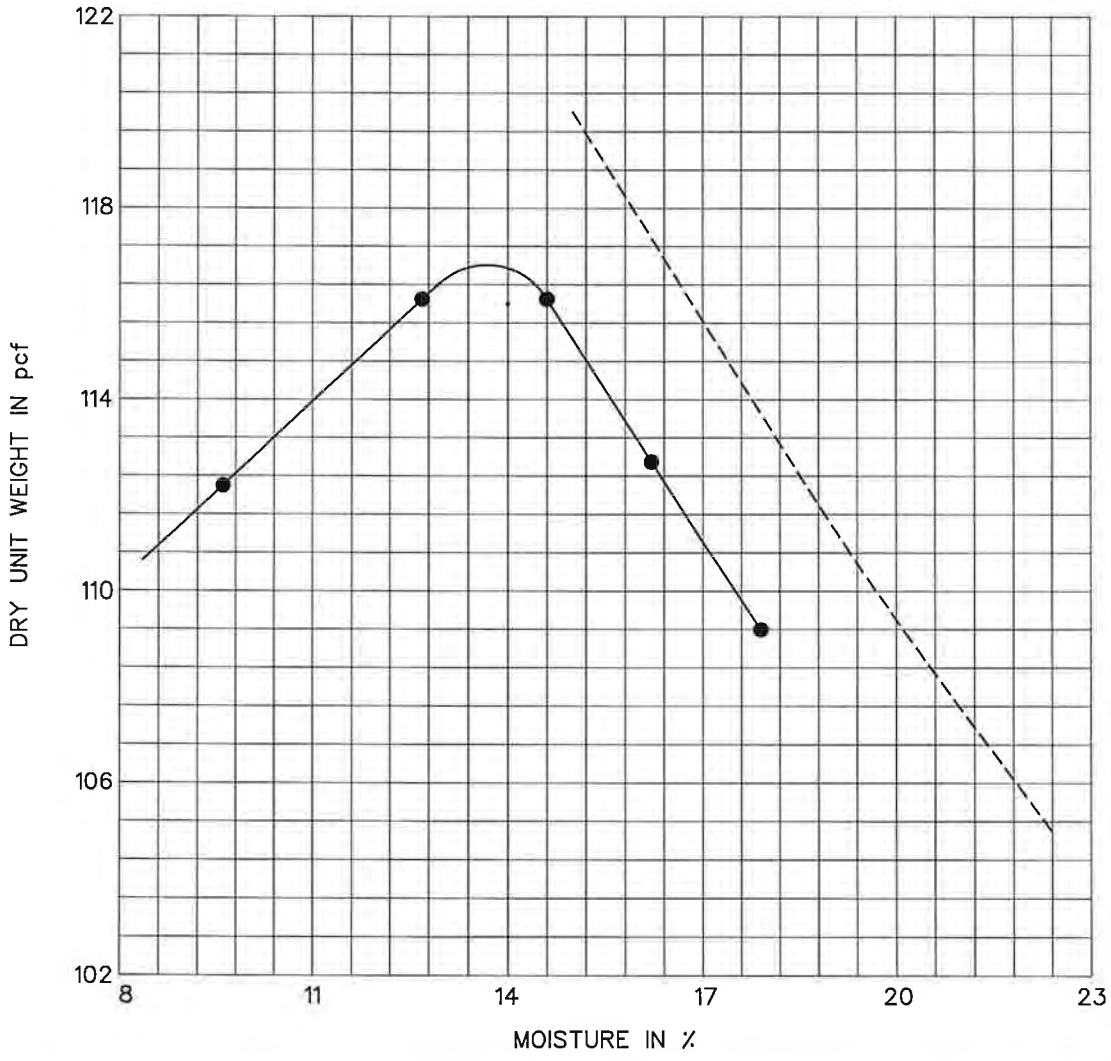
MOISTURE-DENSITY RELATION (PROCTOR)

Project	COVE DAM			Date	6/9/04
Location	ORDERVILLE, UTAH / TEST PIT NO. 1 AT 3'			Technician	G. PEASLEE
Material Description	LT. BROWN TO BROWN LEAN CLAY	USCS	CL-1	Method	ASTM D 698

Procedure Used[1]	A
Classification Procedure[2]	Test

[1] A-No. 4 Sieve, B-⅜" Sieve, C-¾" Sieve
[2] Visual as per ASTM D 2488, Test as per ASTM D 2487

Preparation Method	Moist
Rammer Used	Manual
As-Received Moisture Content (%)	-



Maximum Dry Density (pcf)	**116.0**
Optimum Moisture Content (%)	**14.0**
Modified Maximum Density (pcf)	
Modified Optimum Moisture Content (%)	

– – – – – 100% Saturation Curve

Specific Gravity of Soil	2.70	Est.

OVERSIZE CORRECTION-ASTM D 4718

Specific Gravity of Soil +¾		
Percent Oversize		

Type of Specific Gravity is BULK Unless Otherwise Indicated

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801 374-5771 Provo
801 521-5771 Salt Lake City

PROJECT NO.	200401.025

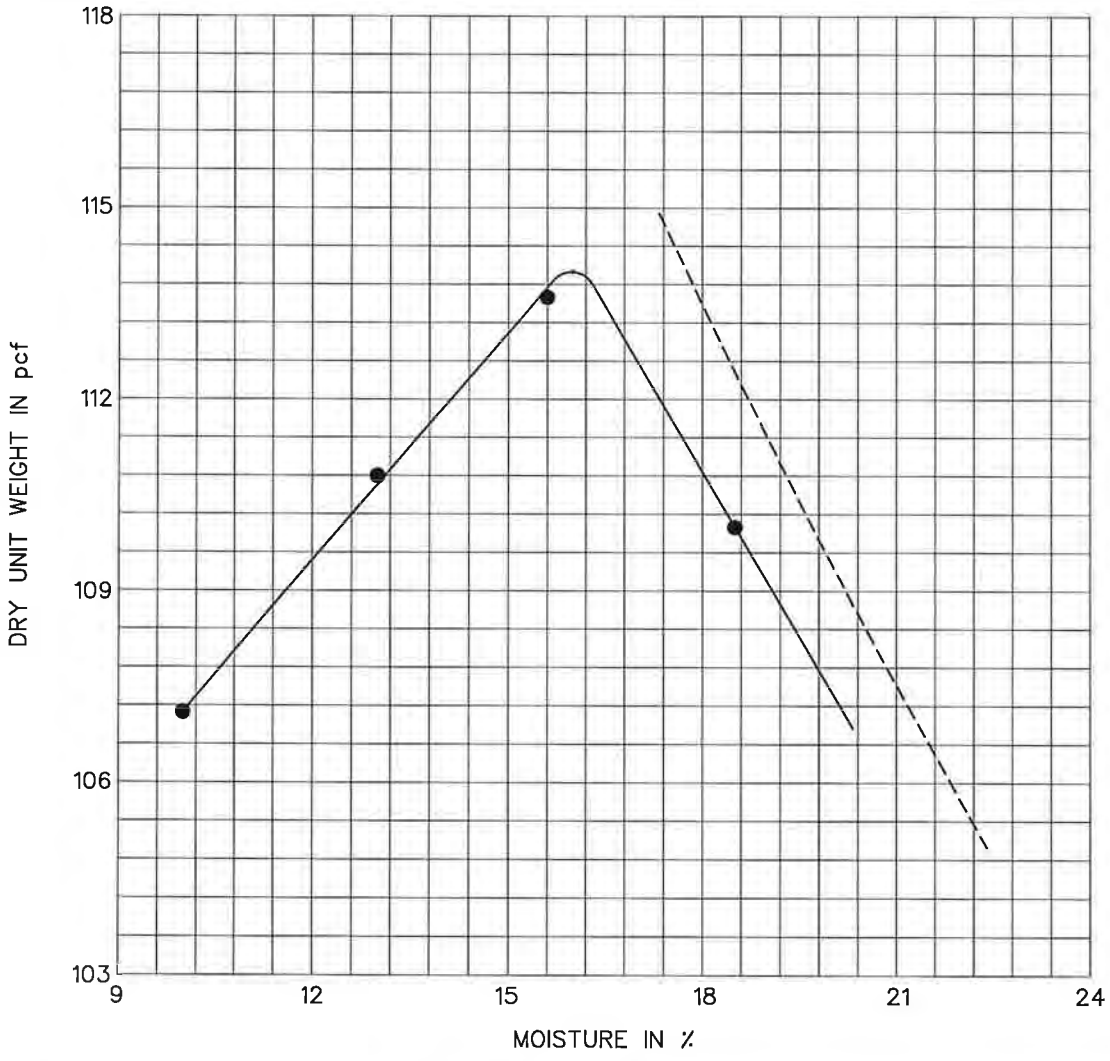
MOISTURE-DENSITY RELATION (PROCTOR)

Project	COVE DAM			Date	6/9/04
Location	ORDERVILLE, UTAH / TEST PIT NO. 7 AT 3'-4'			Technician	G. PEASLEE
Material Description	LT. BROWN TO BROWN SILTY CLAY	USCS	CL-ML	Method	ASTM D 698

Procedure Used[1]	A
Classification Procedure[2]	Test

[1] A-No. 4 Sieve, B-3/8" Sieve, C-3/4" Sieve
[2] Visual as per ASTM D 2488, Test as per ASTM D 2487

Preparation Method	Moist
Rammer Used	Manual
As-Received Moisture Content (%)	-



Maximum Dry Density (pcf)	114.0
Optimum Moisture Content (%)	16.0
Modified Maximum Density (pcf)	
Modified Optimum Moisture Content (%)	

------ 100% Saturation Curve

Specific Gravity of Soil	2.70	Est.

OVERSIZE CORRECTION-ASTM D 4718

Specific Gravity of Soil +3/4		
Percent Oversize		

Type of Specific Gravity is BULK Unless Otherwise Indicated

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PROJECT NO.	200401.025

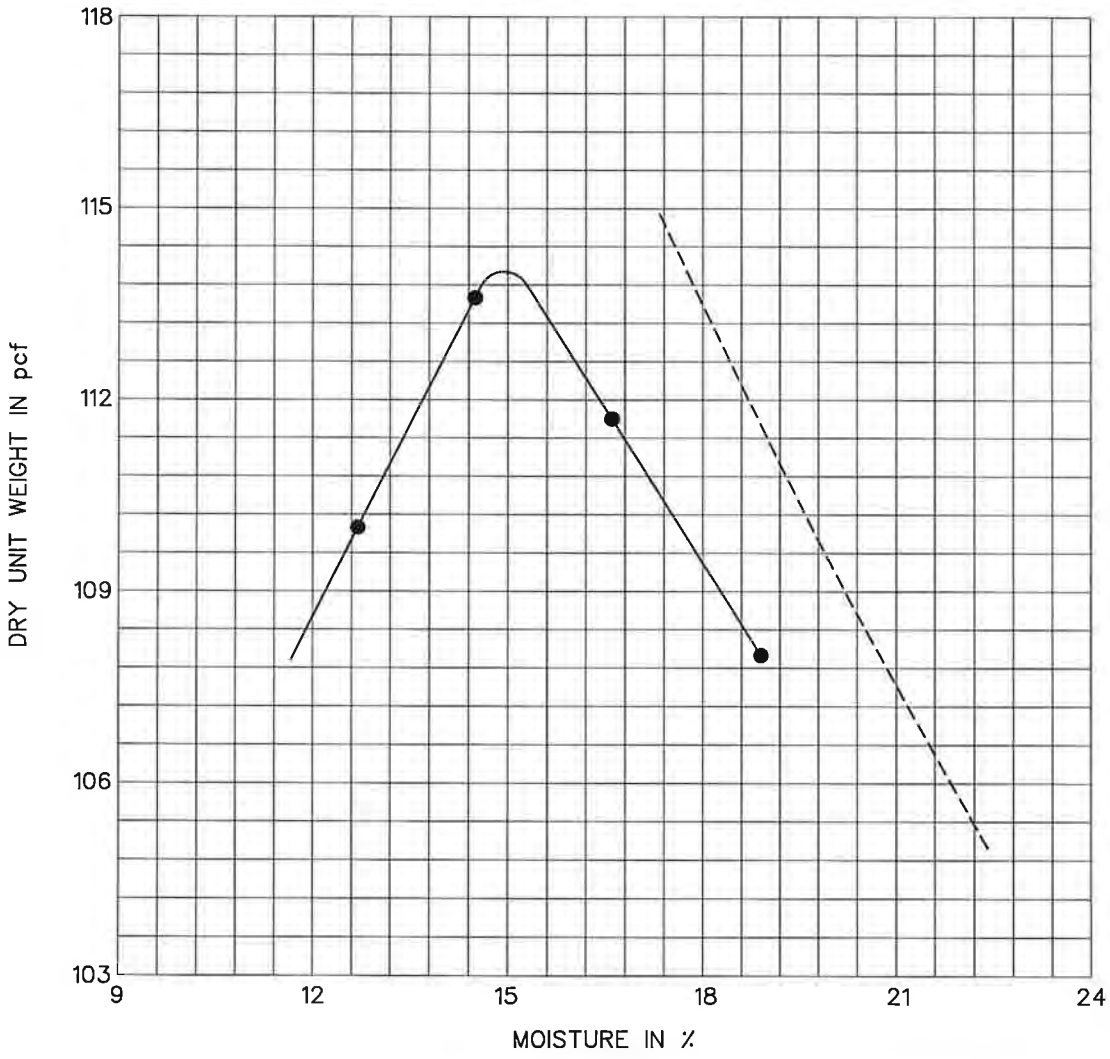
MOISTURE-DENSITY RELATION (PROCTOR)

Project	COVE DAM			Date	6/9/04
Location	ORDERVILLE, UTAH / TEST PIT NO. 7 AT 6'			Technician	G. PEASLEE
Material Description	LT. BROWN TO BROWN LEAN CLAY	USCS	CL-2	Method	ASTM D 698

Procedure Used[1]	A
Classification Procedure[2]	Test

[1] A-No. 4 Sieve, B-⅜" Sieve, C-¾" Sieve
[2] Visual as per ASTM D 2488, Test as per ASTM D 2487

Preparation Method	Moist
Rammer Used	Manual
As-Received Moisture Content (%)	4.0



Maximum Dry Density (pcf)	**114.0**
Optimum Moisture Content (%)	**15.0**
Modified Maximum Density (pcf)	
Modified Optimum Moisture Content (%)	

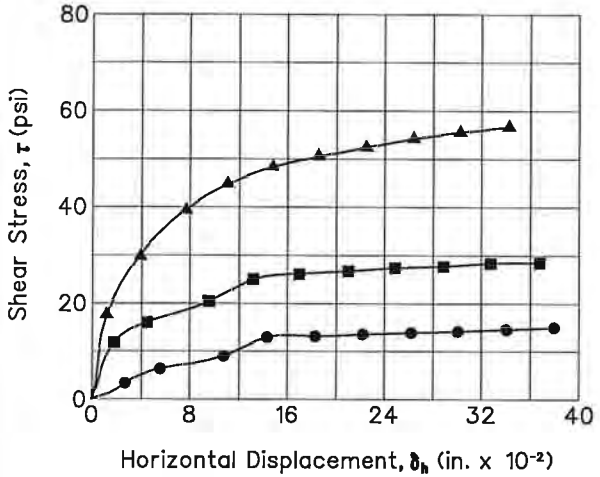
– – – – – 100% Saturation Curve

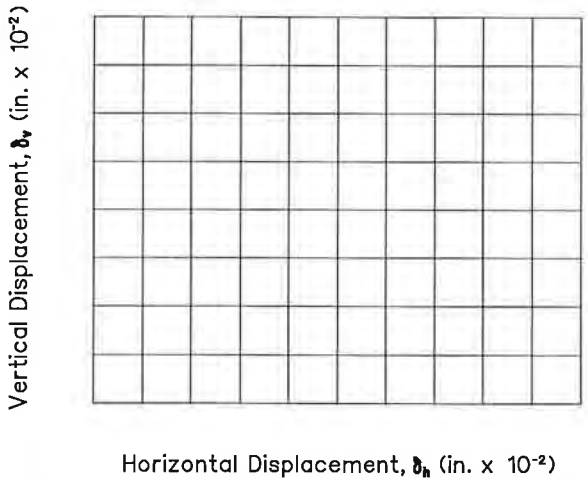
Specific Gravity of Soil	2.70	Est.

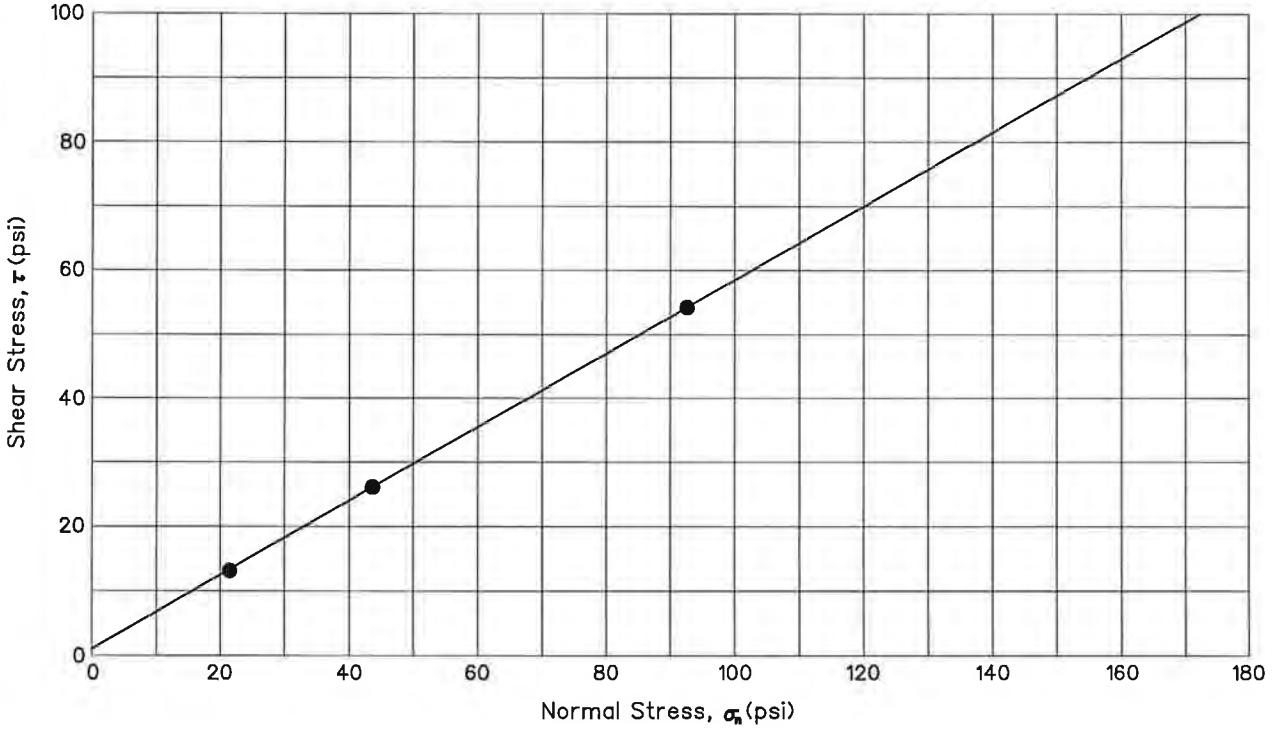
OVERSIZE CORRECTION-ASTM D 4718

Specific Gravity of Soil +¾		
Percent Oversize		

Type of Specific Gravity is BULK Unless Otherwise Indicated







Test No. or Symbol	Sample Size (inches)	Sample Data		Degree of Saturation (%)	Normal Stress δn (psi)	Maximum Shear Stress τ (psi)	Strain Rate (inches/minute)	Shear Strength Parameters	
		Dry Density (pcf)	Moisture Content (%)					Friction Angle ϕ (degrees)	Cohesion (c/psi)
●	2.375	80.4	10.4	~100	21.5	12.9	.0013	29.9	1
■	2.375	82.3	10.4	~100	43.7	26.1	.0013		
▲	2.375	87.1	8.5	~100	92.6	54.2	.0013		

RB&G ENGINEERING INC.
Provo, Utah

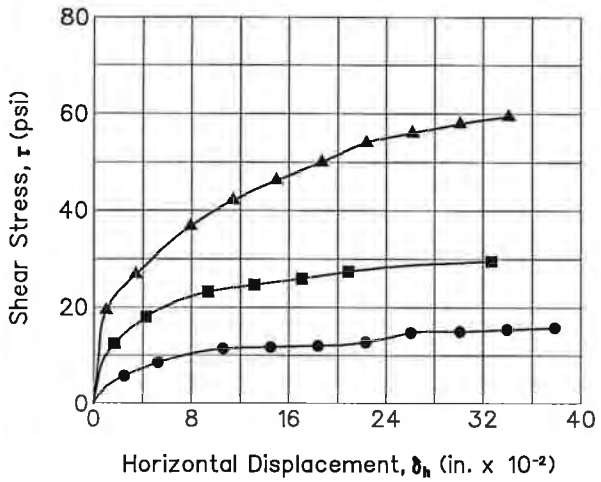
DIRECT SHEAR TEST

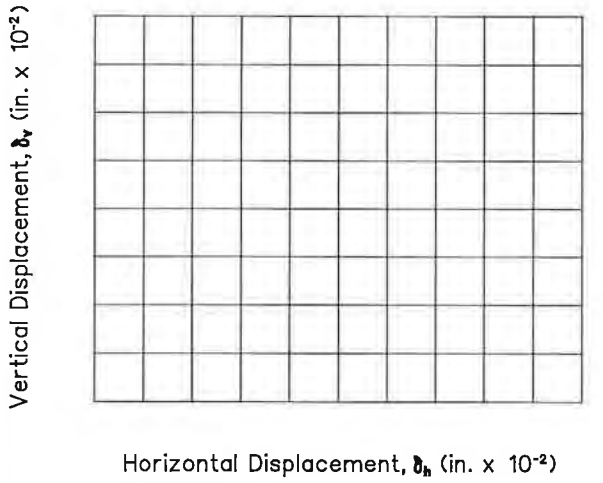
Project: *Cove Dam*
Orderville, Utah

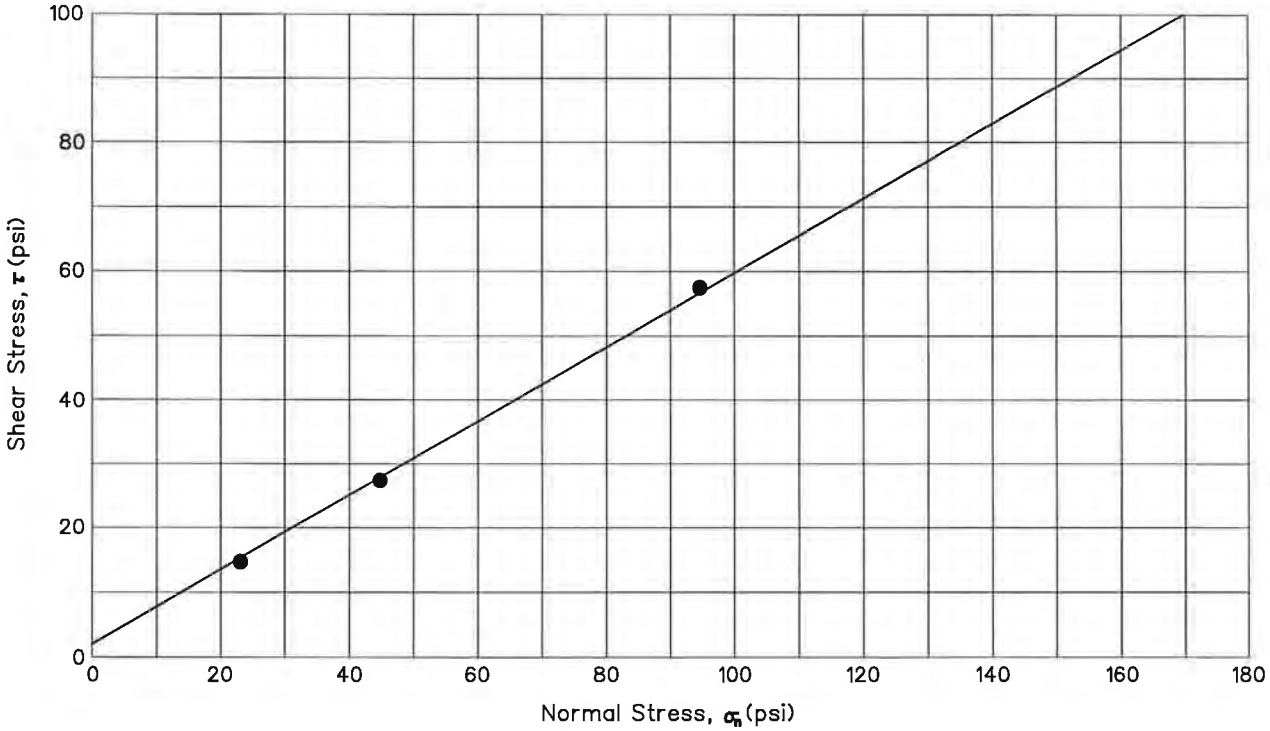
HOLE NO.: TP7

DEPTH: 6'

Figure







REMOLDED SAMPLE COMPACTED TO 98% MAXIMUM DENSITY

Test No. or Symbol	Sample Size (inches)	Sample Data		Degree of Saturation (%)	Normal Stress δn (psi)	Maximum Shear Stress τ (psi)	Strain Rate (inches/ minute)	Shear Strength Parameters	
		Dry Density (pcf)	Moisture Content (%)					Friction Angle ϕ (degrees)	Cohesion (c/psi)
●	2.375	111.5	15.1	100	23.1	14.7	.0013	30.2	2
■	2.375	111.5	15.1	100	44.8	27.4	.0013		
▲	2.375	111.5	15.1	100	94.6	57.9	.0013		

RB&G ENGINEERING INC.
Provo, Utah

DIRECT SHEAR TEST

Project: *Cove Dam*
Orderville, Utah

HOLE NO.: TP7

DEPTH: 6'

Figure

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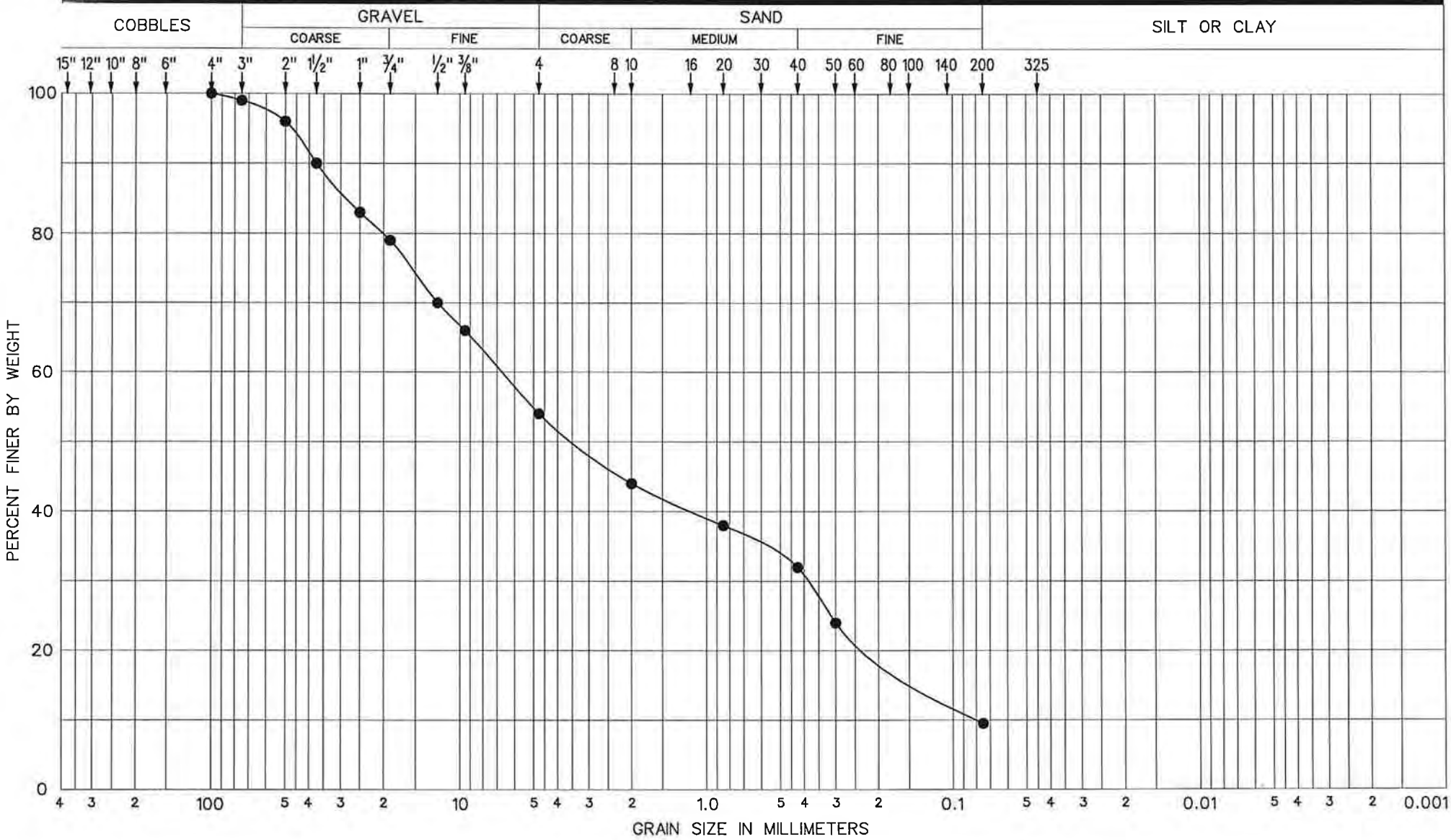
801 374-5771 Provo
801 521-5771 Salt Lake City

PROJECT NO.	200401.025

SIEVE ANALYSIS (GRADATION)



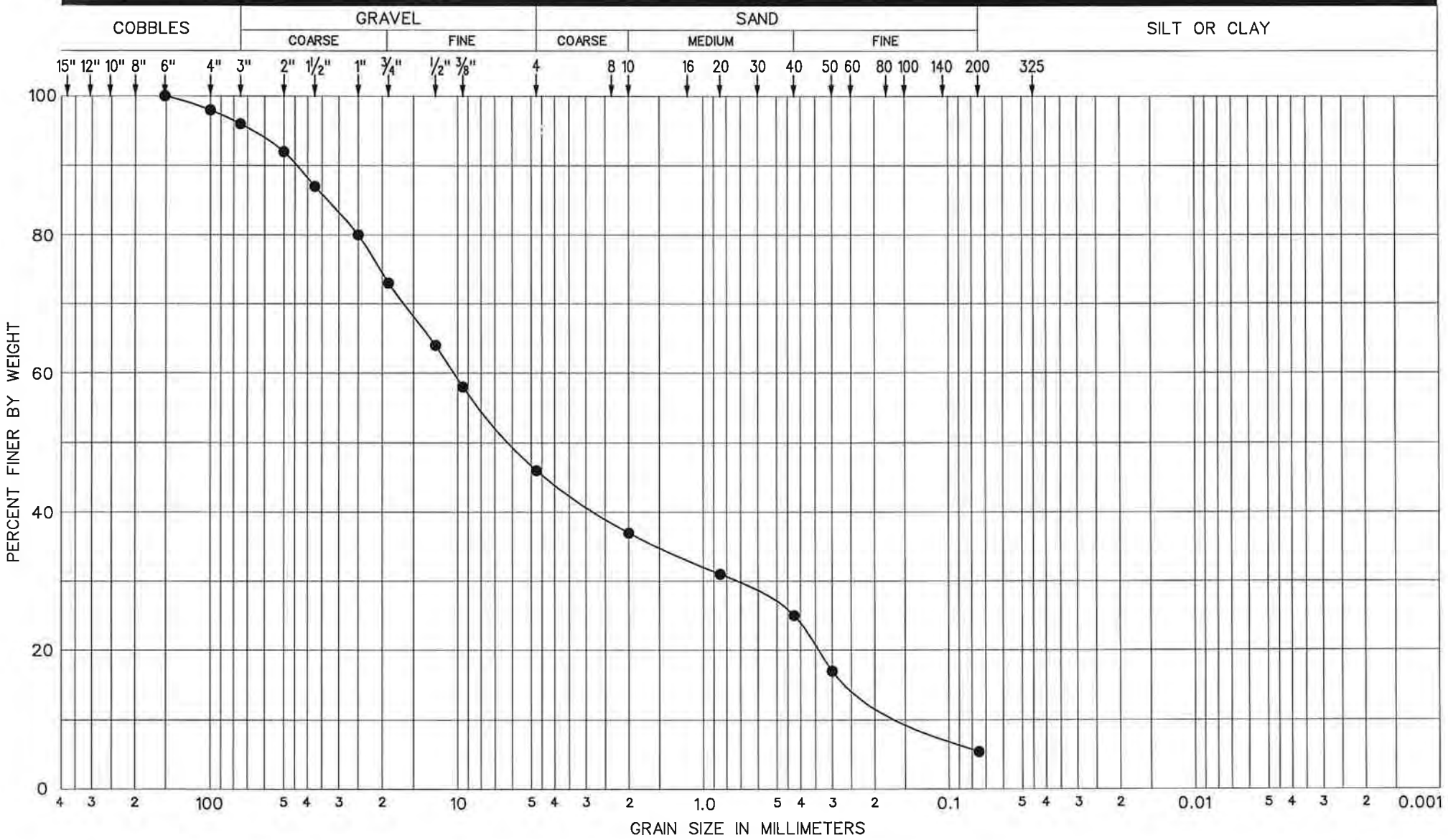
Project	COVE DAM		
Location	ORDERVILLE, UTAH		
Sample No./Depth	ROSE PIT		
Material Description	WELL GRADED GRAVEL W/SILT & SAND	USCS	GW-GM

Date	6/10/04
Technician	K. BRADFORD
Procedure	PLAIN WATER
Method	ASTM C117, C136, C566

RB&G ENGINEERING INC.
1435 West 820 North, Provo, Utah 84601
801 374-5771 Provo
801 521-5771 Salt Lake City

PROJECT NO.	200401.025

SIEVE ANALYSIS (GRADATION)



Project	COVE DAM		
Location	ORDERVILLE, UTAH		
Sample No./Depth	TATE PIT		
Material Description	POORLY GRADED GRAVEL W/SAND	USCS	GP

Date	6/10/04
Technician	K. BRADFORD
Procedure	PLAIN WATER
Method	ASTM C117, C136, C566

Attachment 5 Conceptual Embankment Design

Material Description	Total Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)
ZONE I - LEAN CLAY	130	30	250
ZONE II - SAND & GRAVEL FILTER DRAIN	135	36	0
FOUNDATION - LEAN CLAY	100	30	150
FOUNDATION - WEATHERED BEDROCK	140	30	200
FOUNDATION - COMPETENT BEDROCK	145	45	500

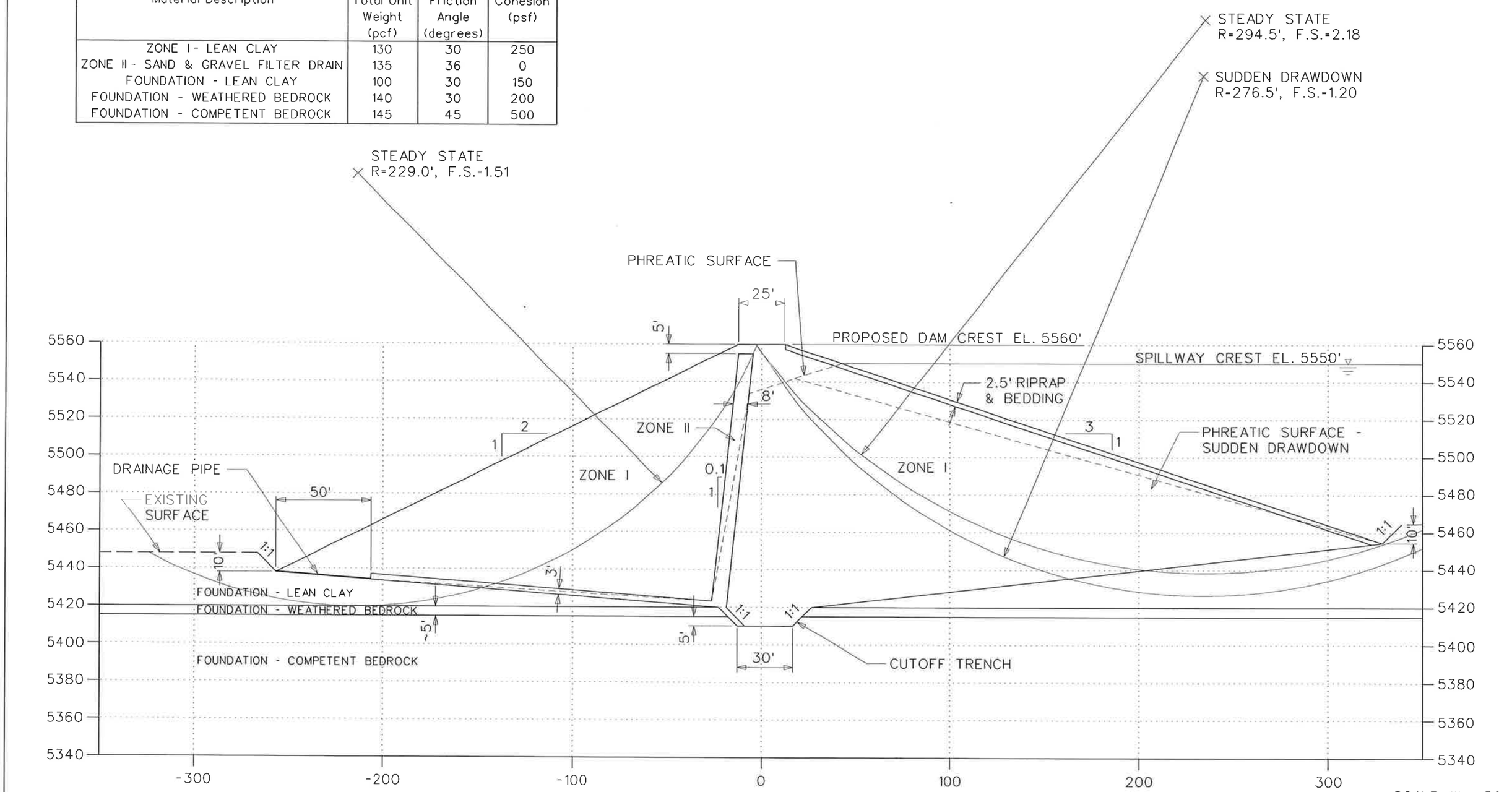


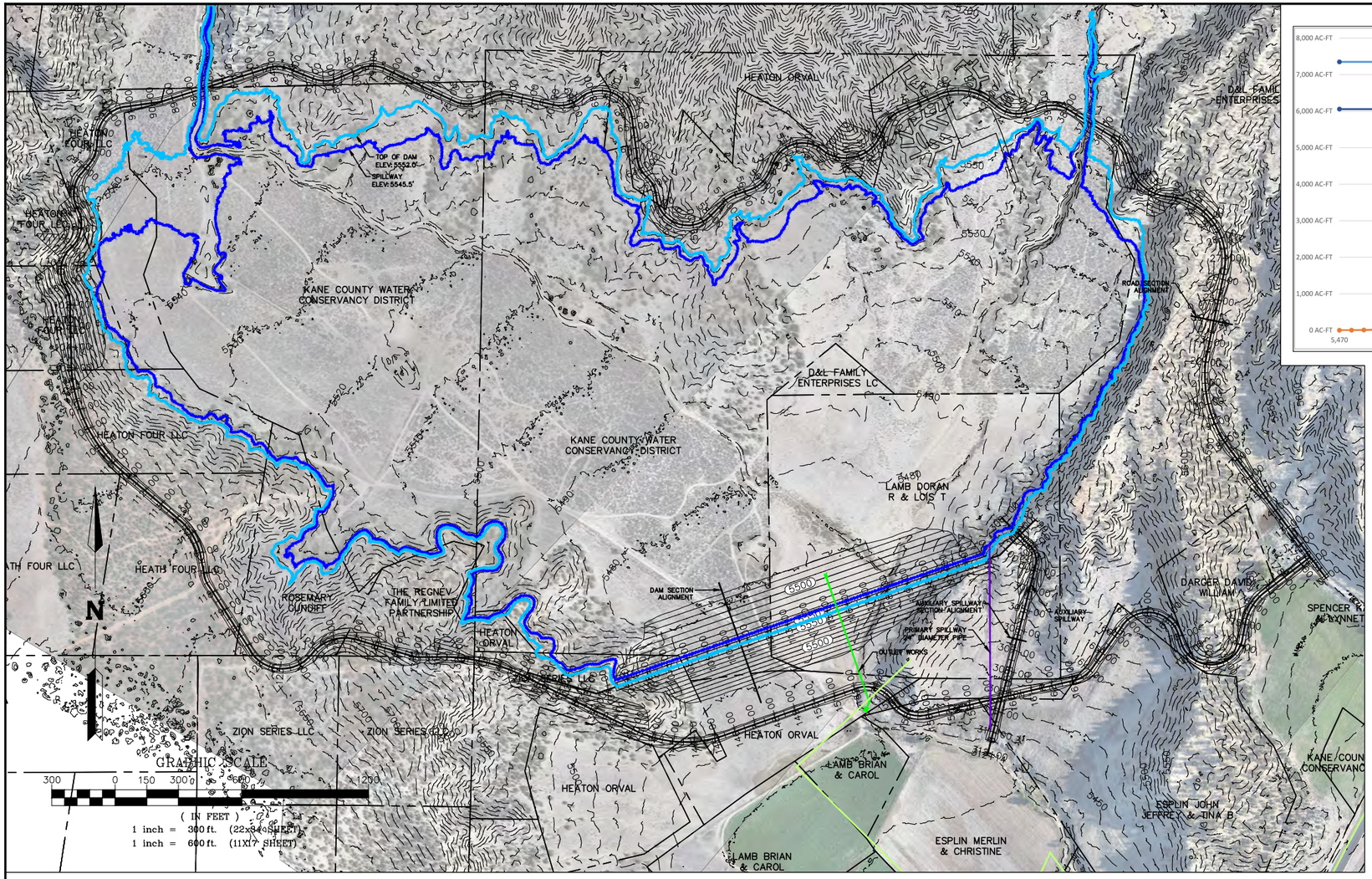
Figure 6

RB&G ENGINEERING INC.
Provo, Utah

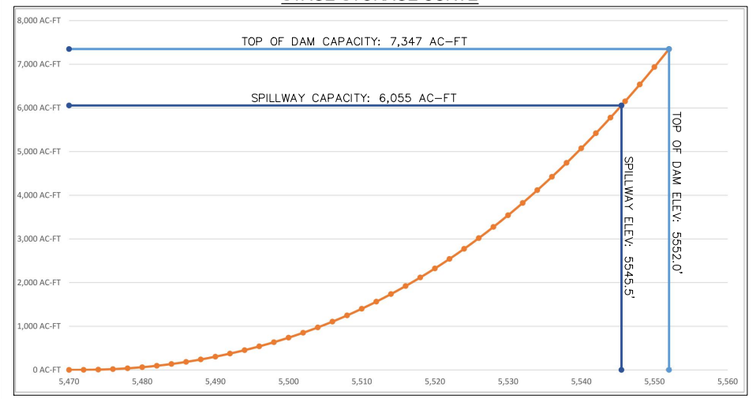
COVE DAM
Orderville, Utah

Maximum Dam Section – Station 10+40

Attachment 6 Concept Design Drawings

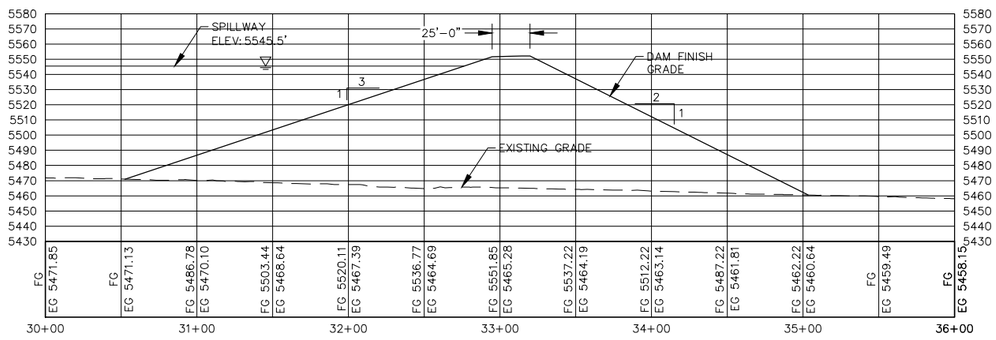


STAGE-STORAGE CURVE

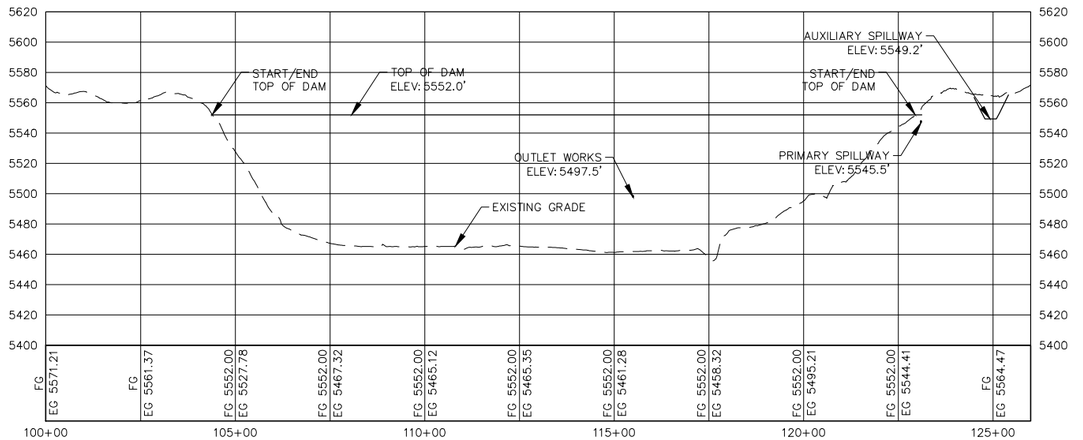


STAGE-STORAGE TABLE

ELEVATION	AREA, AC	VOLUME, AC-FT	ELEVATION	AREA, AC	VOLUME, AC-FT
5,466	0.00	0.00	5,524	119.15	2,773.35
5,468	0.02	0.02	5,526	125.03	3,017.53
5,470	0.13	0.18	5,528	131.10	3,273.65
5,472	1.68	1.99	5,530	137.23	3,541.97
5,474	4.07	7.74	5,532	143.52	3,822.72
5,476	6.77	18.58	5,534	150.00	4,116.24
5,478	11.20	36.54	5,536	156.26	4,422.50
5,480	14.53	62.26	5,538	162.83	4,741.60
5,482	18.32	95.11	5,540	169.38	5,073.81
5,484	22.19	135.62	5,542	175.81	5,419.00
5,486	26.14	183.95	5,544	182.25	5,777.07
5,488	29.87	239.95	**5,545.5**	**188.36**	**6,055.03**
5,490	33.57	303.40	5,546	189.85	6,149.18
5,492	37.23	374.20	5,548	196.21	6,535.24
5,494	41.28	452.71	5,550	203.47	6,934.92
5,496	45.36	539.35	**5,552**	**208.79**	**7,347.18**
5,498	49.59	634.30			
5,500	54.14	738.03			
5,502	58.79	850.95			
5,504	63.64	973.38			
5,506	68.52	1,105.55			
5,508	73.59	1,247.65			
5,510	78.85	1,400.09			
5,512	84.15	1,563.09			
5,514	89.59	1,736.82			
5,516	95.09	1,921.50			
5,518	100.30	2,116.89			
5,520	105.82	2,323.02			
5,522	112.68	2,541.52			



DAM SECTION
HORIZONTAL SCALE: 1" = 100'
VERTICAL SCALE: 1" = 100'



DAM PROFILE
HORIZONTAL SCALE: 1" = 400'
VERTICAL SCALE: 1" = 100'

NO.	DATE	BY	DESCRIPTION

REVISIONS

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PRELIMINARY DESIGN EXHIBIT

COVE RESERVOIR
KANE COUNTY WATER CONSERVANCY DISTRICT

PROJECT #	357-21
NAME	JTM
DATE	AUGUST 2, 2019
SCALE	AS NOTED
SHEET	1 OF 1
FILE	357-21 Overall EXH.dwg

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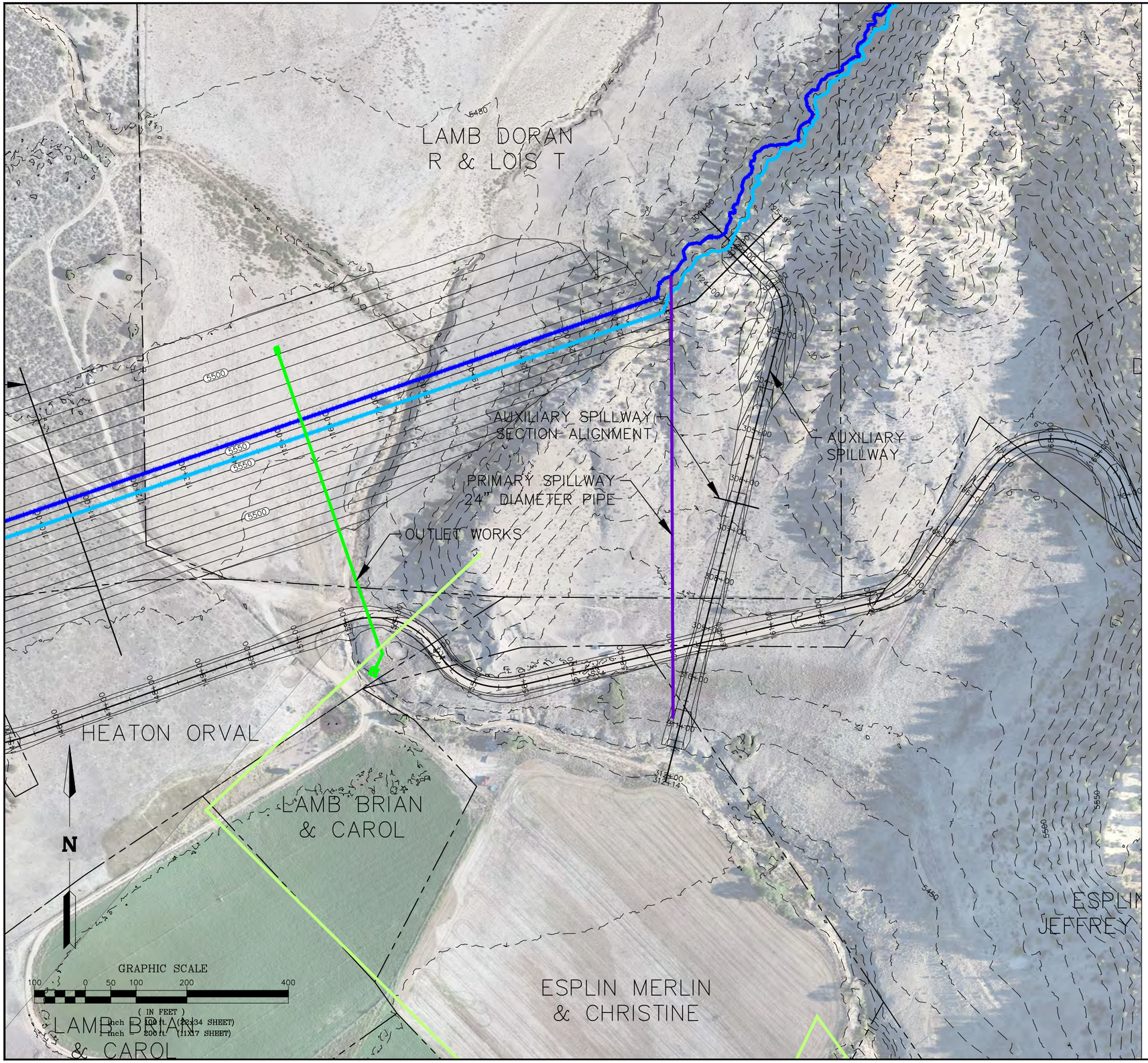
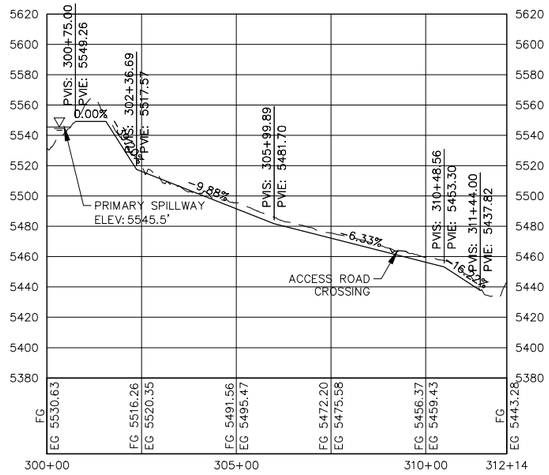
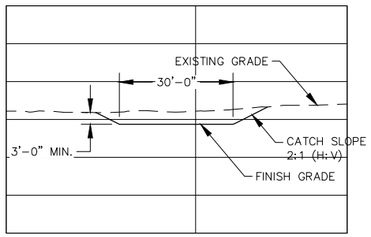




AUXILIARY SPILLWAY PROFILE
HORIZONTAL SCALE: 1" = 400'
VERTICAL SCALE: 1" = 100'



AUXILIARY SPILLWAY SECTION
HORIZONTAL SCALE: 1" = 40'
VERTICAL SCALE: 1" = 40'

NO.	DATE	BY	DESCRIPTION

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TITLE: PRELIMINARY SPILLWAY AND OUTLET WORKS DESIGN EXHIBIT

PROJECT: COVE RESERVOIR
KANE COUNTY WATER CONSERVANCY DISTRICT

PROJECT #	357-21
NAME	JTM
DATE	AUGUST 2, 2019
SCALE	AS NOTED
SHEET	1 OF 1
FILE	357-21 Overall EXH.dwg

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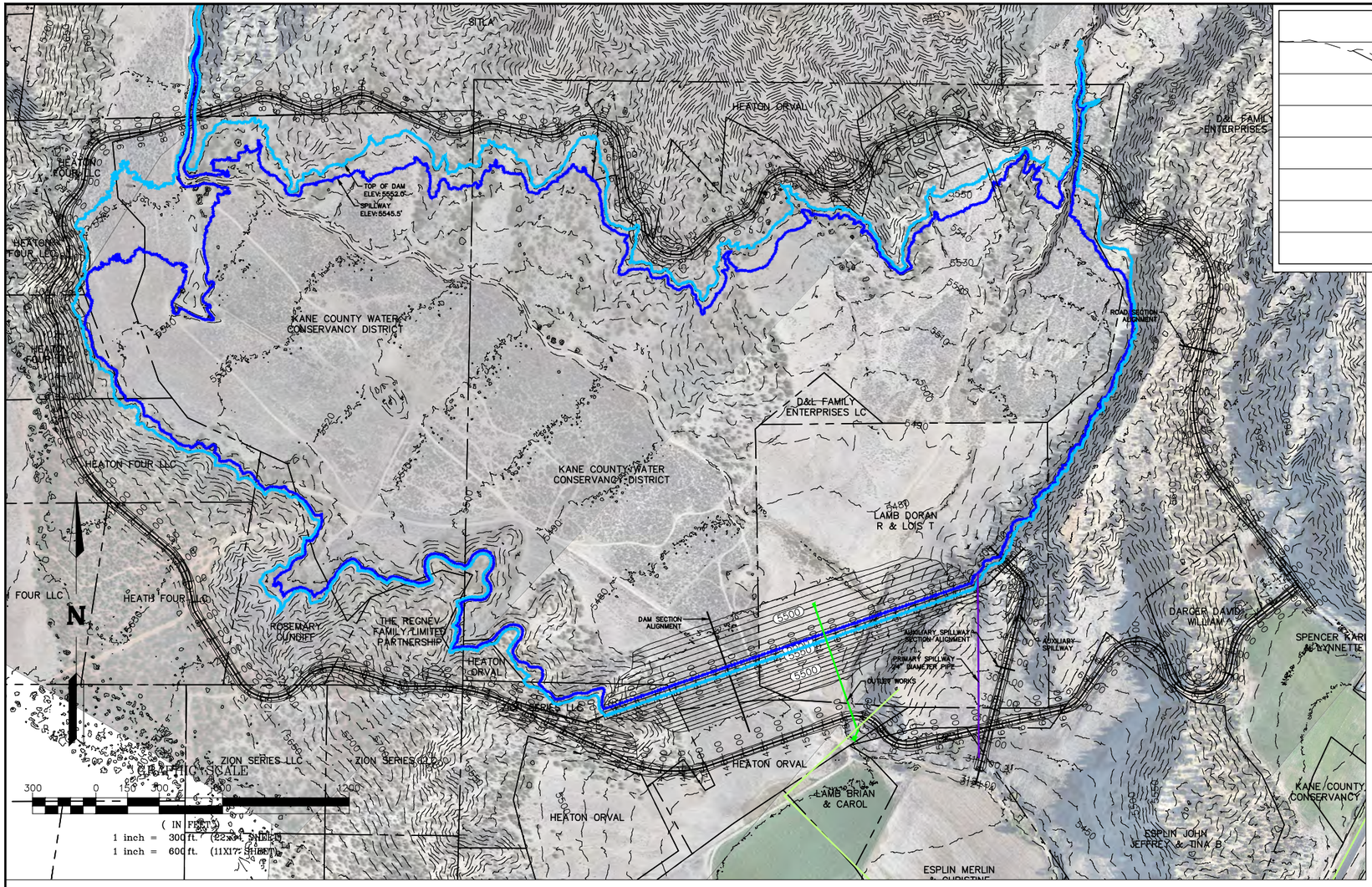
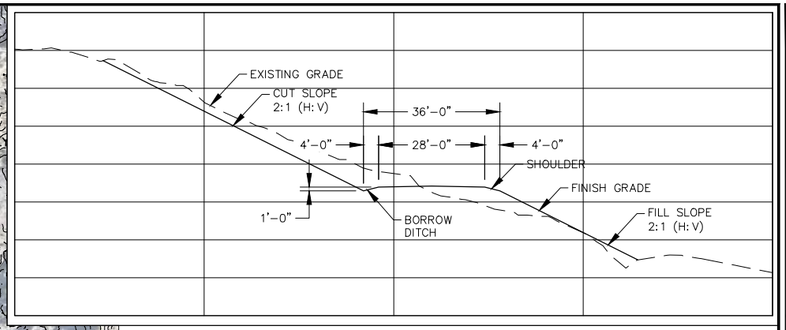
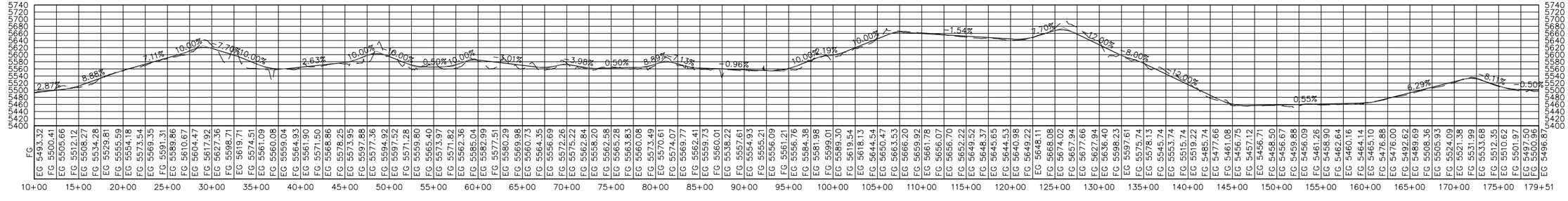




TYPICAL ROAD SECTION
HORIZONTAL SCALE: 1" = 40'
VERTICAL SCALE: 1" = 40'

ROAD DESIGN CRITERIA

DESIGN SPEED: 25 MPH
HORIZONTAL CURVE RADIUS: 150' MIN
VERTICAL CURVE, SAG K: 26
VERTICAL CURVE, CREST K: 12



ROAD PROFILE
HORIZONTAL SCALE: 1" = 1200' (11x17)
VERTICAL SCALE: 1" = 300'

NO.	DATE	BY	DESCRIPTION

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TITLE: PRELIMINARY ACCESS ROAD DESIGN EXHIBIT

PROJECT: COVE RESERVOIR
KANE COUNTY WATER CONSERVANCY DISTRICT

PROJECT #	357-21
NAME	JTM
DATE	AUGUST 2, 2019
SCALE	AS NOTED
SHEET	1
	1 OF 1
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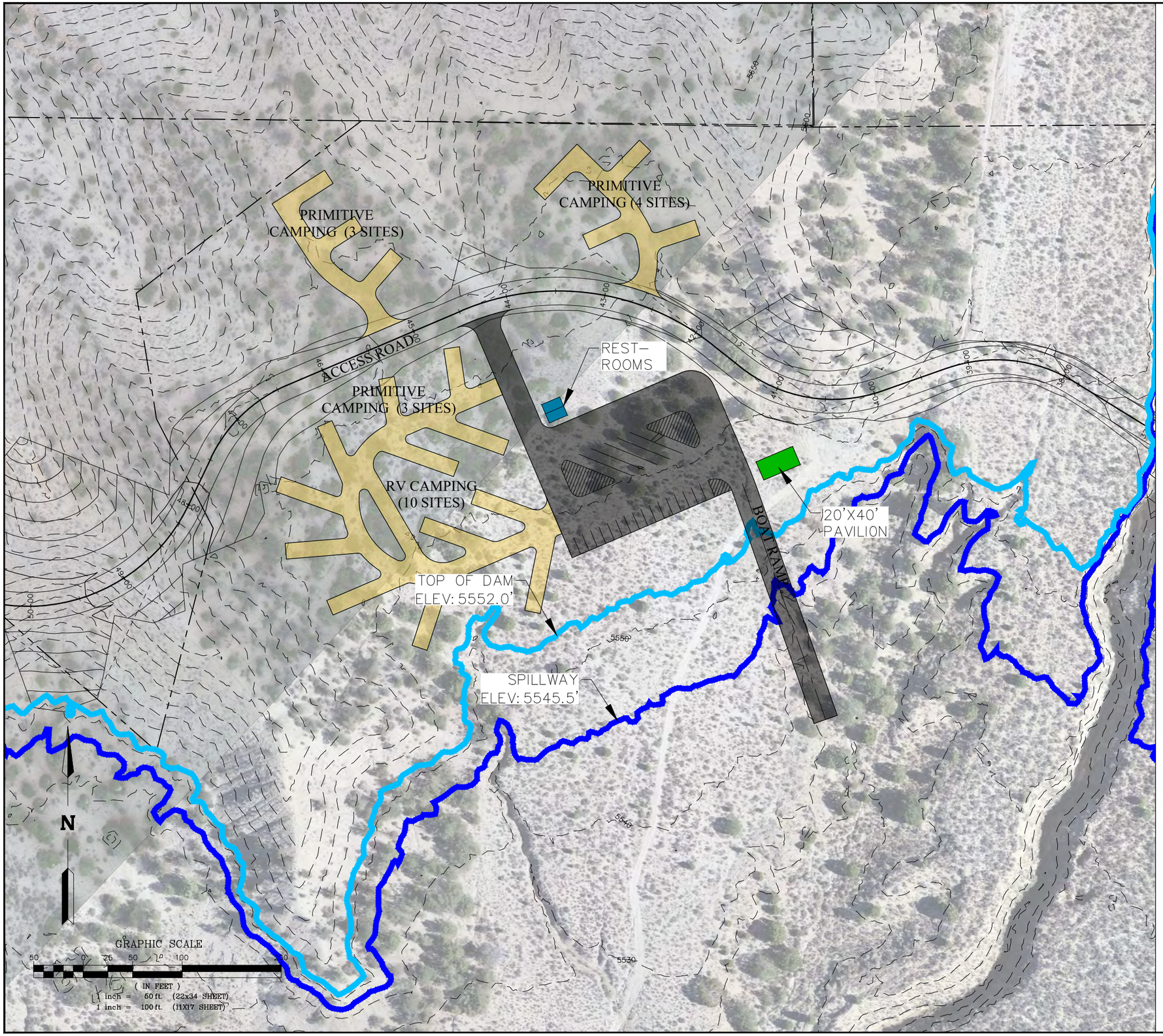

NO.	DATE	BY	DESCRIPTION

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TITLE: PRELIMINARY RECREATION PLAN DESIGN EXHIBIT

PROJECT: COVE RESERVOIR
KANE COUNTY WATER CONSERVANCY DISTRICT

PROJECT #	357-21
NAME	JTM
DATE	AUGUST 2, 2019
SCALE	AS NOTED
SHEET	1
	1 OF 1
FILE	357-21 Overall EXH.dwg

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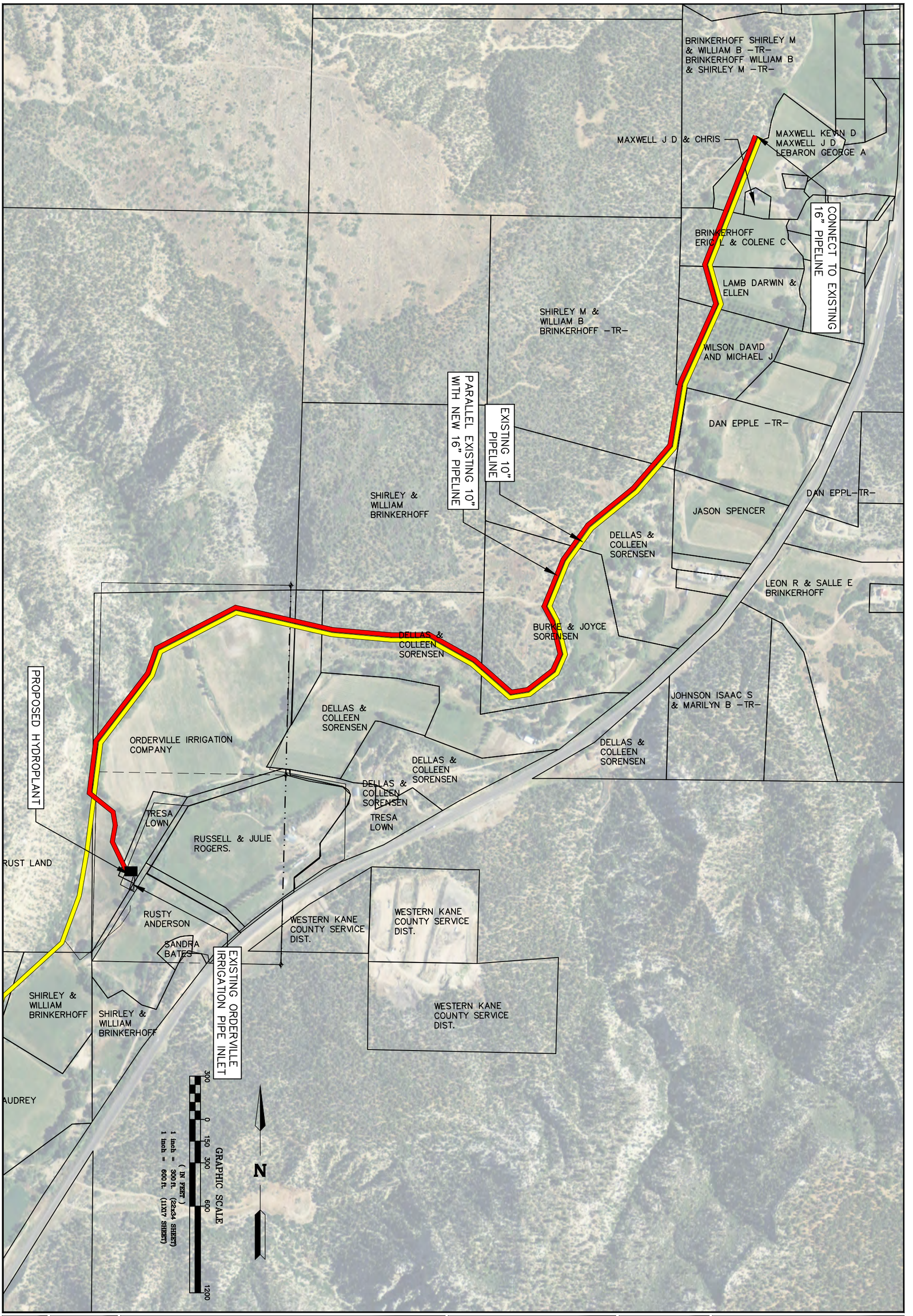

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SCALE: AS NOTED	DATE: MAY 16, 2018	NAME: JSB	PROJECT #: 357-18

TITLE: GLENDALE IRRIGATION EXHIBIT
COVE RESERVOIR

PROJECT: KANE COUNTY WATER CONSERVANCY DISTRICT

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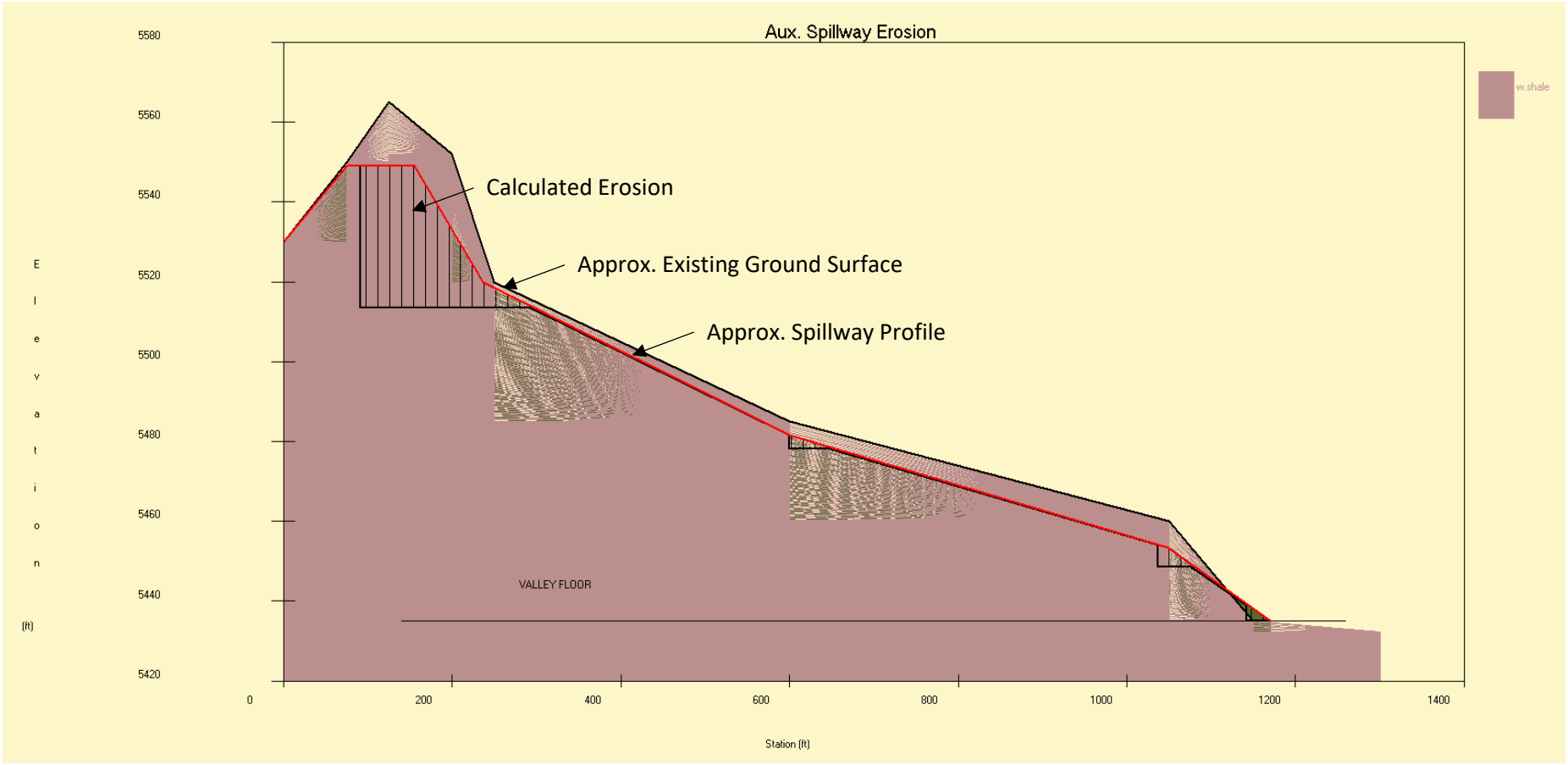
NO.	DATE	BY	DESCRIPTION

Attachment 7 SITES Erosion Analysis



RB&G ENGINEERING, INC.

SITES OUTPUT

Cove Reservoir
Kane County, Utah

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Cove East Fork of the Virgin River Watershed Plan

Proposed NEE Alternative

Kane and Washington Counties, Utah

Prepared for:



September 2026

Prepared by:

Scott Hoag, Jr, Economist

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1.0 Introduction

A Natural Resources Conservation Service (NRCS) Watershed Plan and Environmental Impact Statement (Plan-EIS) is being prepared for the East Fork of the Virgin River (EVFR) Watershed Project (Project) in Kane County, Utah. The Project is authorized under the NRCS Watershed and Flood Prevention Operations Program and funded through the Watershed Protection and Flood Prevention Act of 1954 (PL 83-566). Kane County Water Conservancy District (KCWCD) is the Sponsoring Local Organization. Washington County Water Conservancy District (WCWCD) is a co-sponsor. Cooperating agencies include the Bureau of Land Management (BLM), National Park Service, Environmental Protection Agency, United States Army Corps of Engineers, Utah School and Institutional Trust Lands Administration, and Public Lands Policy Coordination Office.

The Project proposes the installation of a 6,000-acre-foot reservoir for the purposes of Agricultural Water Management (AWM), Recreation, and Municipal and Industrial (M&I) Water Supply.

The purpose of this report is to document Project compliance with Principles, Requirements, and Guidelines (PR&G) for Federal Investments in Water Resources per the *Principles and Requirements for Federal Investments in Water Resources* (Council on Environmental Quality [CEQ] 2013), the *Final Interagency Guidelines* (CEQ 2014), and *NRCS Decision Memorandum* (NRCS 2018).

2.0 Principles, Requirements, and Guidelines Evaluation Process Overview

The PR&G evaluation process is based on an eight-step watershed planning process and was completed for the EFVR Project, as described in section 3.0. The NRCS nine-step planning process was also followed in conjunction with the PR&G evaluation process. The PR&G eight-step evaluation process includes consideration of the federal objective, PL 83-566 general purposes, guiding principles, and ecosystem services. Guiding principles were used to assist in decision making and weighing tradeoffs of Project alternatives. The use of an ecosystem services framework to describe the comprehensive set of benefits that people receive from nature is characterized as ecological goods and services provided by a healthy, functioning environment. The guiding principles outlined in the PR&G documents include:

1) Healthy and Resilient Ecosystems

2) Sustainable Economic Development

3) Floodplains (avoiding unwise use of floodplains)

4) Public Safety (reducing public health and safety risks)

5) Environmental Justice

6) Watershed Approach

Ecosystem services benefits have been organized into four service categories that are reflected in the Department of Agriculture Departmental Manual (DM9500-13) and include:

1) **Provisioning services** are tangible goods provided for direct human use and consumption, such as food, fiber, water, timber, or biomass.

2) **Regulating services** maintain a world in which it is possible for people to live, providing critical benefits that buffer against environmental catastrophe. Examples include flood and disease control, water filtrations, climate stabilization, or crop pollination.

3) **Supporting services** refer to the underlying processes maintaining conditions for life on earth, including nutrient cycling, soil formation, and primary production.

4) **Culture services** make the world a place in which people want to live, including recreational use, spiritual, aesthetic viewsheds, or Tribal values.

The guiding principles and service categories were evaluated for those that were critical to the decision maker, the analysis, and the stakeholders. A measurement of change in services was determined, where applicable, between the Future without Federal Investment (FWOFI) Alternative, also referred to as the No Action Alternative, and the Future with Federal Investment (FWFI) Alternatives, also referred to as Action Alternatives. An evaluation framework was developed to compare the FWOFI and FWFI Alternatives and is attached in Appendix A. This framework was used to select the alternative that maximizes public benefits (environmental, economic, and social goals) with appropriate consideration of costs and included consideration of the guiding principles and ecosystem services.

3.0 Principles, Requirements, and Guidelines Eight-Step Evaluation Process

The PR&G eight-step evaluation process used in decision making is outlined in Sections 3.1 through 3.8 below.

3.1 Identify Problems and Opportunities

Problems and opportunities were identified during the Project scoping process. Input from the sponsors, agencies, public, organizations, and Tribes were solicited as described in Chapter 1.8.4 and Chapter 7.0 of the Plan-EIS. A copy of the Scoping Report is provided in Appendix A of the Plan-EIS. Engineering analysis was completed to further identify and evaluate problems as documented in the engineering technical memorandums attached in Appendix E of the Plan-EIS. The Purpose and Need of the Project was formulated with the problems and opportunities in consideration. Where the “Purpose” identifies the fundamental reason why the action is being proposed and the “Need” describes the problem(s) that the proposed action is intended to address and explains the underlying causes of the problem(s). The Purpose and Need of the Project is included in Chapter 2.0 of the Plan-EIS with information supporting the Purpose and Need and a description of the watershed problems identified in Chapter 2.2.1 of the Plan-EIS. The Purpose

and Need of the Project, as stated in the Plan-EIS (Chapters 2.1 and 2.2) and for reference, is included below.

> The primary purpose of the proposed Project is to enhance the efficiency and reliability of the current agricultural water management in Long Valley, part of the EFVR sub-watershed, while complying with the Zion National Park Water Rights Settlement of 1996. Effective irrigation systems and water management strategies would support farm profitability amid constraints posed by scarce and costly water resources.
>
> The secondary purposes of the project are public recreation and to increase irrigation and M&I water supply to communities in Washington County. The water demand in the WCWCD service area is projected to increase as summer irrigation water shortages continue and more municipal water providers join and receive from the WCWCD system.
>
> The need for this project arises from annual water shortages experienced by local agricultural users served by the Glendale, Orderville, and Mt. Carmel irrigation companies. Due to a difference in timing between the melting of snowpack within the watershed and the peak demand for agricultural water use, these users experience water shortages during the summer months. Contributing factors include variable precipitation patters, EFVR flow trends, absence of sufficient water storage facilities, and inefficiencies in current irrigation water during summer, causing inconsistent agricultural production and limiting the potential for cultivation of water-dependent crops.
>
> Additionally, water users in Washington County, served by the Hurricane Canal Company, experience water shortages during the summer months when Virgin River flows decrease, and a projected county population increase will result in a greater M&I water demand.

3.2 Inventory Existing Resource Conditions

Resources relevant to the proposed action were determined during the scoping process, as described in Chapter 3.1 of the Plan-EIS. The existing conditions of resources determined to be relevant are documented in Chapter 3.2 of the Plan-EIS, which provides the environmental baseline conditions for resources to be evaluated against alternative actions. The best available data and science was used to inventory the existing resource conditions at a level and scale of analysis determined reasonable for evaluating alternatives and impacts.

3.3 Forecast Future Conditions

A forecast of future conditions was made for resources, where reasonable to address, in the Chapter 3.3 of the Plan-EIS. Additional future conditions forecasting was made for each alternative and associated implementation and Operations and Maintenance (O&M) costs. Future forecasting of alternative impacts is described in Chapter 5.0 of the Plan-EIS. The installation and O&M costs for future conditions of each alternative are provided in Chapter 4.0 of the Plan-EIS.

3.4 Develop Array of Alternatives

Project alternatives were formulated following procedures outlined in the National Watershed Program Manual, National Watershed Program Handbook, and PR&G. Alternatives required in the initial consideration per PR&G includes the FWOFI Alternative and the FWFI Alternatives, locally preferred alternative, environmentally preferable alternative, and any additional alternatives. A nonstructural alternative did not meet the Project purpose and need and was determined not feasible. Therefore, the FWOFI Alternative, which would not include any structural measures but maintain the existing situation, is the nonstructural alternative.

Two action alternatives, a 6,000-Acre-Foot Reservoir, and a 3,000-Acre-Foot Reservoir, were developed for the EFVR Watershed for the PL 83-566 water management authorized purpose. Descriptions of alternative measures are provided in 4.2 of the Plan-EIS.

Alternatives were removed from further consideration and analysis during the PR&G evaluation if they were determined infeasible, did not meet the purpose and need, conflicted with the federal objective or guiding principles, had exorbitant costs, or were determined to be inferior due to other critical factors. A detailed description of these alternatives is included in Chapter 4.2 of the Plan-EIS. In those cases, a brief discussion is included in the evaluation framework table (Appendix A) to identify the reasons for elimination of an alternative. A discussion of the alternatives eliminated and the reasons for elimination are also documented in Section 5.3 of the Plan-EIS.

The FWOFI Alternative (No Action Alternative) was also evaluated to provide a benchmark for comparison. The FWOFI Alternative would consist of continued diversion of water from the East Fork of the Virgin River to irrigate 1,109 acres in the Glendale, Orderville and Mt. Carmel irrigation districts.

3.4.1 6,000-Acre Foot Alternative (Preferred Alternative)

The FWFI Alternative consists of construction of a 6,000-acre-foot reservoir and dam, principal and auxiliary spillways, recreation area, pipelines, booster pump station, and access road improvements. Construction elements for the preferred alternative are described in tables 1 through 6 below.

Table 1: 6,000-Acre-Foot Reservoir Construction Elements

ITEM	DESCRIPTION	QUANTITY	UNITS
1	Mobilization (5 percent)	1	Lump Sum (L.S.)
2	Excavation	644,000	Cubic Yards (C.Y.)
3	Foundation Preparation	12,000	Square Yards (S.Y.)
4	Earthfill, Zone I - Dam Embankment	1,575,000	C.Y.
5	Earthfill, Zone II - Filter / Drain	82,000	C.Y.
6	Roadbase - Riprap Bedding	19,000	C.Y.
7	Rock Riprap	28,000	C.Y.
8	Grout Curtain	31,500	Linear Feet (L.F.)
9	Outlet Works	550	L.F.
10	Spillway	1	L.S.
11	Instrumentation	1	L.S.

Table 2: Reservoir Outlet Pipeline Construction Elements

ITEM	DESCRIPTION	QUANTITY	UNITS
1	Mobilization (5 percent)	1	L.S.
2	Replace Line from Existing Glendale Hydro to Orderville Diversion Dam with 10-inch Pipeline	9,200	L.F.
3	Replace Existing 18-inch and 14-inch BV Valves with Gate Valves	2	Each
4	Clean Pipeline	1	L.S.
5	Furnish and Install 10-inch Plunger Valve and Vault	1	L.S.
6	Power Interconnection	1	Each

Table 3: Mt. Carmel Irrigation Pipeline Construction Elements

ITEM	DESCRIPTION	QUANTITY	UNITS
1	Mobilization at 5 percent	1	L.S.
2	8-inch Pipeline	4,960	L.F.
3	10-inch Pipeline	8,300	L.F.
4	12-inch Pipeline	6,400	L.F.
5	16-inch Pipeline	4,100	L.F.
6	Misc. Fittings	1	L.S.
7	Highway Crossings	3	Each
8	Pump Station	1	Each
9	Cultural Resource Mitigation	1	Each

Table 4: Cultural Resource Mitigation

Tasks	Description
Task 1	Project Management and Coordination
Task 2	Drone Flyovers
Task 3	Aerial Photographs
Task 4	Measured Drawings
Task 5	GIS Story Map
Task 6	Informational Brochure
Task 7	Updated Site Records
Task 8	Historic Context

Table 5: Recreation Facilities Construction Elements

ITEM	DESCRIPTION	QUANTITY
1	Mobilization at 5 percent	1
2	Excavation and Subgrade Prep	88,000
3	6-inch Reinforced Concrete (Boat Ramp)	6,500
4	6-inch Untreated Base Course (Boat Ramp)	6,500
5	6-inch Untreated Base Course (Parking)	28,500
6	6-inch Untreated Base Course (Roads)	53,000
7	Camp/RV Site Facilities (Barbeque Grill, Table, Fire Pit)	20
8	Pavilion	1
9	Signage	5
10	Restroom Facility (Assume Pit Toilet System)	2

Table 6: Access Road Construction Elements

ITEM	DESCRIPTION	QUANTITY
1	Mobilization at 5 percent	1
2	Excavation and Subgrade Prep	110,440
3	6-inch Untreated Base Course (24-foot width)	291,408
4	Misc. Culverts	1
5	Signage	4

3.4.2 3,000-Acre Foot Alternative

Alternative 2 consists of construction of a 3,000-acre-foot reservoir and dam, principal and auxiliary spillways, recreation area, pipelines, booster pump station, and access road improvements. Construction elements for the reservoir and recreation area are described in tables 7 and 8 below. Construction for the remainder of the project would be the same as described in section 3.4.1.

Table 7: 3,000 Acre-Foot Reservoir Construction Elements

ITEM	DESCRIPTION	QUANTITY	UNITS
1	Mobilization (5 percent)	1	L.S.
2	Excavation	523,000	C.Y.
3	Foundation Preparation	11,000	S.Y.
4	Earthfill, Zone I - Dam Embankment	1,050,000	C.Y.
5	Earthfill, Zone II - Filter / Drain	64,000	C.Y.
6	Roadbase - Riprap Bedding	15,000	C.Y.
7	Rock Riprap	20,000	C.Y.
8	Grout Curtain	29,000	L.F.
9	Outlet Works	300	L.F.
10	Spillway	1	L.S.
11	Instrumentation	1	L.S.

Table 8: Recreation Facilities Construction Elements

ITEM	DESCRIPTION	QUANTITY
1	Mobilization at 5 percent	1
2	Excavation and Subgrade Prep	88,000
3	6-inch Reinforced Concrete (Boat Ramp)	6,500
4	6-inch Untreated Base Course (Boat Ramp)	6,500
5	6-inch Untreated Base Course (Parking)	28,500
6	6-inch Untreated Base Course (Roads)	53,000
7	Camp/RV Site Facilities (Barbeque Grill, Table, Fire Pit)	12
8	Pavilion	1
9	Signage	5
10	Restroom Facility (Assume Pit Toilet System)	1

3.5 Evaluate Effects of Individual Alternatives

The PR&G evaluation framework assessed two Action Alternatives that included water storage for Cove EFVR. Refer to the framework table provided in Appendix A. The framework table includes the guiding principles listed in Section 2.0 above and ecosystem services for provisioning, regulating, cultural, and supporting, as applicable. The ecosystem services determined to be applicable to Project measures for evaluation are listed below. Because short-term construction impacts would be avoided, minimized, and/or mitigated, only measurable long-term effects to ecosystem services are considered for the framework table and determination of applicability.

Provisioning Services

- Ecosystem Productivity
- Food (agricultural yield)

Regulating Services

- Climate
- Water Regulation (quality and quantity)
- Biological Regulation (plants and animals)

Cultural Services

- Peace and Sustainability
- Community Well-being
- Cultural/Historical Identity and Heritage

Supporting Services

- Water Cycling
- Nutrient Cycling
- Habitat and Biomass

An economic analysis was also completed for the FWOFI (No Action) and FWFI (Action) alternatives evaluated in the framework tables for each site as described in the following section.

3.5.1 Economic Evaluation and Comparison

During June, July, August, and September, the water flow in the EFVR is insufficient to meet the Glendale, Orderville, and Mt. Carmel Irrigation Company agriculture irrigation needs as well as the irrigation water supply needs of the HCC and the M&I water needs in Washington County.

The existing conditions of the Project area are identified in Chapter 3.0 of the Plan-EIS. The economic analysis for the FWFI alternative identified those resources determined necessary for evaluation as part of the alternative development process. The economic evaluation considered the benefits and costs of the FWFI alternative for each of the two reservoir sizes and are described below. The FWOFI alternative was also evaluated. The FWOFI is the likely future condition in the absence of federal action or federal funding and provides the baseline for comparison of the FWFI. The sponsors have obtained funding at local and state level for their share of the Project cost.

3.5.1.1 Calculations

Three primary economic benefits were identified that would result from implementation of the FWFI alternative. Table 1 identifies the beneficial effects that ensue by implementing the Action Alternative. These individual resources are discussed in detail below.

Table 9: Potential Agricultural Water Management, Recreation, and M&I Opportunities

Site Name	Rural Community and Agricultural Benefits	Recreation Benefits	M&I Benefits
AWM	X	-	-
Recreation	-	X	-
Washington County M&I	-	-	X

(Hoag 2023)

The Proposed Project benefit-cost summary of implementing the FWFI alternative is shown below.

Table 10: Benefit-Cost Summary

Purpose	Average Annual Cost	Average Annual Benefit	Benefit-Cost Ratio	Net Benefit
AWM	$503,402	$389,000	0.77	-$114,402
Recreation	$424,749	$414,000	0.97	-$10,749
M&I Water	$431,257	$594,000	1.38	$162,743
Total	$1,359,000	$1,397,000	1.03	$38,000

3.5.2 Agricultural Water Management Benefits

The principal ecosystem services considered in the evaluation of this Project are:

1) Provisioning services are tangible goods provided for direct human use and consumption, such as food, fiber, water, timber, or biomass

2) Healthy and resilient ecosystems

3) Sustainable economic development

Benefits to AWM were assessed by comparing the FWOFI alternative and the FWFI alternative. Crop budgets for alfalfa and alfalfa establishment produced by the Utah State University Cooperative Extension Service were used to assess benefits to increased and reliable water supplies for 1,109 acres in Kane County and 67 acres in Washington County.

The 2016 crop budget operating costs for Kane and Washington Counties were brought to current value using the Producer Prices Paid Index for FY 2026 (152) divided by the Index for 2006 (148), giving a multiplier of 1.03 Fixed costs were not considered in the analysis since each operator has a full complement of machinery and sprinkler systems.

Kane County alfalfa production in the FWOFI alternative is 3 tons per acre while the FWFI alternative is 5 tons per acre. Washington County, alfalfa production is 4 tons and 6 tons per acre, respective to the FWOFI and FWFI alternatives. Residue grazing values were also assessed in both Kane and Washington Counties.

Per acre benefits were calculated by subtracting the FWOFI alternative net return from the FWFI alternative net return. This was done for both Kane and Washington Counties. The 1,109 acres in Kane County are comprised of three Irrigation companies: Orderville, 286.05 acres; Glendale, 427.26 acres; and, Mt Carmel, 395.75 acres. There are 198 acres in Mt. Carmel sprinkler irrigated and 198 acres flood irrigated. A per-acre, sprinkler system purchase-cost was calculated and included in the 198 flood irrigated acres in the Mt. Carmel district. The FWFI alternative and a benefit was calculated as above. The same analysis was employed for oat hay/alfalfa establishment.

AWM benefits were calculated assuming a 10-year crop rotation: 8 years in alfalfa and 2 years in oat hay/alfalfa establishment. A weighted average (80 percent alfalfa, 20 percent oat hay/alfalfa establishment) per-acre net return was calculated for the 713.31 acres in Glendale and Orderville. A weighted average (80 percent alfalfa, 20 percent oat hay/alfalfa establishment and 50 percent sprinkler irrigated and 50 percent flood to sprinkler irrigated) per-acre net return was calculated for the Mt. Carmel area. Total AWM benefits are shown in Table 2. Evaluation files for AWM are found in the EXCEL workbook titled Irrigation Benefit Analysis (Appendix B). Each sheet in the workbook details the AWM analysis.

3.5.3 Recreation Benefits

Benefits to recreation were assessed based on the Army Corps of Engineers Unit Day Values for recreation activities. Point values for General Recreation and Specialized Recreation for each category (Recreation Experience, Availability of Opportunity, Carrying Capacity, Accessibility, Environmental Quality) were assigned based on the Tables 1 and 2 in the above EGM. Point values were converted to dollar values based on the table of Conversion of Points to Dollar Values (page 2 of the EGM).

Recreation benefits were calculated based on recreation use at Jackson Flat Reservoir (14,090 annual visits). Total points were determined for General Recreation (64) and Specialized Recreation (53). A dollar value was calculated for both General Recreation and Specialized Recreation for each of the categories listed above and a weighted average (assuming 50 percent General and 50 percent Specialized) computed for the Project equal to $28.53 per annual visit for a benefit of $414,000. The USCOE EGM point values and their conversion are in the following tables.

Table 2: USCOE EGM point values

-	Unit Day Value Point Values (General Recreation)	Unit Day Value Point Values (Specialized Recreation)
Recreation experience	23	13
Availability of Opportunity	4	3
Carrying Capacity	11	11
Accessibility	11	11
Environmental quality	15	15
TOTAL PTS	64	53
Value	$12.23	$44.82

Table 11: Dollar Values and Corresponding Point Values

Point Values	General Recreation Values (1)	General Fishing and Hunting Values (1)	Specialized Fishing and Hunting Values (2)	Specialized Recreation Values other than Fishing and Hunting (2)
0	$5.17	$7.44	$36.22	$21.02
10	$6.14	$8.41	$37.19	$22.31
20	$6.79	$9.05	$37.84	$23.93
30	$7.76	$10.02	$38.81	$25.87
40	$9.70	$11.00	$39.78	$27.49
50	$11.00	$11.97	$43.66	$31.05
60	$11.97	$13.26	$47.54	$34.28
70	$12.61	$13.91	$50.45	$41.39
80	$13.91	$14.88	$54.33	$48.18
90	$14.88	$15.20	$58.21	$54.98
100	$15.52	$15.52	$61.44	$61.44

Table 4: Calculations based on Dollar and Point Values

General Recreation $ value at 60 pts	$11.97
General Recreation $ value at 70 pts	$12.61
General Recreation $ value at 64 pts equals (12.61-11.97) times .4 plus 11.97 equals	$12.23
Specialized Recreation $ value at 50 pts	$43.66
Specialized Recreation $ value at 60 pts	$47.54
Specialized Recreation $ value at 53 pts equals ($47.54-$43.66) times .3 plus $43.66 equals	$44.82
Combined Value equals .5 times 12.23+.5 times 47.54	$28.53

3.5.4 Municipal and Industrial Water Benefits

Benefits to M&I in Washington County were assessed based on cost information in the following study prepared for the WCWCD: Washington County Small Surface Water Storage Project Feasibility Study. The average annual cost of the Ash Creek Project per acre-foot was computed from information in Table 5-1: Cost Comparison of Water Supply Alternatives of the Feasibility Study. The 2022 cost per acre-foot was updated to the current value based on a multiplier computed from the Engineering News Record Construction Cost indices for FY 2022 and FY 2025. The average annual cost per acre-foot was then multiplied by the 300-acre-foot unit provided by the Cove EFVR Reservoir. This value is then a cost savings attributed to WCWCD and is the computed M&I benefit. The following table shows the calculations.

Table 5: Municipal and Industrial Water Benefits Calculations

-	Construction Cost	Amortized Const Cost	Acre-Foot	Ave Ann Const Cost per Acre-Foot	Benefit per 300 Acre-Foot
	$101,622,816	$3,443,338	1,739	$1,932 $1,980	$594,020

3.5.5 Cost Allocation

Cost allocation is described in Part 611 Water Resources Handbook for Economics National Resource Economics Handbook at 611.0601 Cost allocation. Separable Cost/Remaining Benefit–Use of Facilities was used to allocate the Costs of the Multipurpose Reservoir. Calculations are shown in the table below.

Table 12: Use of Facilities Cost Allocations

		Purpose			
		Irrigation	Recreation	M&I	Total
1 Benefits		$14,284,234	$13,133,232	$17,117,471	$44,534,937
2 Alternative cost		$35,098,689	$21,799,133	$16,738,530	$73,636,352
3 Lesser of step 1 or 2		$14,284,234	$13,133,232	$16,738,530	$44,155,996
4 Separable cost		$1,803,015	$2,008,713	$1,285,234	$5,096,962
5 Use of facility (ac ft)		1,700	1,500	2,800	6,000
5a Percentage use of facility		28%	25%	47%	100%
6 Allocated joint cost		$1,444,139	$1,274,240	$2,378,582	$5,096,962
7 Total allocated cost		$3,247,154	$3,282,953	$3,663,816	$10,193,923
8 Net benefits		$11,037,080	$9,850,279	$13,074,714	$33,962,073
Total Allocated Cost		31.9%	32.2%	35.9%	100.0%

Step 1: Report the benefits for each purpose for which the plan was formulated. Benefits are shown in present value terms.

Step 2: The alternative cost is the financial cost of achieving the same or equivalent benefits by a single purpose project.

Step 3: Record the lesser of the benefits or the alternative cost, by purpose.

Step 4: Separable cost is the cost of adding each purpose to the multiple purpose project. This figure indicates the minimum cost that will be allocated to the purpose. If the separable cost for a purpose exceeds the amount shown in step 3, the project contains an infeasible purpose.

Step 5: is the use each purpose makes of the multiple purpose facility in acre-feet. When two purposes make joint use of the same reservoir capacity, that capacity is equally divided among the purposes.

Step 6: The allocated joint cost in the total column is the difference between project financial cost and the sum of the separable costs for all of the purposes. The total allocated joint cost is distributed to each purpose by the percentage shown for that purpose in step 5a.

Step 7: Total allocated cost for each purpose is the sum of the separable cost and allocated joint cost for the purpose.

Step 8: Net benefits are the difference between the amounts in Step 3 and Step 7. Because purpose feasibility is not automatic in this method, Step 8 is added.

Cost allocation is defined below (see Part 611, Water Resources Handbook for Economics, National Resource Economics Handbook, 611.0601 Cost Allocation):

Public Law 83-566, as amended, authorizes the U.S. Secretary of Agriculture "to make allocations of costs to the various purposes, and to show the basis of such allocations and to determine whether benefits exceed costs" (PL 83-566). NRCS national policy directs that, in allocating total project financial costs among the purposes served by the project or plan, "separable costs will be assigned to their respective purposes, and all joint costs will be allocated to purposes for which the project was formulated." The distinction between cost allocation and cost sharing must be recognized. Cost allocation pertains to works of improvement serving more than one purpose. It is the process of dividing costs of the structure equitably among the purposes served, with each purpose receiving its fair share of the advantage resulting from multiple purpose installation. Cost sharing is the division of the cost allocated to each purpose by the financing agencies or groups involved. In NRCS water resource projects, costs of the works of improvement are shared between federal and local funds. The need for allocation stems from cost-share rates that vary among purposes. Although either annual equivalents or capital costs can be used in allocations, NRCS policy is to use capital costs.

3.5.6 Environmental Evaluation

A detailed analysis was completed for each alternative evaluated in the Plan-EIS. These are the FWOFI Alternative (No Action Alternative) and the FWFI Alternative (Action Alternative). The potential effects of implementing each alternative were analyzed and documented in Chapter 5.0 of the Plan-EIS.

3.6 Compare Alternatives

A measurement of change in services was determined, where applicable, between the FWOFI alternative and the FWFI alternative. The alternatives for each site meeting the guiding principles were noted in the framework table for side-by-side alternative comparison. The ecosystem services were also compared in the framework table. The PR&G evaluation comparison tables for decision making are included in Attachment A of this document.

The two alternatives were evaluated to determine the locally, environmentally, and socially preferred alternative plans. The preferred alternative was coordinated with the those having local interests and oversight for implementation authorities and responsibilities. The local entities include the KCWCD, WCWCD, BLM. The environmentally preferred alternative was selected based on evaluations conducted during the NEPA process and from the determination of

environmental consequences as documented in Chapter 6.0 of the Plan-EIS. Determination of the socially preferred alternative compared impacts or benefits for each alternative related to the social well-being of the community. Specifically for this Project, these comparison items included socioeconomic effects on the community.

3.7 Identify Recommended Alternative

NRCS must identify the federally assisted alternative that best maximize public benefits (environmental, economic, and social goals) with appropriate consideration of costs, guiding principles, and ecosystem services. This alternative is known as the NRCS National Economic Efficiency (NEE) Alternative. The NEE Alternative also reflects national priorities, economic development, and environmental protection through:

1) Seeking to maximize sustainable economic development

2) Seeking to avoid the unwise use of floodplains and flood-prone areas and minimizing adverse impacts and vulnerabilities in any case in which a floodplain or flood-prone area must be used

3) Protecting and restoring the functions of natural systems and mitigating any unavoidable damage to natural systems.

The FWFI alternative is in line with the federal objectives outlined above. This alternative was formulated to maximize sustainable economic development and economic benefits for the agricultural community, recreationists, and M&I water users in Washington County. Implementation of the FWFI alternative would improve agriculture water management and avoid short water supplies in late summer and early fall. Producers would be assured of a full water supply for the entire growing season. Recreationists can take advantage of a flat-water reservoir with RV sites. Users will enjoy boating, fishing, hiking and camping.

The NEE alternative was selected based on the best option determined from the comparison of alternatives included in the framework table in Appendix A. In comparing the FWOFI and FWFI alternatives, the FWFI option was the preferred option, based on the purpose and need and objectives of the Project. The FWFI alternative resulted in the least cost (installation and operation, maintenance, and replacement costs versus Project benefits) over the evaluated life of the Project and was selected as the NEE alternative. This alternative would meet the guiding principles, provide the greatest benefits for ecosystem services, and is in line with the federal objective and PL 83-566 general purposes. This alternative was also determined to be the locally preferred, environmentally preferred, and socially preferred alternative. The Plan-EIS incorporates a description of the decision-making process for selection of the NEE alternative in Chapter 6.0. See Benefit-Cost Summary Tables in Chapter 6.12 of the Plan-EIS.

3.8 Implement and Evaluate

The NEE alternative (FWFI or Action Alternative) was evaluated, and the subsequent environmental consequences are analyzed in Section 6.0 of the Plan-EIS. The No Action alternative (FWOFI Alternative) was also evaluated to provide a baseline comparison as well as evaluate the effects of not implementing the FWI alternative. The effects of these alternatives were determined for each potentially affected resource relevant to the proposed action. The evaluation assessed the alternatives against the baseline data presented in Section 4.0 of the Plan-EIS. An

additional evaluation of the NEE alternative was completed that included information on implementing the proposed measures. This included recommended measures to be installed, avoidance/minimization measures, required permits and compliance, installation/financing, O&M, costs, cost share, and economic benefits. This is included in Section 8.0 of the Plan-EIS.

3.9 Environmental and Social Benefits

Environmental and social benefits were not monetized but are further explained for each alternative studied in detail in the Chapter 5.0 of the Plan-EIS. The proposed project would have long-term, beneficial effect son agricultural production, recreation, M&I, and hydroelectric power production. Short-term, adverse effects could result from construction activities and are summarized below:

- Additional water would be provided to local water users during summer months on approximately 1,100 acres in Kane County and 770 acres in Washington County, increasing agricultural production. A new water-based recreation opportunity would also be available. The existing Orderville hydroelectric power plant would be able to produce energy during the summer months.
- Approximately 259 acres of permanent surface disturbance would occur during a 15-month construction period. Approximately 64 acres of additional temporary surface disturbance would result from installation of pipelines and access roads.
- Changes in stream flows would result in negligible changes to river depth and channel width. No WSR values in EFVR in Zion National Park would be affected.
- Emissions from construction equipment and fugitive dust would be anticipated during the 15-month construction period.
- Negligible changes in river flows below the Quail Creek Dam Diversion would not adversely affect the listed Woundfin or Virgin River Chub habitat.
- Construction activities may disturb migratory birds and eagles in the short term. Increased human presence in the project area could disturb these species in the long-term. Additional habitat is located adjacent to the project area.
- Construction-related effects would expose disturbed areas to invasive plant species growth.
- An increase in human presence in the project area may drive some wildlife away from the area long-term. Construction of the reservoir would result in additional riparian and aquatic habitat.
- Two historic ditches eligible for listing under the NRHP would be converted from open ditches to buried pipe. The NRCS, with SHPO concurrence, has determined an Adverse Effect to historic properties. Indirect effects could arise from visitor activity at the proposed reservoir site. Tribal groups have been notified about the project, and no concerns have been raised.
- Dam failure is a risk with all dams and would affect homes and other infrastructure located below the dam site.
- Roads could be damaged from use by large construction vehicles. Increased traffic could result in an increase of traffic-related accidents.

- There is potential for short-term effects resulting from the accidental release of hazardous materials.
- Construction activities would have a short-term, temporary noise impact. The effects would be minimal due to the short duration of construction and implementation of BMPs.
- Short-term, temporary effects would be visible during construction activities. The presence of the reservoir and associated facilities would alter the appearance of the local landscape.

4.0 References

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Appendix A: Tables

TABLE A-1.

TEMPLATE FOR TABLE SUMMARIZING PROJECT ALTERNATIVES AND ASSOCIATED ECOSYSTEM SERVICES

	Alternatives		
	(FWOFI)	3,000 AcFt Reservoir	6,055 AcFt Reservoir
Alternatives			
Locally Preferred			X
Environmentally Preferable			X
Brief Description of Major		3,000 ACFT reservoir	6,055 ACFT Reservoir
Project Features		to provide water for	to provide water for
		798 acres	1,191 acres
		Recreation Facilities	Recreation Facilities
		with 12 RV Sites	with 20 RV Sites
		200 ACFT of M&I water	300 ACFT of M&I water
Total Project Investment	$0	$32,345,000	$39,511,000
Average Annual including OM&R		$1,104,000	$1,347,000
Monetized Net Benefits		-$123,000	$162,000
Provisioning Services			
Municipal and Industrial Water		Provides 200 ACFT to	Provides 300 ACFT to
		Washington Co residents	Washington Co residents
		Benefit = $387,000	Benefit = $580,000
		Cost = $343,000	Cost = $429,000
Irrigation Water		Provides water for	Provides water for
		798 acres	1,191 acres
		Benefit = $327,000	Benefit = $484,000
		Cost = $417,000	Cost = $494,000
Cultural Services		12 RV sites	20 RV sites
Recreation		Benefit = $267,000	Benefit = $580,000
		Cost = $344,000	Cost = $429,000

TABLE A-2.
TEMPLATE FOR TABLE DISPLAYING CONSIDERATION OF PR&G GUIDING PRINCIPLES

PR&G GUIDING PRINCIPLES	Alt A FWOFI	Alt B 3,000 acft reservoir	Alt C 6,055 acft reservoir
Healthy and Resilient Ecosystems	The system is well balanced and diverse, maintaining its structure and function over time	The system will be improved with an increased water supply for 798 acres, recreational facilities for 12 RV sites, and 200 acft of water to augment domestic water supplies in Washington County.	The system will be improved with an increased water supply for 1,191 acres, recreational facilities for 20 RV sites, and 300 acft of water to augment domestic water supplies in Washington County.
Sustainable Economic Development	Limited water supplies lead to highly variable alfalfa production	A consistent water supply will allow alfalfa production of 5 tons per acre on 798 acres.	A consistent water supply will allow alfalfa production of 5 tons per acre on 1,191 acres.
Floodplains	No issues with floodplains	No issues with floodplains	No issues with floodplains
Public Safety	No issues with public safety	No issues with public safety	No issues with public safety
Environmental Justice	No ongoing activities to address Envionment Justice	All landowners and operators in the watershed will have access to increased irrigation water for 798 acres. Recreation facilities will provide fishing, boating, and camping (12 developed RV sites). Residents in Washington will have access to increased domestic water supplies.	All landowners and operators in the watershed will have access to increased irrigation water for 1,191 acres. Recreation facilities will provide fishing, boating, and camping (20 developed RV sites). Residents in Washington will have access to increased domestic water supplies.
Watershed Approach	Landowners and operators are engaged in planning for sustainable development	Land owners and operators, along with the residents of Glendale, Oderville, and Mt. Carmel, as well as residents in Washington County, are engaged in planning and sustaining economic development.	Land owners and operators, along with the residents of Glendale, Oderville, and Mt. Carmel, as well as residents in Washington County, are engaged in planning and sustaining economic development.

Appendix B: AWM Evaluation Files

Explanatory Notes for Irrigation Analysis

1	Kane County Crop Budgets tab - 2006 budget data by USU Extension	https://extension.usu.edu/apec/agribusiness-food/	scroll to *Kane* , click *Alfalfa* or *Oat Hay*
1a	Washington County Crop Budgets tab - 2006 budget data by USU Extension	https://extension.usu.edu/apec/agribusiness-food/	scroll to *Washington* , click *Alfalfa* or *Oat Hay*
2	Alfalfa Hay NR Tab - Without and With analysis of the base budget from Utah State University Extension Service. Net return for alfalfa hay calculated based on Costs and Returns for Growing Alfafa Hay, Kane County, 2006, USU. Cost data was brought to current value using Producers Prices Paid 2016 to 2023 for FY 2024. Value of hay is based on The Hoyt Report data for Southern Utah and then normalized.		
3	Oat Hay NR Tab - Without and With analysis of the base budget from Utah State University Extension Service Net return for oat hay calculated based on Costs and Returns for Growing Oat Hay, Kane County, 2006, USU. Cost data was brought to current value using Producers Prices Paid 2006 to 2023. Value of hay is based on The Hoyt Report data for Southern Utah and then normalized.		
3b	The Mt Carmel Irrigation District is 395.75 Acres. Half (200 ac) are sprinkled and half (200 ac) are flood irrigated. The composit net return for alfalfa and oat hay are calculated at the Mt Carmel Alfalfa and Mt Carmel Oat tabs. Half the acres (200) include a cost to purchase sprinkler systems. The composite net return accounts for this in the four budgets (2 in Alfafa and 2 in Oat hay).		
*	Same ananlysis for Washington County as in 2 and 3 above except increased water supply will serve 67 idle acres in Hurricane Canal Company Net return and cost WO/ Project are zero. The W/ Project net return is gross return minus production costs.		
4	Price and Indices Tab - Producer Prices Paid and Received and current normalized price for hay - FY 2026 values		
5	AWM-Weighted Net Return. Calculations on a per acre basis for each irrigation district; 8 years in alfalfa and 2 years in oathay/alfalfa establishment		
6	AWM Weighted Benefits calculates benefits generated by each irrigation district; 8 years in alfalfa and 2 years in oathay/alfalfa establishment		
7	AWM-Benefit Evaluation. This sheet evaluates the trade-off between M&I Water and AWM in the Bench Lake area		
8	AWM Benefit Ck. Provides a check benefit calculations using per acre values and irrigated acres to calculate AWM benefits for each irrigation disrict		

Utah State University
Extension Economics

Modify Colored Columns

Costs and Returns per acre from growing alfalfa hay, 2006
Kane County

Receipts	Quantity per acre	Unit	Price/cost per unit	Value/cost per acre	Base Value
Alfalfa hay	3.3	tons	$88.57	$292.27	$292.27
Residue	0.25	AUM	$11.53	$2.88	$2.88
Subtotal				$295.15	$295.15
Operating costs					
Fertilization					
Phosphate	125	pounds	$0.18	$22.31	$22.31
Custom ap	1	acre	$7.82	$7.82	$7.82
Pesticides/herbicides					
Furadan	1.00	pints	$10.50	$10.50	$10.50
Custom ap	1	acre	$7.82	$7.82	$7.82
Irrigation (wheel line)	7	irrigations			
Labor	2.33	hours	$10.00	$23.33	$23.33
Water asse	1	share	$20.00	$20.00	$20.00
Repairs/ma	1	acre	$2.30	$2.30	$2.30
Pumping	43	acre inch	$0.00	$0.00	$0.00
Harvesting					
Swathing	3	acre	$15.56	$46.68	$46.68
Turning	3	acre	$4.69	$14.07	$14.07
Baling	3.30	tons	$4.79	$15.81	$15.81
Hauling/sta	3.30	tons	$3.63	$11.98	$11.98
Interest on operating capital			7.61%	$4.40	$5.24
Subtotal				$187.02	$232.11
Ownership costs (excludes cost of land)				$117.83	$117.83
Farm insurance	1	acre	$2.00	$2.00	$2.00
Machinery ownership c	1	acre	$107.58	$107.58	$107.58
Irrigation equipment co	1	acre	$8.25	$8.25	$8.25
Total costs				$304.84	$349.94
Net returns to owner for unpaid labor, management, equity and risk					
Above operating costs				$108.14	$63.04
Above total listed costs				-$9.69	-$54.78

Assumptions
1. Alfalfa already established. Harvested in June, August, September.
2. Interest computed on fertilization/herbicide costs for 6 months and operating costs for 3 months.
3. Custom rates for all field operations.
4. Only owned machinery are a loader and truck.

Budget prepared by: E. Bruce Godfrey, Cody Bingham and Kevin Heaton
go to: https://extension.usu.edu/apec/agribusiness-food/crops
scroll to *Kane* , click *Alfalfa*

Utah State University
Extension Economics

Modify Colored Columns

Costs and Returns per acre from establishing alfalfa in oat hay, 2006
Kane County

Receipts	Quantity per acre	Unit	Price/cost per unit	Value/cost per acre	Base Value
Oat hay	2.3	tons	$67.67	$155.63	$155.63
Residue	-	AUM	$0.00	$0.00	$0.00
Subtotal				$155.63	$155.63
Operating costs					
Land preparation					
Plowing	1	acre	$22.78	$22.78	$22.78
Roller harrc	2	acre	$14.33	$28.66	$28.66
Planting	1	acre	$12.21	$12.21	$12.21
Seed					
Oat seed	20	pounds	$0.17	$3.40	$3.40
Alfalfa seec	16	pounds	$2.52	$40.32	$40.32
Fertilization					
Nitrogen (3	294	pounds	$0.18	$52.48	$52.48
Phosphate	96	pounds	$0.18	$17.14	$17.14
Custom ap	1	acre	$7.82	$7.82	$7.82
Irrigation (wheel line)	6	irrigations			
Labor	2.00	hours	$10.00	$20.00	$20.00
Water asse	1	share	$20.00	$20.00	$20.00
Repairs/ma	1	acre	$2.30	$2.30	$2.30
Pumping	43	acre inch	$0.00	$0.00	$0.00
Harvesting					
Swathing	1	acre	$15.56	$15.56	$15.56
Turning/rak	1	acre	$4.69	$4.69	$4.69
Baling	2.30	tons	$4.79	$11.02	$11.02
Hauling/sta	2.30	tons	$3.63	$8.35	$8.35
Interest on operating capital			7.61%	$11.36	$11.36
Subtotal				$278.09	$308.93
Ownership costs (excludes cost of land)				$117.83	$117.83
Farm insurance	1	acre	$2.00	$2.00	$2.00
Machinery ownership c	1	acre	$107.58	$107.58	$107.58
Irrigation equipment co	1	acre	$8.25	$8.25	$8.25
Total costs				$395.91	$426.75
Net returns to owner for unpaid labor, management, equity and risk					
Above operating costs				-$122.45	-$182.00
Above total listed costs				-$240.28	-$271.12

Assumptions
1. Grain and alfalfa planted in May and harvested in July.
2. Interest computed on land preparation and planting costs for 10 months and fertilization/herbicide/irrigation costs for 6 months.
3. Custom rates for all field operations.
4. Only owned machinery are a loader and truck.

Budget prepared by: E. Bruce Godfrey, Cody Bingham and Kevin Heaton
go to: https://extension.usu.edu/apec/agribusiness-food/crops
scroll to *Kane* , click *Established Alfalfa Oat Hay*

Costs and Returns per acre from growing alfalfa hay, 2006
Kane County

					WO/Project			W/Project		
Receipts	**Quantity per acre**	**Unit**	**Price/cost per unit**	**Value/cost per acre**	**Quantity per acre**	**Price/cost per unit**	**Value/cost per acre**	**Quantity per acre**	**Price/cost per unit**	**Value/cost per acre**
Alfalfa hay	3.3	tons	$88.57	$292.27	3	$220.57	$661.71	5	$220.57	$1,102.85
Residue	0.25	AUM	$11.53	$2.88	0.25	$13.13	$3.28	0.4	$13.13	$5.25
Subtotal				$295.15			$664.99			$1,108.10
Operating costs										
Fertilization										
Phosphate (11-52-0)	125	pounds	$0.18	$22.31	125	$0.18	$22.92	125	$0.18	$22.92
Custom application	1	acre	$7.82	$7.82	1	$8.03	$8.03	1	$8.03	$8.03
Pesticides/herbicides										
Furadan	1.00	pints	$10.50	$10.50	1.00	$10.78	$10.78	1.00	$10.78	$10.78
Custom application	1	acre	$7.82	$7.82	1	$8.03	$8.03	1	$8.03	$8.03
Irrigation (wheel line)	7	irrigations			7			7	$0.00	$0.00
Labor	2.33	hours	$10.00	$23.33	2.33	$10.27	$23.96	2.33	$10.27	$23.96
Water assessment	1	share	$20.00	$20.00	1	$20.54	$20.54	1	$20.54	$20.54
Repairs/maintenance	1	acre	$2.30	$2.30	1	$2.36	$2.36	1	$2.36	$2.36
Pumping	43	acre inch	$0.00	$0.00	43	$0.00	$0.00	43	$0.00	$0.00
Harvesting										
Swathing	3	acre	$15.56	$46.68	3.0	$15.98	$47.94	5.0	$15.98	$79.90
Turning	3	acre	$4.69	$14.07	3.0	$4.82	$14.45	5.0	$4.82	$24.08
Baling	3.30	tons	$4.79	$15.81	3.0	$4.92	$14.76	5.0	$4.92	$24.60
Hauling/stacking	3.30	tons	$3.63	$11.98	3.0	$3.73	$11.18	5.0	$3.73	$18.64
Interest on operating capital			7.61%	$4.40		4.88%	$2.86		4.88%	$3.58
Subtotal				$187.02			$187.82			$247.43
Ownership costs (excludes cost of land)				$117.83						
Farm insurance	1	acre	$2.00	$2.00						
Machinery ownership costs	1	acre	$107.58	$107.58						
Irrigation equipment costs	1	acre	$8.25	$8.25						
Total costs				$304.84						
Net returns to owner for unpaid labor, management, equity and risk										
Above operating costs				$108.14			$477.17			$860.67
Above total listed costs				-$9.69						

Budget prepared by: E. Bruce Godfrey, Cody Bingham and Kevin Heaton

go to: https://extension.usu.edu/apec/agribusiness-food/crops
scroll to *Kane* , click *Alfalfa*

Change in NR - Hay	
per acre	$383.50

911 acres curently under sprinkler irrigation Glendale - 427, Orderville - 286 and 198 Mt Carmel acres

1. Alfalfa already established. Harvested in June, August, September.
2. Interest computed on fertilization/herbicide costs for 6 months and operating costs for 3 months.
3. Custom rates for all field operations.
4. Only owned machinery are a loader and truck.

Costs and Returns per acre from establishing alfalfa in oat hay, 2006
Kane County

Receipts	Quantity per acre	Price/cost per unit	Price/cost per unit	Value/cost per acre	Base Value	WO/Project Quantity per acre	WO/Project Price/cost per unit	WO/Project Value/cost per acre	W/Project Quantity per acre	W/Project Price/cost per unit	W/Project Value/cost per acre
Oat hay	2.3	tons	$ 67.67	$ 155.63	$ 155.63	2.3	$220.57	$507.31	3.8	$220.57	$838.17
Residue	0.2	AUM	$ 11.53	$ 2.31	$ -	0.2	$0.00	$0.00	0.3	$0.00	$0.00
Subtotal				$ 157.94	$ 155.63			$507.31			$838.17
Operating costs											
Land preparation											
Plowing	1	acre	$ 22.78	$ 22.78	$ 22.78	1	$23.40	$23.40	1	$23.40	$23.40
Roller harrow	2	acre	$ 14.33	$ 28.66	$ 28.66	2	$14.72	$29.43	2	$14.72	$29.43
Planting	1	acre	$ 12.21	$ 12.21	$ 12.21	1	$12.54	$12.54	1	$12.54	$12.54
Seed											
Oat seed	20	pounds	$ 0.17	$ 3.40	$ 3.40	20	$0.17	$3.49	20	$0.17	$3.49
Alfalfa seed	16	pounds	$ 2.52	$ 40.32	$ 40.32	16	$2.59	$41.41	16	$2.59	$41.41
Fertilization											
Nitrogen (34-0-0)	294	pounds	$ 0.18	$ 52.48	$ 52.48	294	$0.18	$53.90	294	$0.18	$53.90
Phosphate (11-52-0)	96	pounds	$ 0.18	$ 17.14	$ 17.14	96	$0.18	$17.60	96	$0.18	$17.60
Custom application	1	acre	$ 7.82	$ 7.82	$ 7.82	1	$8.03	$8.03	1	$8.03	$8.03
Irrigation (wheel line)	6	irrigations				6			6		
Labor	2	hours	$ 10.00	$ 20.00	$ 20.00	2	$10.27	$20.54	2	$10.27	$20.54
Water assessment	1	share	$ 20.00	$ 20.00	$ 20.00	1	$20.54	$20.54	1	$20.54	$20.54
Repairs/maintenance	1	acre	$ 2.30	$ 2.30	$ 2.30	1	$2.36	$2.36	1	$2.36	$2.36
Pumping	43.2	acre inch	$ -	$ -	$ -	43.2			43.2		
Harvesting											
Swathing	2.3	acre	$ 15.56	$ 35.79	$ 15.56	2.3	$15.98	$36.76	3.8	$15.98	$60.73
Turning/raking	2.3	acre	$ 4.69	$ 10.79	$ 4.69	2.3	$4.82	$11.08	3.8	$4.82	$18.30
Baling	2.3	tons	$ 4.79	$ 11.02	$ 11.02	2.3	$4.92	$11.31	3.8	$4.92	$18.69
Hauling/stacking	2.3	tons	$ 3.63	$ 8.35	$ 8.35	2.3	$3.73	$8.57	3.8	$3.73	$14.17
Interest on operating capital			$ 0.08	$ 11.36	$ 11.36		$0.05	$9.13		$0.05	$10.20
Subtotal				$ 304.41	$ 308.93			$310.09			$355.34
Ownership costs (excludes cost of land)				$ 117.83	$ 117.83						
Farm insurance	1	acre	$ 2.00	$ 2.00	$ 2.00						
Machinery ownership costs	1	acre	$ 107.58	$ 107.58	$ 107.58						
Irrigation equipment costs	1	acre	$ 8.25	$ 8.25	$ 8.25						
Total costs				$ 422.24	$ 426.75						
Net returns to owner for unpaid labor, management, equity and risk											
Above operating costs				$ (146.47)	$ (182.00)			$197.22			$482.83
Above total listed costs				$ (264.30)	$ (271.12)						
								Change in NR - Oat Hay/1			
							per acre				$285.61

Assumptions

1. Grain and alfalfa planted in May and harvested in July.

2. Interest computed on land preparation and planting costs for 10 months and fertilization/herbicide/irrigation costs for 6 months.

3. Custom rates for all field operations.

4. Only owned machinery are a loader and truck.

Budget prepared by: E. Bruce Godfrey, Cody Bingham and Kevin Heaton

go to: https://extension.usu.edu/apec/agribusiness-food/crops

scroll to *Kane* , click *Established Alfalfa Oat Hay*

https://extension.usu.edu/apec/agribusiness-food/crops

911 acres curently under sprinkler irrigation Glendale - 427, Orderville - 286 and 198 Mt Carmel acres

Costs and Returns per acre from growing alfalfa hay, 2006
Kane County

Receipts	Quantity per acre	Unit	Price/cost per unit	Value/cost per acre	Costs and Returns per acre from growing alfalfa hay Mt Carmel Sprinkler Irrigated — WO/Project Quantity per acre	WO/Project Price/cost per unit	WO/Project Value/cost per acre	W/Project Quantity per acre	W/Project Price/cost per unit	W/Project Value/cost per acre	Costs and Returns per acre from growing alfalfa hay Mt Carmel Flood Irrigated to Sprinkler Irrigated — WO/Project Flood Irrigated Quantity per acre	WO/Project Flood Irrigated Price/cost per unit	WO/Project Flood Irrigated Value/cost per acre	W/Project Sprinkler Irrigated Quantity per acre	W/Project Sprinkler Irrigated Price/cost per unit	W/Project Sprinkler Irrigated Value/cost per acre
Alfalfa hay	3.3	tons	$88.57	$292.27	3	$220.57	$661.71	5	$220.57	$1,102.85	3	$220.57	$661.71	5	$220.57	$1,102.85
Residue	0.25	AUM	$11.53	$2.88	0.25	$13.13	$3.28	0.4	$13.13	$5.25	0.25	$20.49	$5.12	0.4	$20.49	$8.20
Subtotal				$295.15			$664.99			$1,108.10			$666.83			$1,111.05
Operating costs																
Fertilization																
Phosphate (11-52-0)	125	pounds	$0.18	$22.31	125	$0.18	$22.92	125	$0.18	$22.92	125	$0.34	$35.13	125	$0.34	$42.06
Custom application	1	acre	$7.82	$7.82	1	$8.03	$8.03	1	$8.03	$8.03	1	$14.74	$12.31	1	$14.74	$14.74
Pesticides/herbicides																
Furadan	1.00	pints	$10.50	$10.50	1.00	$10.78	$10.78	1.00	$10.78	$10.78	1.00	$19.79	$16.53	1.00	$19.79	$19.79
Custom application	1	acre	$7.82	$7.82	1	$8.03	$8.03	1	$8.03	$8.03	1	$14.74	$12.31	1	$14.74	$14.74
Irrigation (wheel line)	7	irrigations			7			7	$0.00	$0.00	7			7	$0.00	$0.00
Labor	2.33	hours	$10.00	$23.33	2.33	$10.27	$23.96	2.33	$10.27	$23.96	6.00	$18.85	$113.11	2.33	$18.85	$43.99
Water assessment	1	share	$20.00	$20.00	1	$20.54	$20.54	1	$20.54	$20.54	1	$37.70	$31.49	1	$37.70	$37.70
Repairs/maintenance	1	acre	$2.30	$2.30	1	$2.36	$2.36	1	$2.36	$2.36	-	$4.34	$3.62	1	$4.34	$4.34
Pumping	43	acre inch	$0.00	$0.00	43	$0.00	$0.00	43	$0.00	$0.00	43	$0.00	$0.00	43	$0.00	$0.00
Harvesting																
Swathing	3	acre	$15.56	$46.68	3.0	$15.98	$47.94	5.0	$15.98	$79.90	3.0	$29.33	$73.49	5.0	$29.33	$146.66
Turning	3	acre	$4.69	$14.07	3.0	$4.82	$14.45	5.0	$4.82	$24.08	3.0	$8.84	$22.15	5.0	$8.84	$44.21
Baling	3.30	tons	$4.79	$15.81	3.0	$4.92	$14.76	5.0	$4.92	$24.60	3.0	$9.03	$24.89	5.0	$9.03	$45.15
Hauling/stacking	3.30	tons	$3.63	$11.98	3.0	$3.73	$11.18	5.0	$3.73	$18.64	3.0	$6.84	$18.86	5.0	$6.84	$34.22
Interest on operating capital			7.61%	$4.40		4.88%	$2.86		4.88%	$3.58		4.88%	$5.36		4.88%	$6.57
Subtotal				$187.02			$187.82			$247.43			$369.24			$454.17
Ownership costs (excludes cost of land)				$117.83												
Farm insurance	1	acre	$2.00	$2.00							Cost per Acre of Sprinkler System /1					
Machinery ownership costs	1	acre	$107.58	$107.58										1	$46.61	$46.61
Irrigation equipment costs	1	acre	$8.25	$8.25							/1 See 2011 Budget tab for calculastions, cells A82 to G83					
Total costs				$304.84												
Sprinkler irrigation implementation																
Net returns to owner for unpaid labor, management, equity and risk																
Above operating costs				$108.14			$477.17			$860.67			$297.59			$610.27
Above total listed costs				-$9.69												

Change in NR - Hay Sprinkler Irrigated	
per acre	$383.50
198 acres	

Change in NR - Flood to Hay Sprinkler Irrigated	
per acre	$312.68
198 acres	

Budget prepared by: E. Bruce Godfrey, Cody Bingham and Kevin Heaton
go to: https://extension.usu.edu/apec/agribusiness-food/crops
scroll to *Kane* , click *Alfalfa*

1. Alfalfa already established. Harvested in June, August, September.

2. Interest computed on fertilization/herbicide costs for 6 months and operating costs for 3 months.
3. Custom rates for all field operations.
4. Only owned machinery are a loader and truck.

Weighted Net Return MT Carmel Alfalfa	Net Return
Sprinkler Irrigated Alfalfa	$383.50
Flood to Sprinkler Irr Alfafa	$312.68
Weighted Net Return	$350.00

Preliminary Design Report

Cove Reservoir

Kane County

Water Conservancy District

PRELIMINARY

June 2026

ALPHA ENGINEERING

RB&G ENGINEERING, INC.

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Part I. Introduction

The Kane County Water Conservancy District (KCWCD) is proposing to install a new reservoir known as Cove Reservoir with associated facilities to be located near Orderville, Utah. The reservoir is a joint venture between KCWCD and the Washington County Water Conservancy District (WCWCD). The system will store water rights from local irrigation companies for use throughout the year.

The engineering design is being performed by Alpha Engineering Company (Alpha) out of St. George, Utah, and RB&G Engineering, Inc., (RB&G) out of Provo, Utah. Alpha is responsible for providing hydraulic analyses and spillway and water conveyance facility design, and RB&G is responsible for providing geologic investigations and dam structure design.

The project includes the construction of an off-stream reservoir less than one mile off the main drainage course, East Fork Virgin River (see **Figure 1** below). The reservoir is designed to hold approximately 6,055 acre-feet of water. The dam will be an earthen structure with principal and emergency spillways adjacent to the left abutment. To convey flows to and from the reservoir, new piping will be installed to tie into existing water transmission facilities. Due to immediately downstream homes, this dam is classified as High Hazard.

This report is being prepared as a comprehensive analysis of the design elements associated with the construction and operation of Cove Reservoir. The project location is shown below and overall exhibits of the project components—which include the dam structure, principal and auxiliary spillways, outlet works, an access road around the reservoir and a water conveyance system that ties the reservoir into the existing water system—are shown in **Appendix A, Exhibits 1 and 2**.

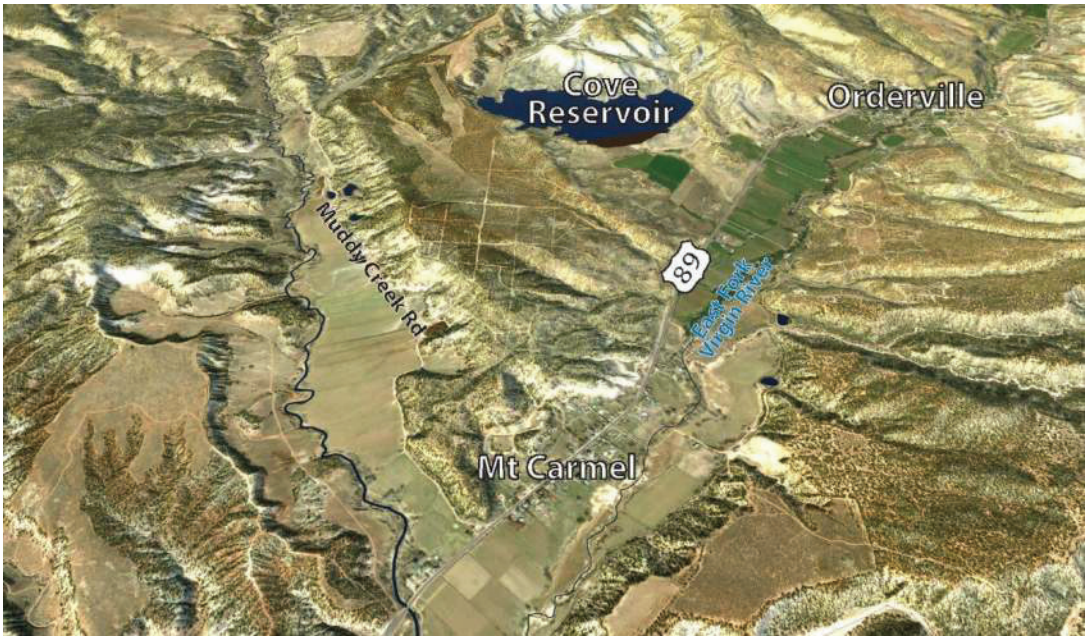


Figure 1 Cove Reservoir Location

This study references the following sources in the analysis of the hydrologic conditions at the Cove Reservoir:

- Technical Release 210-60 (TR-60), USDA 2019
- Technical Release 55 (TR-55), USDA 1986
- Technical Release 56 (TR-56), USDA 2014
- Utah Administrative Code Rule R655-11 (UAC), utah.gov 2020
- Hydrometeorological Report 49 (HMR-49), USACE 1984
- PMP Studies by Donald T. Jensen (Jensen), USU 1995 and 2003
- National Engineering Handbook, Section 4 (NEH-4), Mockus 1965 and 1972
- NOAA Atlas 14 (NWS), NWS 2018
- National Land Cover Database (NLCD), MRLC 2011
- Web Soil Survey (WSS), NRCS 2018
- National Engineering Handbook Part 630 (NEH), USDA 2019
- Flood Hydrology Manual (USBR), USBR 1989

The following software programs were used in modeling the hydrologic/hydraulic conditions and breach analysis:

- HEC-1 version 4.1 (HEC-1), USACE 1998
- USDA Water Resource Site Analysis version 2005.1.8 (SITES), USDA 2005
- HEC-RAS version 7.0.1 (HEC-RAS), USACE 2026
- Bentley FlowMaster version V8i (FlowMaster), Bentley 2009

Part II. Hydrology Analysis

A. Site Location and Existing Conditions

The Cove Reservoir dam is located 0.6 miles west of Highway 89 along Cove Road due southwest of the town of Orderville, Utah, or 37.269° North Latitude and 112.661° West Longitude. The reservoir surface area generated with the construction of the dam is approximately 188 acres and is comprised of undisturbed shrub ground cover, natural drainage channels, dirt roads and a section of ranch land used for grazing.

An aerial drone survey was performed across the anticipated footprint of the reservoir and was used to generate a 3D model of the existing surface with an approximate one-foot vertical accuracy and six inch horizontal accuracy. This surface model was used in designing the different components of the project and are shown at 10-foot contour intervals on **Appendix A, Exhibit 2**.

Using available USGS DEM data, the area upstream of the proposed reservoir was delineated to determine the drainage area tributary to the reservoir. The drainage basin tributary to the Cove Reservoir site is 3,034 acres, or 4.7 square miles, and is generally comprised of undeveloped shrub and evergreen forest ground cover. The centroidal location of the tributary drainage basin is 37.305° North Latitude and 112.662° West Longitude. The mean basin elevation is 6271'. The average annual temperature for the area is 51.2°F (NWS, Climate Monitoring) with an average annual precipitation of 15.6 inches (USGS, StreamStats). The Climatic Index calculates to 0.6 (NEH 630, Equation 21-1). An exhibit of the Cove Reservoir and its tributary drainage basin is shown in **Appendix A, Exhibit 3**. This exhibit also shows delineated subbasins of the overall tributary drainage basin as will be discussed later in this report.

B. Design Criteria

The hydrographs analyzed in this study, as required by NRCS and Utah Dam Safety, are summarized in **Table 1**. The NRCS requires hydrograph analyses for the Principal Spillway, Auxiliary Spillway and Freeboard (TR-60, Part 2). The Utah State Engineers Office requires hydrograph analyses for probable maximum flood events (general and local storms) and for 100-year events with saturated soil conditions (UAC, Section 11-4A). As directed by the NRCS, additional hydrographs with varying return frequencies are being analyzed for informational purposes.

Hydrograph	Frequency	Duration	Precipitation
NRCS Required Hydrographs			
Principal Spillway Hydrograph	100-year	10-day	TR-60, Fig 2-1 (NWS)
Auxiliary Spillway Hydrographs	Maximum	6- & 24-hour	TR-60, Fig 2-2
Freeboard Hydrographs	Maximum	6- & 24-hour	TR-60, Fig 2-2
Varying Frequency Hydrographs	2-, 5-, 10-, 25-, 50-, 100- & 500-year	24-hour	NWS
Utah State Required Hydrographs			
SEP Hydrographs	Maximum	6- & 72-hour	Jensen
100-year (AMC III) Hydrographs	100-year	6- & 72-hour	NWS

Table 1 Summary of Design Hydrographs

Each of the above hydrographs is included in this analysis as separate Storm Events. For purposes of this analysis, **Table 2** assigns numbers to each Storm Event.

	Storm Event	Duration	Frequency	AMC
01	2-year 24-hour	24-hour	2-year	II
02	5-year 24-hour	24-hour	5-year	II
03	10-year 24-hour	24-hour	10-year	II
04	25-year 24-hour	24-hour	25-year	II
05	50-year 24-hour	24-hour	50-year	II
06	100-year 24-hour	24-hour	100-year	II
07	500-year, 24-hour	24-hour	500-year	II
08	100-year 6-hour AMC III	6-hour	100-year	III
09	100-year 24-hour AMC III	24-hour	100-year	III
10	Local SEP Hydrograph (SEP-L)	6-hour	Maximum	II
11	General SEP Hydrograph (SEP-G)	72-hour	Maximum	II
12	Principal Spillway Hydrograph (PSH)	10-day	100-year	-[1]
13	Local Auxiliary Spillway Hydrograph (ASH-L)	6-hour	Maximum	II
14	General Auxiliary Spillway Hydrograph (ASH-G)	24-hour	Maximum	II
15	Local Freeboard Hydrograph (FBH-L)	6-hour	Maximum	II
16	General Freeboard Hydrograph (FBH-G)	24-hour	Maximum	II

Table 2 Summary of Storm Events

The Principal Spillway Hydrograph (Storm Event 12) will be used in designing the Principal spillway. The most critical of the Auxiliary Spillway, Freeboard and SEP Hydrographs (Storm Events 10, 11, 13, 14, 15 and 16) will be used in designing the auxiliary spillway and establishing the top-of-dam elevation. The Local Auxiliary Spillway Hydrograph (Storm Event 13) is used to check the stability of auxiliary spillway.

[1] As directed in NEH 630.2102(a)(1), Curve Numbers reflected in NEH 630.2102, Table 21-2, are used for the PSH because the precipitation value exceeds 6 inches.

C. Precipitation Values

The precipitation values for the 2- to 500-year, 24-hour and the 100-year, 10-day storm events (Storm Events 01 through 09 and 12) are taken from NWS. For the PSH (Storm Event 12), see also TR-60, Figure 2-1. Fourteen evenly spaced points throughout the drainage basin were taken and averaged out to calculate a single overall precipitation value for each storm frequency. An exhibit reflecting these points is included in **Appendix A, Exhibit 4**, and calculations are included in **Appendix B**.

The precipitation values for the SEP storms (Storm Events 10 and 11) are taken from HMR-49 and Jensen. It is noted that HMR-49 outlines the method used in calculating the Probable Maximum Precipitation (PMP) values for this drainage basin. Jensen has been accepted by the Utah State Engineer's Office and further updates the PMP values. PMP values that have been updated by Jensen are referred to as Spillway Evaluation Precipitation (SEP) values and are used in lieu of the PMP values. Calculations for the SEP values are included in **Appendix B**.

The precipitation value for the ASH and FBH storm events (Storm Events 13 through 16) are taken from TR-60, Figure 2-2. The precipitation values are calculated using the NWS 100-year and Jensen SEP precipitation values. Calculations for the ASH and FBH values are included in **Appendix B**.

The precipitation values for each storm event are summarized in **Table 3**.

	Storm Event	Precipitation Value
01	2-year 24-hour	1.61 in
02	5-year 24-hour	2.01 in
03	10-year 24-hour	2.34 in
04	25-year 24-hour	2.79 in
05	50-year 24-hour	3.14 in
06	100-year 24-hour	3.51 in
07	500-year, 24-hour	4.69 in
08	100-year 6-hour AMC III	2.75 in
09	100-year 24-hour AMC III	3.51 in
10	Local SEP Hydrograph (SEP-L)[2]	7.67 in
11	General SEP Hydrograph (SEP-G)	12.50 in
12	Principal Spillway Hydrograph (PSH)	6.83 in
13	Local Auxiliary Spillway Hydrograph (ASH-L)	4.03 in
14	General Auxiliary Spillway Hydrograph (ASH-G)	5.85 in
15	Local Freeboard Hydrograph (FBH-L)	7.67 in
16	General Freeboard Hydrograph (FBH-G)	10.20 in

Table 3 Storm Event and Precipitation Values

[2] As allowed by UAC, SEP values are used in this analysis and are updated values (Jensen) to PMP values calculated in HMR-49. For comparison purposes, the Local PMP Precipitation Value is 9.46 inches and the General PMP Precipitation Value is 12.50 inches.

D. Drainage Basin Parameters

The 4.7-square mile tributary drainage basin for the Cove Reservoir was divided into 12 smaller subbasins, ranging in size from 0.13 square miles to 1.01 square miles, to facilitate calculations of the overall basin and account for the varying land cover conditions across each subbasin. The subbasin characteristics are summarized in **Table 4** and discussed in following sections.

Sub-basin	Area (sq mi)	CN, AMC II/III	Flow Length (ft)	Ave Slope (%)	Lag Time, AMC II/III (hr)	Time of Conc, AMC II/III (hr)	Initial Abst, AMC II/III (in)
1	0.503	72.8/86.0	7,814	44.5	0.30/0.20	0.51/0.34	0.75/0.32
2	0.436	72.5/85.8	7,709	42.1	0.31/0.21	0.52/0.34	0.76/0.33
3	0.279	71.0/84.9	5,069	42.6	0.23/0.15	0.39/0.25	0.82/0.36
4	0.453	73.3/86.3	7,181	42.1	0.29/0.19	0.48/0.32	0.73/0.32
5	0.805	74.1/86.8	10,349	42.7	0.38/0.25	0.63/0.42	0.70/0.30
6	0.150	84.3/92.5	3,221	36.9	0.12/0.08	0.19/0.14	0.37/0.16
7	0.327	75.7/87.8	7,022	39.6	0.27/0.18	0.46/0.31	0.64/0.28
8	1.012	84.0/92.4	11,194	23.1	0.40/0.29	0.67/0.48	0.38/0.17
9	0.242	85.5/93.1	4,699	34.4	0.16/0.11	0.26/0.19	0.34/0.15
10	0.129	86.7/93.7	3,010	33.3	0.11/0.08	0.18/0.14	0.31/0.13
11	0.279	84.8/92.8	6,019	24.0	0.23/0.17	0.39/0.28	0.36/0.16
12	0.127	81.2/90.9	3,485	12.0	0.24/0.17	0.40/0.28	0.46/0.20
Total[3]	**4.742**	**77.8/88.9**	**33,591**	**35.4**	**0.95/0.65**	**1.58/1.09**	**0.57/0.25**

Table 4 Drainage Subbasin Parameters

i. Land Use

Land use and soil data were obtained from NLCD and WSS. The majority of the basin is comprised of *42-Evergreen Forest*, with portions of *52-Shrub/Scrub* and smaller portions of *41-Deciduous Forest*, *21/22-Developed Open Space/Low Intensity* and *31-Barren Land*. An exhibit of the land use is included in **Appendix A, Exhibit 5**. The soil data for the site classifies the basin to have a relatively even mixture of all four hydrologic soil groups. An exhibit of the hydrologic soil groups is included in **Appendix A, Exhibit 6**.

Each subbasin is assigned a Soil Conservation Service Curve Number (CN) that associates the land use with the soil data. As different types of soil cover exist throughout a subbasin, CNs have been prorated on an area-weighted basis. CNs for each subbasin are taken from NEH, Tables 9-2 and 9-5. Because NLCD land use designations do not directly correspond to NEH land cover descriptions, **Table 5** demonstrates how each correspond for this analysis.

NLCD Land Use Designation	NEH Land Cover Designation
21/22-Developed Open Space/Low Intensity	Open Space, Poor (Table 9-5)
31-Barren Land	Desert Shrub, Fair (Table 9-2)

[3] While the Area for the Overall basin is a sum of each of the subbasins, the flow length is derived from portions of Subbasins B1, B2, B4, B6 and B8, which comprise the longest path through the Overall basin and is used to calculate the lag time and time of concentration. The average slope, curve number and initial abstraction were calculated based on the Overall basin.

41-Deciduous Forest	Pinyon-Juniper, Fair (Table 9-2)
42-Evergreen Forest	Pinyon-Juniper, Poor (Table 9-2)
52-Shrub/Scrub	Desert Shrub, Good (Table 9-2)

Table 5 NLCD Land Use to NEH Land Cover Designations

CNs for the individual subbasins are summarized in **Table 4** and range between 71.0 and 86.7 for AMC II and between 84.9 and 93.7 for AMC III. CNs used for the PSH (Storm Event 12) are modified per NEH 630.2102, Table 21-2, and range between 53.0 and 75.4. The overall basin CN is 77.8 for AMC II and 88.9 for AMC III. NLCD Land Use descriptions and curve number calculations are included in **Appendix B**.

ii. Lag Times

Lag times and times of concentration for the subbasins were calculated using methodology outlined in NEH Chapter 15, which estimates the lag time, TLAG, and time of concentration, T_c, for large drainage basins as:

$$TLAG = \frac{l^{0.8}\left(\left(\frac{1000}{CN} - 10\right) + 1\right)^{0.7}}{1{,}900Y^{0.5}}$$

$$T_c = \frac{TLAG}{0.6}$$

Paths for the basin lengths (l) are shown in **Appendix A, Exhibit 3**. Criteria and calculated lag times and times of concentration for the individual subbasins are summarized in **Table 4**. The overall time of concentration for the entire tributary basin—having a basin length of 33,591 feet, an average CN of 77.8/88.9 (AMC II/III), and an average watershed land slope of 35.4%–are 1.58 hours for AMC II and 1.09 hours for AMC III. For the PSH (Storm Event 12), which uses a CN based on NEH 630.2102, Table 21-2, the average CN is 71.8 and the overall time of concentration is 1.88 hours.

iii. Initial Abstraction

Initial abstraction depths for the subbasins were calculated using methodology outlined in TR-55, which estimates the initial abstraction depth, I_a, as:

$$I_a = 0.2 \times \left(\frac{1000}{CN} - 10\right)$$

Initial abstraction depth for the individual subbasins are summarized in **Table 4**. The overall basin initial abstraction depth equates to 0.57 inches for AMC II and 0.25 inches for AMC III. For the PSH (Storm Event 12), which uses a CN based on NEH 630.2102, Table 21-2, the initial abstraction for the overall basin is 0.79 inches.

iv. Reach Parameters

In developing the hydrologic models of the drainage basin, accumulating flows were routed along reach paths as shown in **Appendix A, Exhibit 3**. The geometry and characteristics of these reaches were based on field observations and engineering judgment. A trapezoidal channel was assumed along the reaches in conformance with field measurements having an increasing flow width, ranging from 20 to 40 feet wide, and a roughness coefficient of 0.30.

E. Storm Hydrographs

For the PSH, ASH and FBH (Storm Events 12-16), the hydrographs were developed using NEH 630.2102 and 2103. For all other storm events (Storm Events 01-11), a dimensionless design storm distribution (NEH 630.2103, Figure 21-9) was applied and modeled using HEC-1 software. The dimensionless storm distribution and calculated storm hydrographs are shown in tabular form with calculations in **Appendix B**.

F. Results

As mentioned, Storm Events 01 through 10 were modeled using HEC-1 software to determine the hydrographs. Each of the storm events were setup as separate models, and model output for the models is included in **Appendix C**. Storm Events 12-16 were developed using NEH 630.2103 and 2103 but were also modeled using HEC-1 software for comparison purposes, the calculations for which can also be found in **Appendix C**. The most conservative value between the NEH 630 results and HEC-1 model was used for these storm events. The peak inflows into the reservoir and total inflow volumes for each storm event are summarized in **Table 6**.

	Storm Event	Peak Inflow	Volume
01	2-year 24-hour	89 cfs	77 af
02	5-year 24-hour	175 cfs	130 af
03	10-year 24-hour	261 cfs	178 af
04	25-year 24-hour	396 cfs	254 af
05	50-year 24-hour	506 cfs	317 af
06	100-year 24-hour	632 cfs	387 af
07	500-year, 24-hour	1,064 cfs	624 af
08	100-year 6-hour AMC III	2,280 cfs	425 af
09	100-year 24-hour AMC III	1,031 cfs	601 af
10	Local SEP Hydrograph (SEP-L)	6,395 cfs	1,286 af
11	General SEP Hydrograph (SEP-G)	1,587 cfs	2,439 af
12	Principal Spillway Hydrograph (PSH)	850 cfs	749 af
13	Local Auxiliary Spillway Hydrograph (ASH-L)	2,180 cfs	498 af
14	General Auxiliary Spillway Hydrograph (ASH-G)	1,766 cfs	868 af
15	Local Freeboard Hydrograph (FBH-L)	6,395 cfs	1,286 af
16	General Freeboard Hydrograph (FBH-G)	3,524 cfs	1,880 af

Table 6 Peak Flows by Storm Event

Part III. Hydraulic Analysis

A. Spillway Analysis

The principal spillway (PS)—which will be an inlet and pipe carrying the flows away from the dam structure—is sized based on TR-60, Section 2-1 and Part 6. The auxiliary spillway (AS)—which will be a broad-crested weir discharging into a trapezoidal open channel—is sized based on TR-60, Section 2-2 and Part 7. The hydrographs analyzed in designing the spillway configuration are the Principal Spillway Hydrograph (PSH), Auxiliary Spillway Hydrographs (ASH) and the Freeboard Hydrographs (FBH) (Storm Events 12-16). The remaining storm events are being analyzed for comparison purposes and to ensure they are routed adequately through the principal and auxiliary spillways configuration.

SITES was used to model the PSH, ASH and FBH (Storm Events 12-16). Iteratively designed principal and auxiliary spillways were used in the model to accurately reflect conditions. A conservative auxiliary spillway crest elevation was used and each of the storm events were attenuated accordingly through the reservoir using HEC-1 modeling. A summary of the maximum water surface elevations produced in the HEC-1 models is shown in **Table 7**.

	Storm Event	Maximum Water Elevation
01	2-year 24-hour	5546.0’
02	5-year 24-hour	5546.4’
03	10-year 24-hour	5546.7’
04	25-year 24-hour	5547.3’
05	50-year 24-hour	5547.7’
06	100-year 24-hour	5548.1’
07	500-year, 24-hour	5548.9’
08	100-year 6-hour AMC III	5548.3
09	100-year 24-hour AMC III	5548.8’
10	Local SEP Hydrograph (SEP-L)	5551.0’
11	General SEP Hydrograph (SEP-G)	5551.6’
12	Principal Spillway Hydrograph (PSH)	5548.2’
13	Local Auxiliary Spillway Hydrograph (ASH-L)	5548.6’
14	General Auxiliary Spillway Hydrograph (ASH-G)	5549.6’
15	Local Freeboard Hydrograph (FBH-L)	5551.0’
16	General Freeboard Hydrograph (FBH-G)	5551.8’

Table 7 Maximum Water Surface Elevation by Storm Event

The worst-case scenario storm event is the General Freeboard Hydrograph (Storm Event 16). This storm event is also referred to as the Inflow Design Flood (IDF).

A comparative analysis was performed to see the changes in hydrologic flows during the higher frequency storm events with construction of the proposed reservoir, a summary of which is included in **Table 8**.

	Storm Event	Peak Flow *before* Proposed Reservoir	Peak Flow *after* Proposed Reservoir
01	2-year 24-hour	89 cfs	16 cfs
02	5-year 24-hour	175 cfs	22 cfs
03	10-year 24-hour	261 cfs	26 cfs
04	25-year 24-hour	396 cfs	31 cfs
05	50-year 24-hour	506 cfs	35 cfs
06	100-year 24-hour	632 cfs	38 cfs
07	500-year, 24-hour	1,064 cfs	43 cfs

Table 8 Peak Flows Before and After the Proposed Reservoir

B. Spillway Parameters

Models were setup in SITES based on the governing storm events for the PSH, ASH and FBH (Storm Events 12-16). The inflow hydrographs produced in the Hydrology Analysis section was input into the model. Output for the model is included in **Appendix C**. The results from the SITES model, which incorporate the principal and auxiliary spillway parameters at an AS width of 30 feet, include the following:

- Peak Inflow (ASH-L): 2,180 cfs
- Peak Inflow (FBH-G): 6,395 cfs
- Principal Spillway Crest Elevation: 5545.5’
- Auxiliary Spillway Crest Elevation: 5548.5’
- Maximum Water Surface (ASH-L): 5548.7’
- Maximum Water Surface (FBH-G): 5552.3’
- Peak reservoir outflow (FBH-G): 648 cfs (PS: 127 cfs, AS: 521 cfs)
- Maximum depth above AS crest: 3.8 feet

Additional constraints are considered in the design of the principal and auxiliary spillways. A riser is proposed to be installed at the inlet to the principal spillway. The riser shall have a larger cross-sectional area to reduce excessive surging, noise, vibration and vortex action. Per TR-60, Section 6-2, this cross-sectional area shall be a minimum of 2.5’ x 7.5’ (L x W). A trash rack shall be incorporated into the riser structure to avoid clogging, and an anti-vortex device (i.e. anti-vortex baffle plate) shall also be incorporated to prevent a vortex condition as water spills into the riser. An air vent is also added to the inlet to remove air and improve hydraulic performance.

It is noted that the SITES model maximum water surface elevation of 5552.3’. A more conservative auxiliary spillway crest elevation was chosen at elevation 5549.2’. All storm event hydrographs

were modeled in HEC-1 using this elevation. Based on the HEC-1 model results and the site and code constraints, the following spillway parameters were selected:

- Principal Spillway (Pipe)
  - Crest Elevation: 5545.5'
  - Pipe Material: Ductile Iron Encased in Concrete
  - Pipe Diameter: 30 inches
- Auxiliary Spillway (Trapezoidal Channel)
  - Crest Elevation: 5549. 2'
  - Material: Earthen
  - Base Width: 30 feet
  - Bank Slopes: 2:1 (H:V)

The HEC-1 results are summarized as follows:

- Peak Inflow: 3,524 cfs
- Peak Outflow: 404 cfs
- Maximum Water Surface: 5551.8'
- Maximum depth above AS crest: 2.6 feet
- Time to Maximum Water Surface: 19.2 hours (0.8 days)
- Time to first flow in auxiliary spillway: 10.2 hours (0.4 days)
- Time to zero flow in auxiliary spillway: 105.8 hours (5.4 days)

C. *Emergency Drain and Outlet Works*

The emergency drain pipeline is required in order to drain the water supply storage in case of emergency. According to Utah State Code R655-11-7A, the pipeline is required to drain 90% of the storage volume within 30 days neglecting reservoir inflows.

Due to geographical constraints, the proposed drain is approximately 675 feet in length. The water discharges approximately 300 feet from the base of the dam into an existing ephemeral drainage channel. The maximum water surface elevation is 5545.5 feet (principal spillway crest elevation providing for 6,055 acre-feet of storage), and the outlet works discharge elevation is 5497.5 feet, which provides for 600 acre-feet of storage. A minimum 24-inch pipeline is required to drain the Cove Reservoir within the required amount of time.

A 24-inch ductile iron (DI) pipeline encased in concrete has been selected to be installed through the dam section in order to withstand bearing pressures and minimize thermal expansion. A riser is proposed to be installed at the inlet to the emergency drain pipeline with a control valve to allow use as needed. The riser shall have a larger cross-sectional area to reduce excessive surging, noise, vibration and vortex action. A trash rack shall be incorporated into the riser structure to avoid clogging, and an anti-vortex device (i.e. anti-vortex baffle plate) shall also be incorporated

to prevent a vortex condition as water spills into the riser. An air vent is also added to the inlet to remove air and improve hydraulic performance. Once the emergency drain pipeline exits through the dam section, a pipeline will be upsized to 30 inches to allow the reservoir to drain in the appropriate amount of time. An energy dissipation structure and trash rack will be installed at the outlet of the pipe as it discharges into the existing channel.

Different configurations of the riser, valve and pipe inlet were evaluated, including:

1. A sloping structure constructed on the upstream face of the dam that extends to the dam crest with a stem-operated gate.

2. A shorter vertical structure with one slide gate. This structure would be partially submerged under normal reservoir operation and would not extend to the dam crest.

Of the two configurations considered, it was decided that the first configuration consisting of a sloping structure and stem operated gate would best meet the needs of the project. The second configuration was not used due to cost considerations and functionality of the valve. A stem for the gate will extend up along the face of the dam and will be supported on concrete blocks spaced every 10 feet. The blocks will have adjustable stem guides to allow for re-alignment, as required.

Reservoir discharge data has been determined by combining the amount of head in the reservoir combined with losses from the entrance, pipe friction, and other minor losses. Calculations are included in **Appendix A**. **Table 9** summarizes the discharge data:

Water Surface Elevation (ft)	Water Storage (ac-ft)	Discharge Time (days)
5545.5	6055	0.0
5530	3542	10.1
5514	1737	18.1
5797	587	23.9

Table 9 Emergency Drain Discharge Rating

The emergency drain pipeline will be also used as the feed into the reservoir. The pipeline will tie into the existing irrigation system. A new pump station will be installed on the existing irrigation system that will pump flows from the East Fork Virgin River into the reservoir. Valving will be installed to allow pressurized flows to fill the reservoir while stopping flows from discharging into the existing channel. During emergencies, pumping will stop and the valving will be opened to allow flows to discharge into the existing channel and drain the reservoir.

Part IV. Freeboard Analysis

A. Storm and Wind Events

The Administrative Rules for Dam Safety and TR-60, Part 5, state that the freeboard above the principal spillway crest elevation must exceed the values produced by the scenarios given below. In analyzing a permeable and an impermeable dam, a range of freeboard is given for the first and second condition. The dam is considered to be semi-permeable, and therefore, the actual freeboard requirement is adjusted within this range.

1. 100-year, 24-hour storm (AMC III) in conjunction with a 50-mph wind.
2. 100-mph wind without any significant rainstorm.
3. IDF (or FBH-G) without any significant windstorm.
4. ASH with Wave Action (TR-60)

B. Maximum Wave Runup

Historic data for the design wind for the Cove Reservoir area is not available. As required, wind speeds of 50 mph and 100 mph were analyzed. For these two wind speeds, the wind setup, wave height, and total wave runup was calculated as summarized in **Table 10**. Calculations are included in **Appendix B**.

Wind Velocity	Wave Runup	Wind Setup	Wave Freeboard
50 mph	2.8 ft	0.1 ft	2.9 ft
100 mph	5.8 ft	0.1 ft	5.9 ft

Table 10 Wave Runup by Wind Speed

Wave Action was further calculated using procedures outlined in TR-56. The maximum overwater wind velocity calculated to 87 mph and produced a significant wave height 1.8 ft. Calculations are included in **Appendix B**.

C. Results

The total required freeboard for each storm and wind event is summarized in **Table 11**. The Storm Freeboard is taken from the difference between the principal spillway crest elevation and the maximum water surface elevation produced by the respective storm events. The Total Freeboard is the sum of the Storm Freeboard plus the Wave Freeboard.

Scenario	Wave Freeboard	Storm Freeboard	Total Freeboard
1	2.9 ft	3.3 ft	6.2 ft
2	5.9 ft	0.0 ft	5.9 ft
3	0.0 ft	6.3 ft	6.3 ft
4	1.8 ft	4.1 ft	5.9 ft

Table 11 Total Freeboard Requirements

The governing total freeboard requirement is 6.3 feet as taken from Scenario 3. With a principal spillway crest elevation of 5545.5', the minimum top of dam elevation allowing for adequate freeboard is 5551.8'. The proposed top of dam elevation is 5552.0'.

Part V. Breach Analysis

A. Criteria

Breach simulations were completed for "Sunny Day" and "Rainy Day" scenarios. Both scenarios assume the water level is at the auxiliary spillway crest elevation (5549.2') at the start of the model. The "Sunny Day" scenario breaches immediately with no storm event attenuating through the reservoir. The "Rainy Day" scenario attenuates the worst-case storm event and breaches as the water surface elevation approaches the top of the dam.

A sensitivity analysis was performed to determine the most extreme breach within NRCS parameters. Per TR-60, the minimum peak discharge of the breach hydrograph is:

$$Q_{max} = 1{,}100\left(\frac{V_s H_w}{A}\right)^{1.35} = 1{,}100\left(\frac{(8{,}058)(94)}{25{,}615}\right)^{1.35} = 106{,}428\ cfs$$

But not less than:

$$Q_{max} = 3.2H_w^{2.5} = 3.2(94^{2.5}) = 274{,}138\ cfs$$

Nor more than:

$$Q_{max} = 65H_w^{1.85} = 65(94^{1.85}) = 290{,}536\ cfs$$

As a result of the analysis, the most extreme breach occurred under the following breach parameter

- Storm Event: Local Freeboard Hydrograph (Storm Event 15)
- Depth of water at breach: 94'
- Water surface elevation: 5560'
- Bottom width: 520'
- Side slope: 3:1 upstream, 2.5:1 downstream (H:V)
- Time to develop: 0.95 hours
- Storm event for "Rainy Day" scenario
    - Peak inflow: 6,395 cfs
    - Inflow volume: 1,286 af
- Manning's 'n': 0.05
- Width of the downstream valley: approx. 1,100'
- Breach location at maximum section of dam
- Cross-sectional area of dam embankment at breach location: approx. 25,615 sf
- Reservoir storage at breach: 8,058 af

B. Methodology

Separate HEC-RAS models were setup for the “Sunny Day” and “Rainy Day” scenarios. Constraints were input based on the Hydrology, Hydraulic and Freeboard Analyses of this report. The terrain downstream of the dam structure was imported into the HEC-RAS geometry editor using USGS DEM files to simulate a 2D breach for each scenario.

C. Results

Inundation maps have been prepared based on the results of the HEC-RAS models, as shown in **Appendix A, Exhibits 7 and 8**. Model output from the HEC-RAS models are included in **Appendix D**. The results of the models are summarized below.

- Sunny Day
  - Maximum outflow: 266,454 cfs
  - Total volume: 12,287 ac-ft
- Rainy Day
  - Maximum outflow: 329,203 cfs
  - Total volume: 15,529 ac-ft

Appendix A. Exhibits

Exhibit 1. Overall Project Components

Exhibit 2. Reservoir Project Components

Exhibit 3. Reservoir Drainage Basin

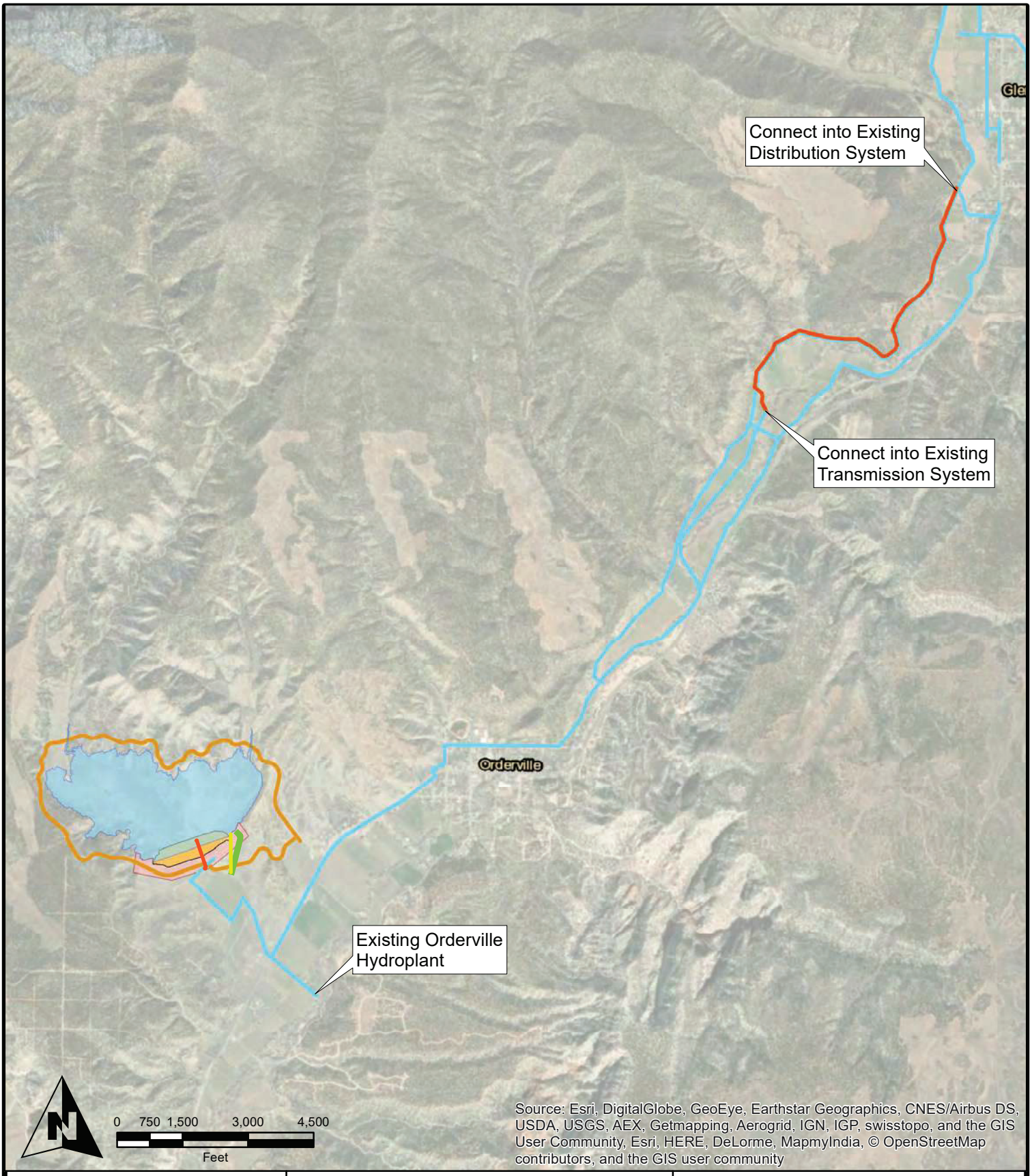
Exhibit 4. NWS Precipitation Points

Exhibit 5. NLCD Soil Data

Exhibit 6. Hydrologic Soil Groups

Exhibit 7. Sunny Day Breach Inundation Map

Exhibit 8. Rainy Day Breach Inundation Map



ALPHA ENGINEERING

RB&G ENGINEERING, INC.

- Cove Reservoir
- Cove Dam Structure
- Construction/Instrumentation Buffer Area
- Existing Transmission Pipeline
- New Transmission Pipeline

Overall Project Components
Exhibit 1 - Cove Reservoir

Spatial Reference:	UT83-SF
Drawn By:	JTM
Scale:	1 inch = 3,000 feet
Date:	September 17, 2019

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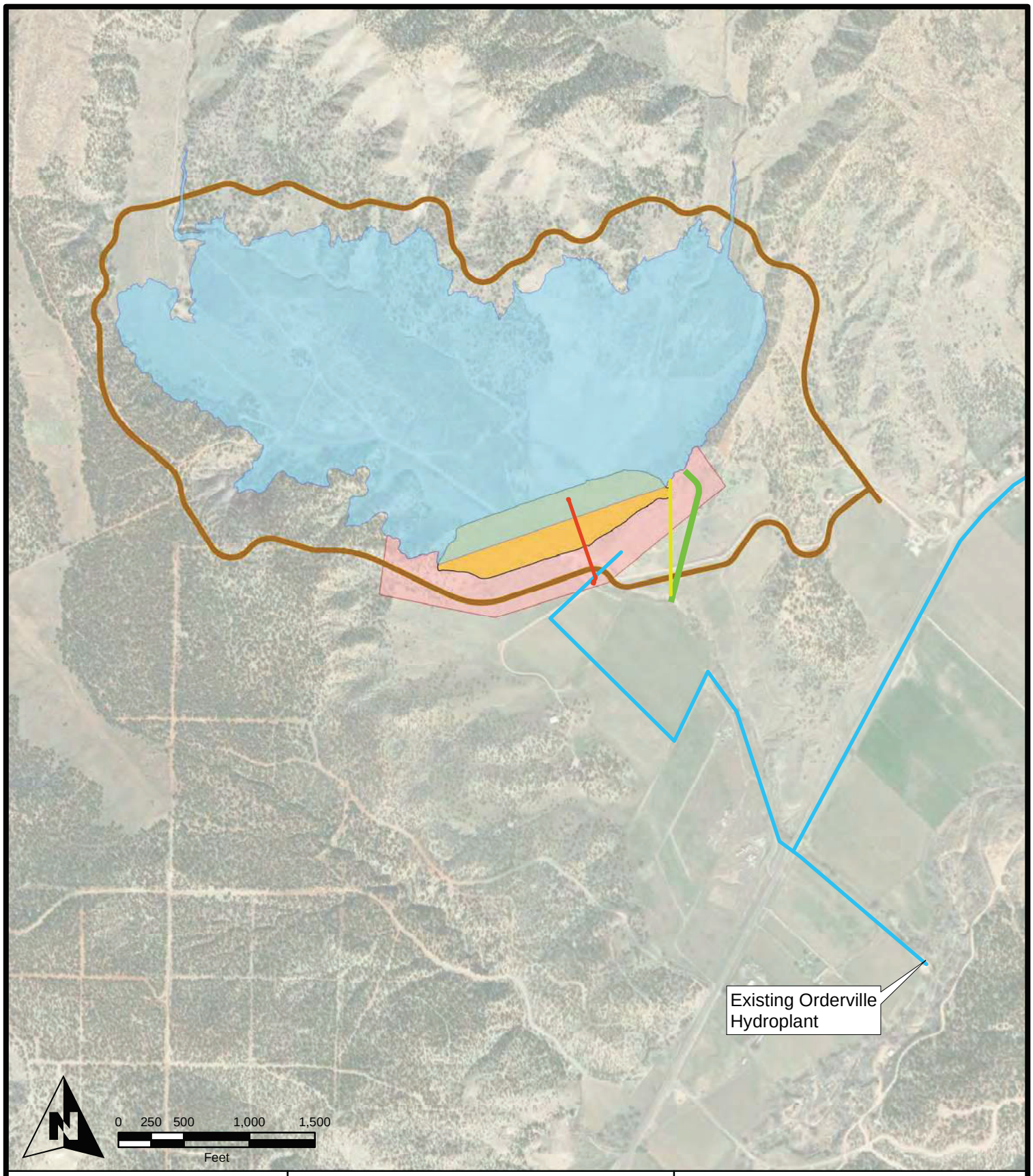

ALPHA ENGINEERING

RB&G ENGINEERING, INC.

- Cove Reservoir
- Cove Dam Structure
- Construction/Instrumentation Buffer Area
- Existing Transmission Pipeline
- OutletWorks
- Principal Spillway
- Auxiliary Spillway
- Access Road

Reservoir Project Components

Exhibit 2 - Cove Reservoir

Spatial Reference:	UT83-SF
Drawn By:	JTM
Scale:	1 inch = 1,000 feet
Date:	September 17, 2019

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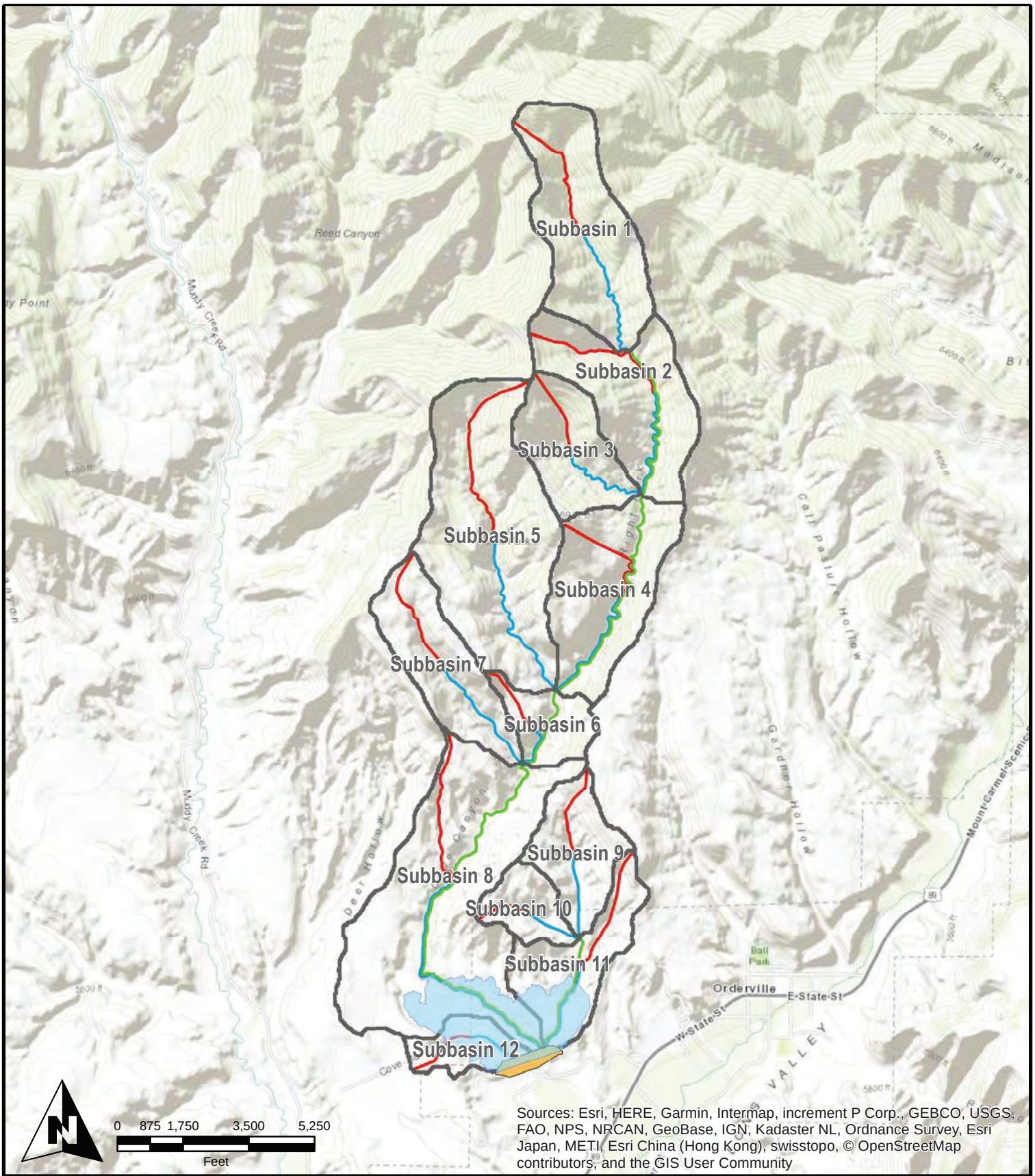

ALPHA ENGINEERING

RB&G ENGINEERING, INC.

- Cove Reservoir
- Drainage Subbasins
- Centroidal Water Course
- Maximum Water Course
- Routed Flow (Modeling)

Reservoir Drainage Basin

Exhibit 3 - Cove Reservoir

Spatial Reference:	UT83-SF
Drawn By:	JTM
Scale:	1 inch = 3,500 feet
Date:	September 17, 2019

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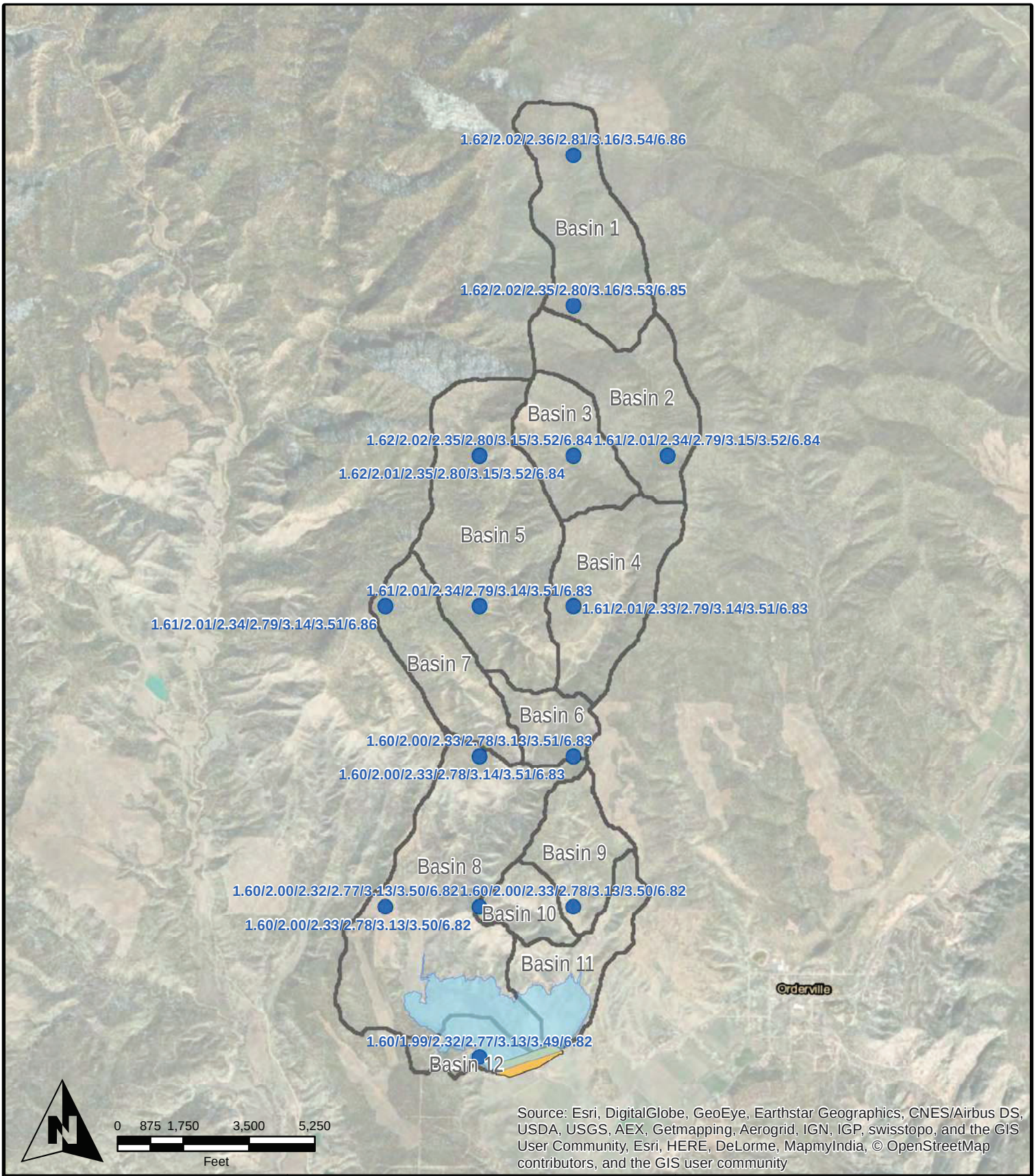

ALPHA ENGINEERING

RB&G ENGINEERING, INC.

Cove Reservoir

Drainage Subbasins

NOAA Precipitation Values
2-yr / 5-yr / 10-yr / 25-yr / 50-yr / 100-yr / 100-yr (10-day)

NOAA Precipitation Points

Exhibit 4 - Cove Reservoir

Spatial Reference:	UT83-SF
Drawn By:	JTM
Scale:	1 inch = 3,500 feet
Date:	September 17, 2019

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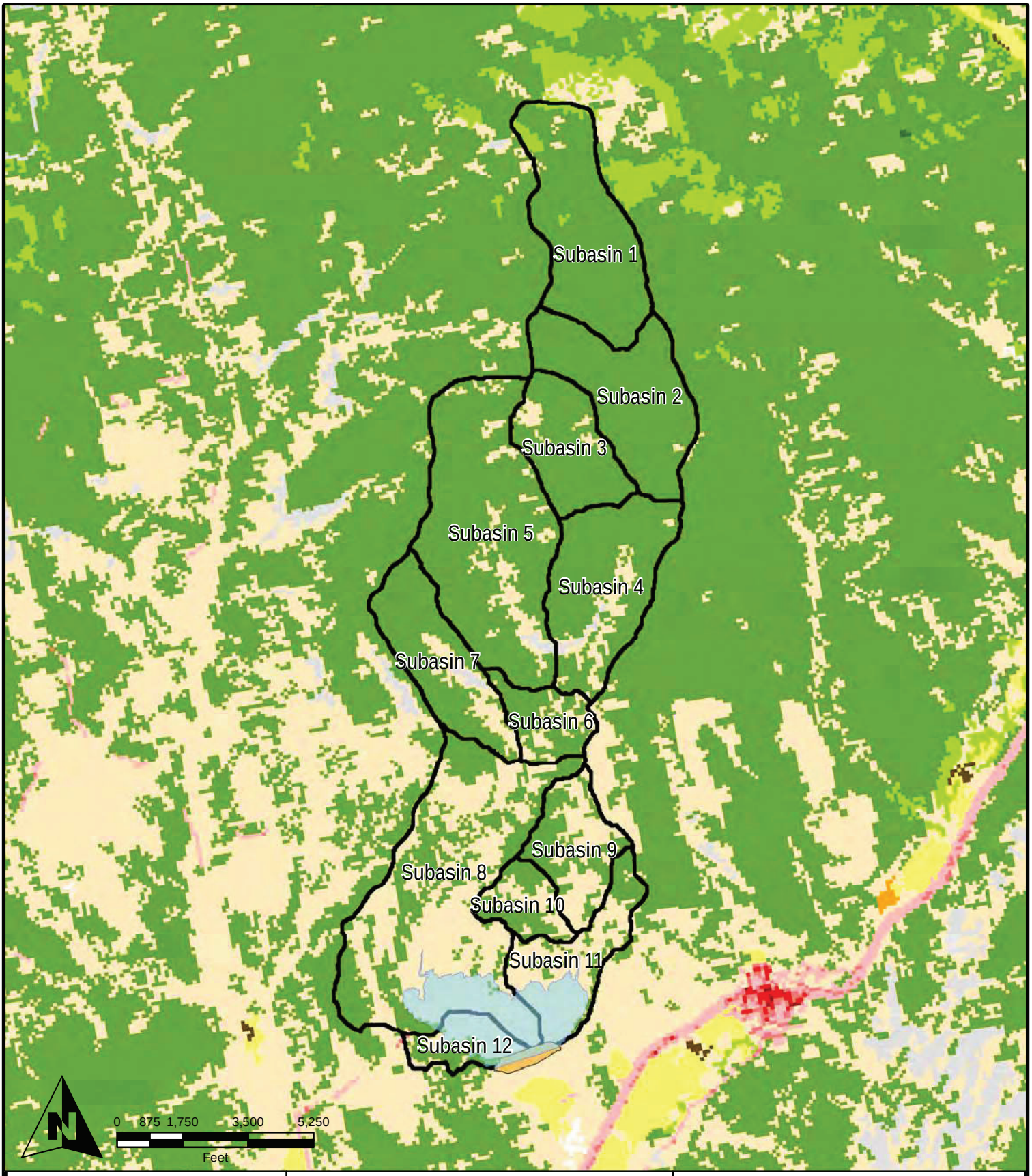

ALPHA ENGINEERING

RB&G ENGINEERING, INC.

Cove Reservoir
Drainage Subbasins
NLCD Land Cover
21 - Developed, Open Space
22 - Developed, Low Intensity
23 - Developed, Medium Intensity
24 - Developed, High Intensity
31 - Barren Land (Rock/Sand/Clay)
41 - Deciduous Forest
42 - Evergreen Forest
43 - Mixed Forest
52 - Shrub/Scrub
81 - Pasture/Hay
82 - Cultivated Crops
90 - Woodly Wetlands

NLCD Soil Data
Exhibit 5 - Cove Reservoir

Spatial Reference:	UT83-SF
Drawn By:	JTM
Scale:	1 inch = 3,500 feet
Date:	September 17, 2019

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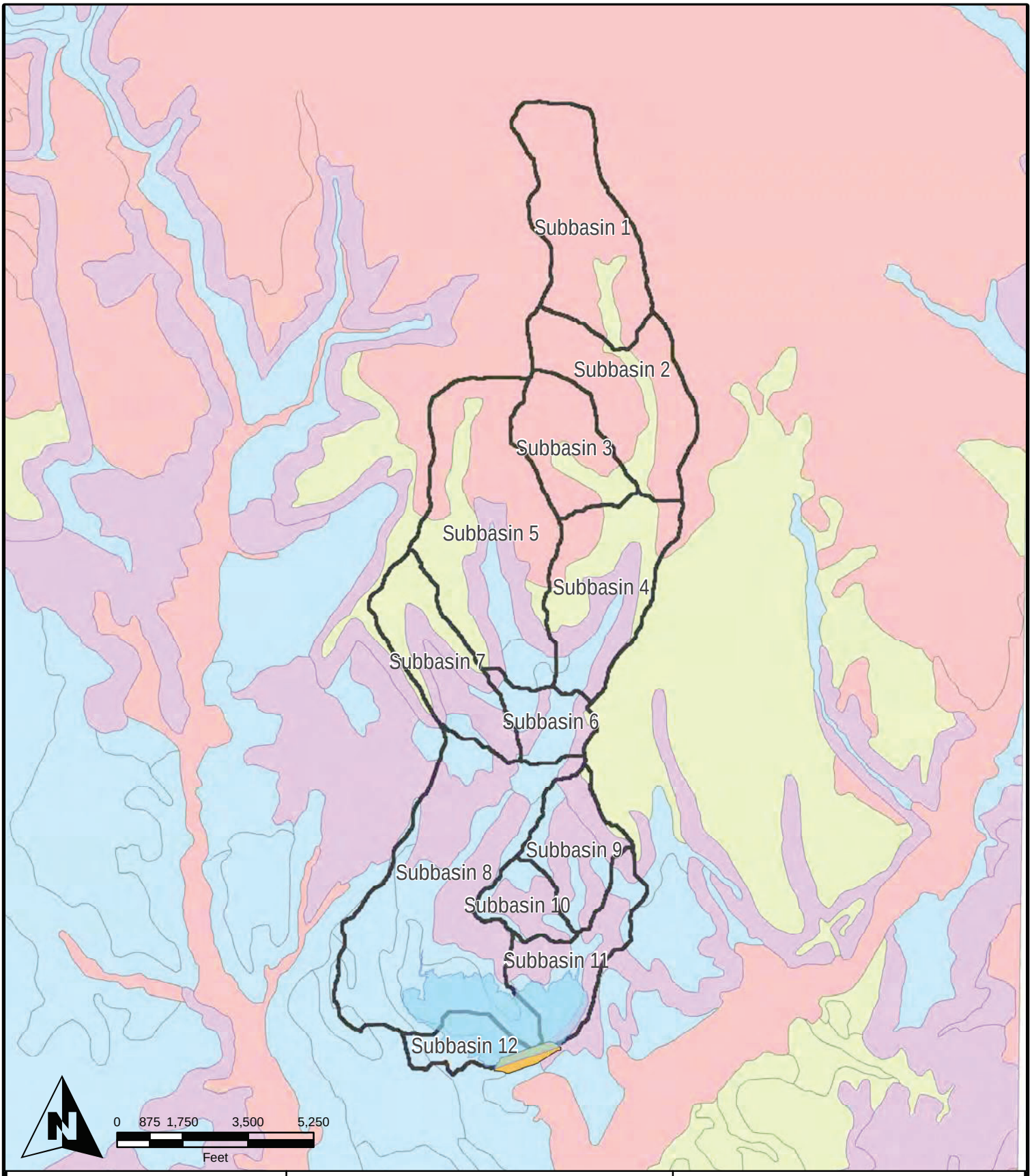

ALPHA ENGINEERING

RB&G ENGINEERING, INC.

Cove Reservoir
Drainage Subbasins
Hydrologic Soil Group
A
B
C
D

Hydrologic Soil Groups

Exhibit 6 - Cove Reservoir

Spatial Reference:	UT83-SF
Drawn By:	JTM
Scale:	1 inch = 3,500 feet
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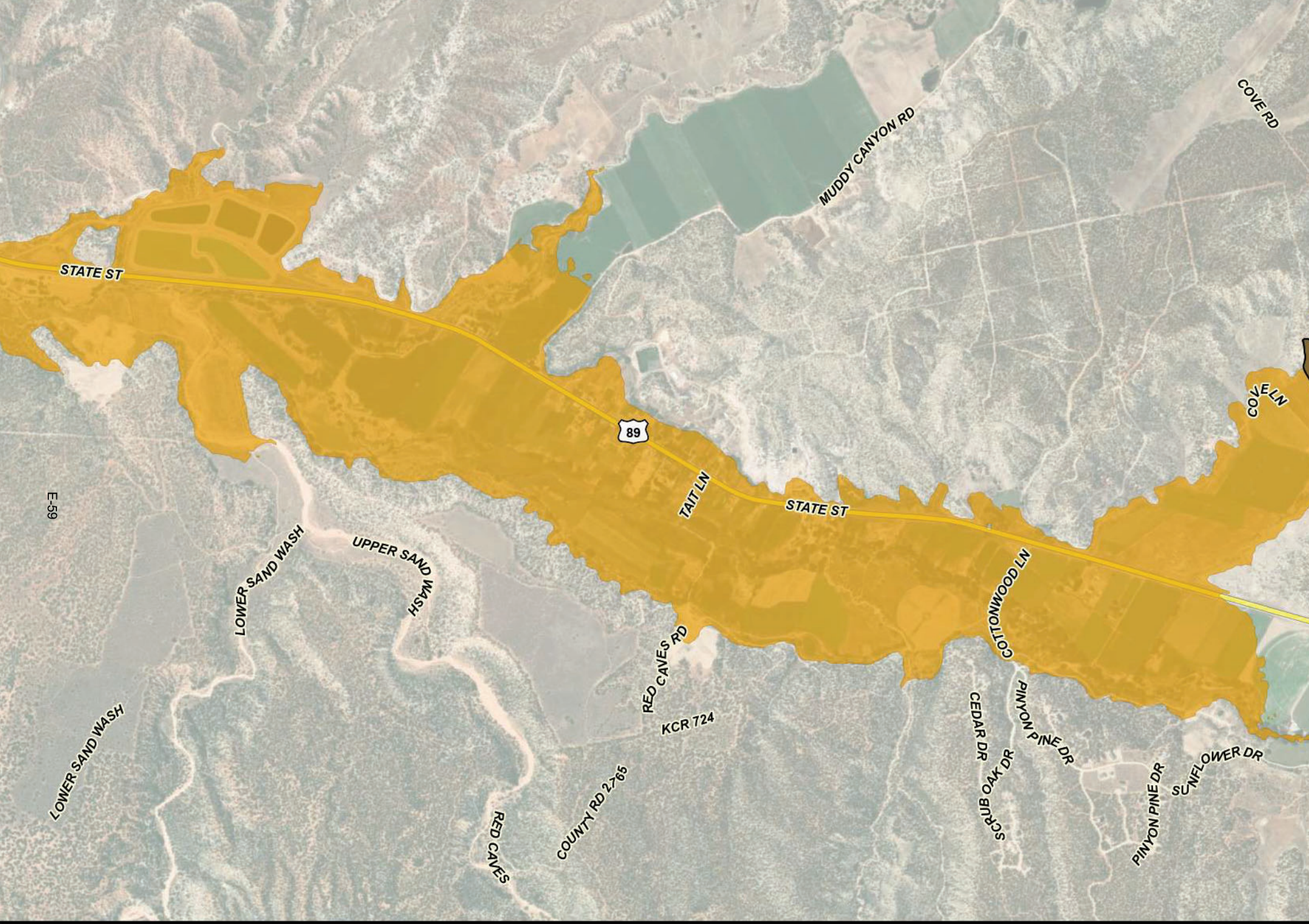


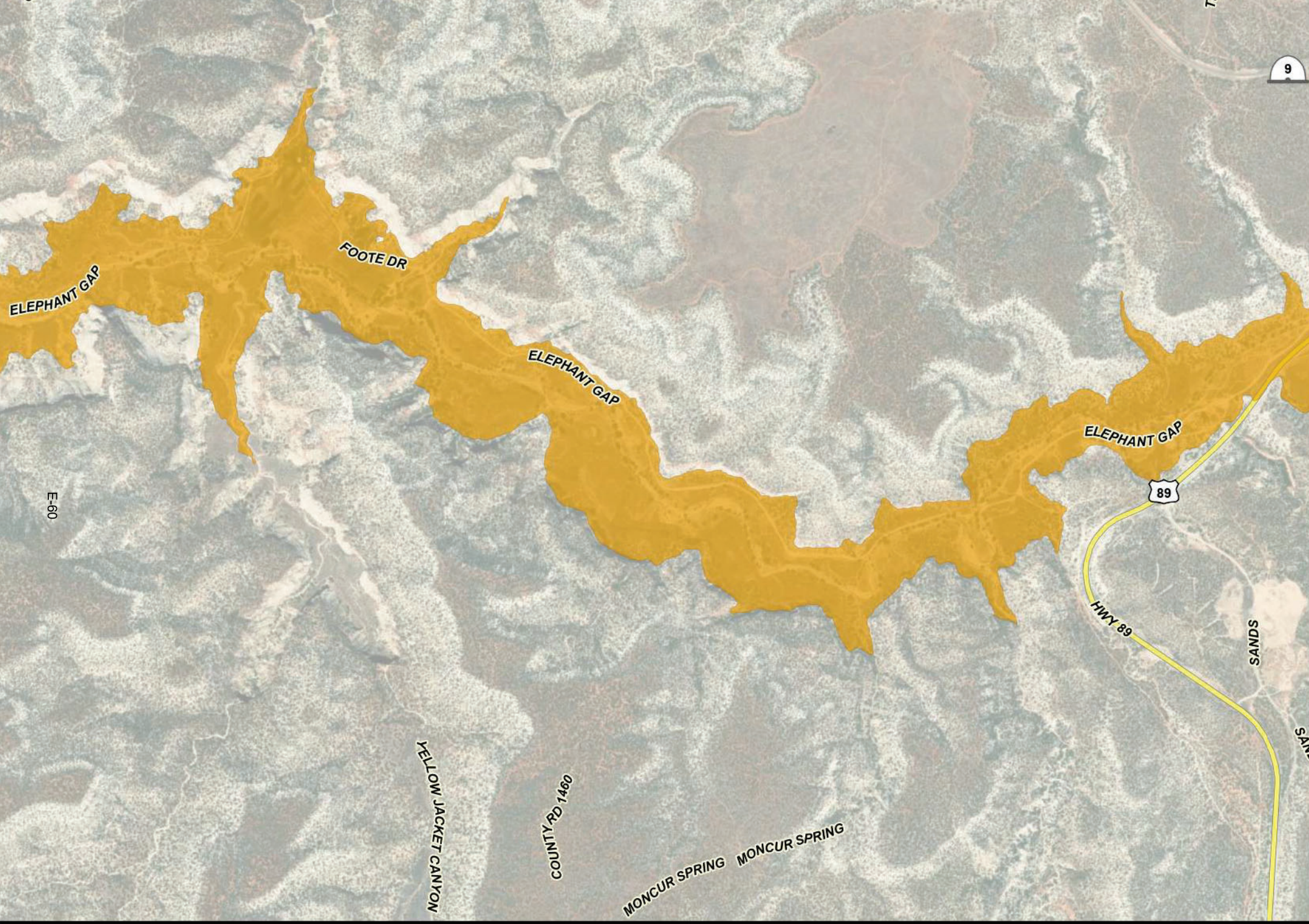
Legend

- Cove Dam Structure
- Inundation Boundary (Sunny Day)

N

Dam Breach Sunny

Cove Reserv



Legend

Cove Dam Structure

Inundation Boundary (Sunny Day)

Dam Breach Sunny

Cove Reserv



Legend

Cove Dam Structure

Inundation Boundary (Sunny Day)

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Dam Breach Sunny

Cove Reserv



Legend

- Cove Dam Structure
- Inundation Boundary (Sunny Day)

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Dam Breach Sunny

Cove Reserv



Legend

Cove Dam Structure

Inundation Boundary (Sunny Day)

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Dam Breach Sunny

Cove Reserv



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Cove Dam Structure

Inundation Boundary (Sunny Day)

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Dam Breach Sunny

Cove Reserv



Legend

- Cove Dam Structure
- Inundation Boundary (Sunny Day)

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Cove Dam Structure

Inundation Boundary (Sunny Day)

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Legend

- Cove Dam Structure
- Inundation Boundary (Sunny Day)

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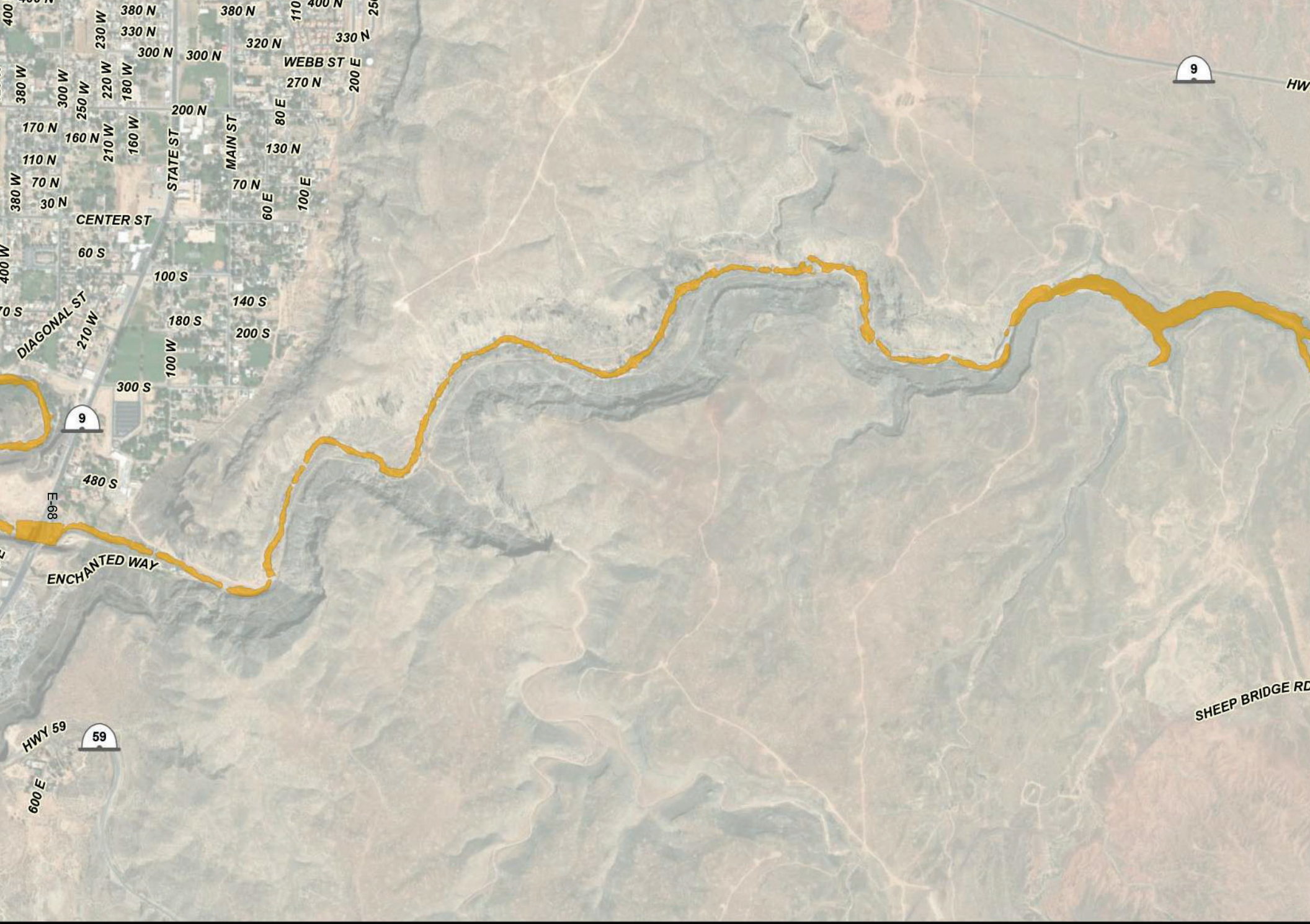

Legend

Cove Dam Structure

Inundation Boundary (Sunny Day)

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Dam Breach Sunny

Cove Reserv



Legend

- Cove Dam Structure
- Inundation Boundary (Sunny Day)

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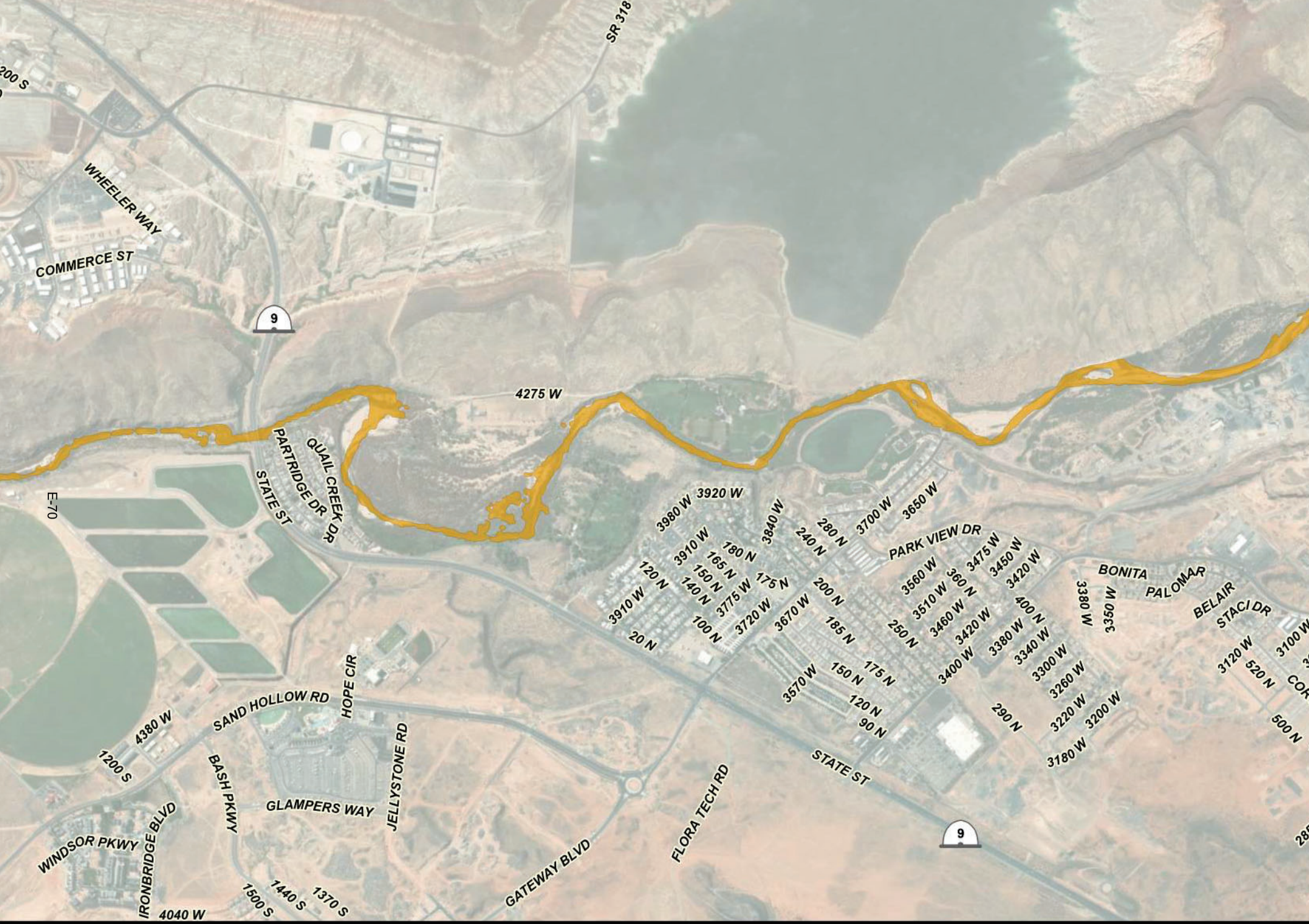
Dam Breach Sunny

Cove Reserv



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- Cove Dam Structure
- Inundation Boundary (Sunny Day)

Dam Breach Sunny

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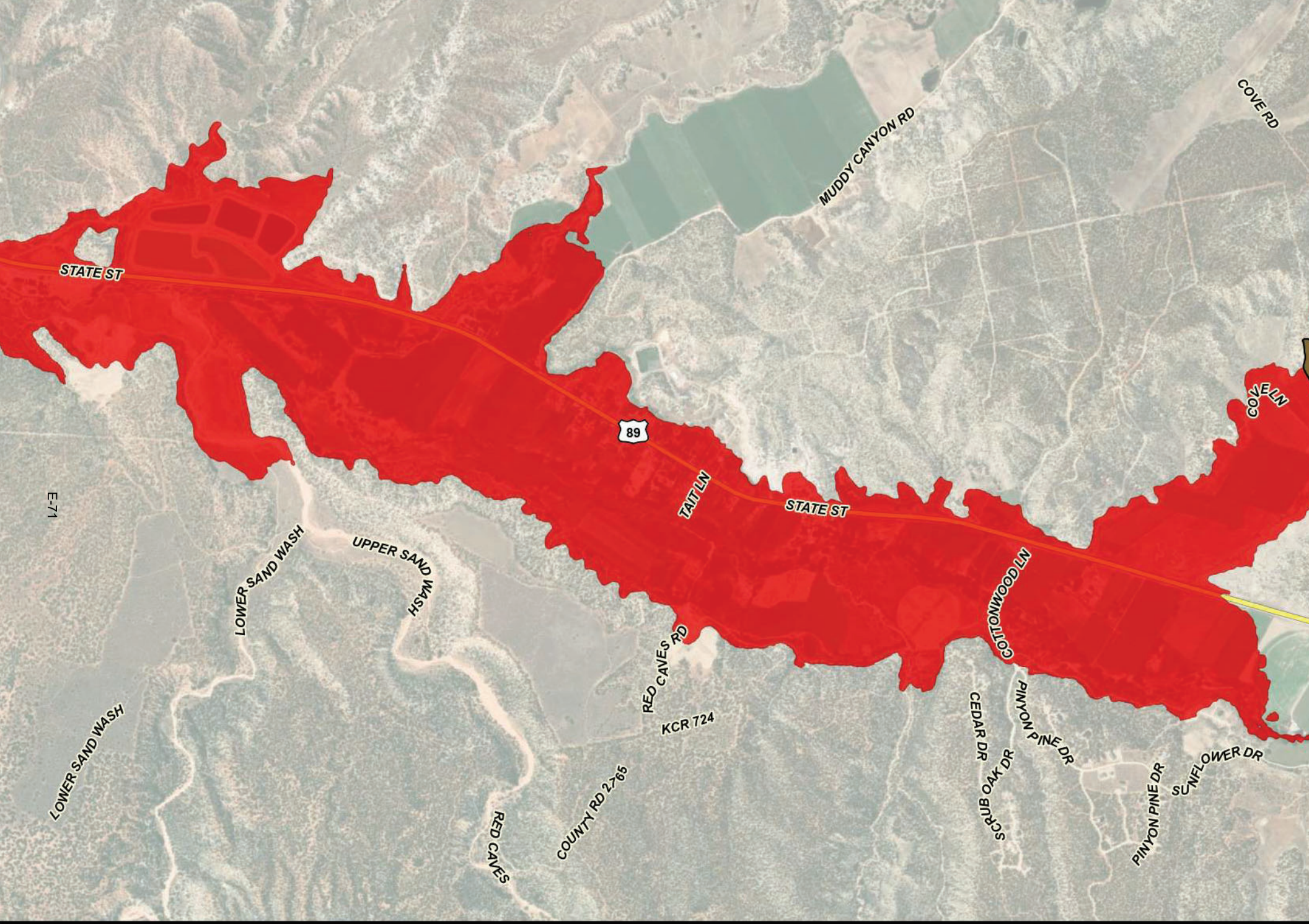

Legend

Inundation Boundary (Rainy Day)

Cove Dam Structure

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Dam Breach Rainy I

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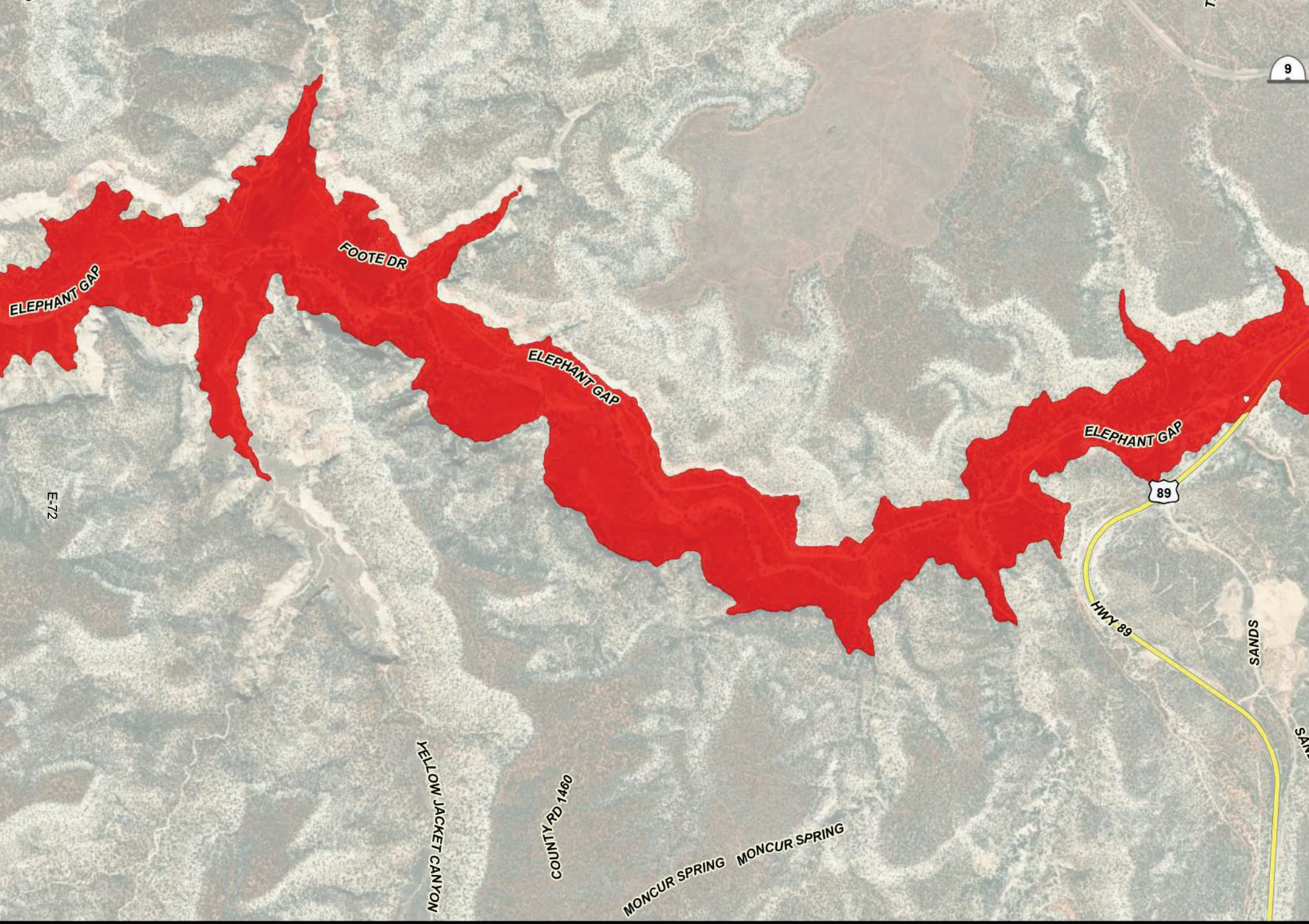

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Inundation Boundary (Rainy Day)

Cove Dam Structure

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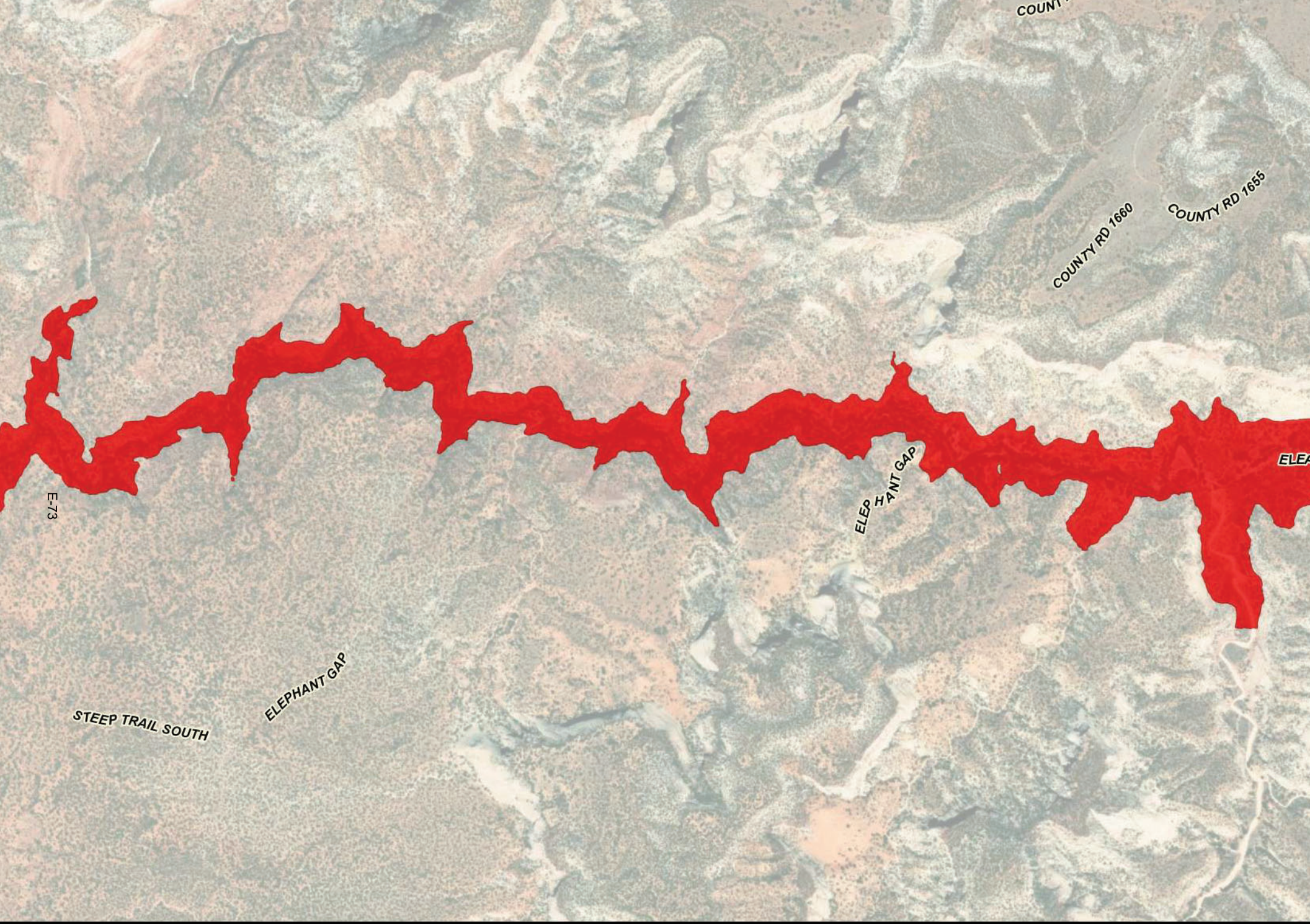

Legend

Inundation Boundary (Rainy Day)

Cove Dam Structure

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Legend

Inundation Boundary (Rainy Day)

Cove Dam Structure

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Inundation Boundary (Rainy Day)

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Legend

Inundation Boundary (Rainy Day)

Cove Dam Structure

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Legend

Inundation Boundary (Rainy Day)

Cove Dam Structure

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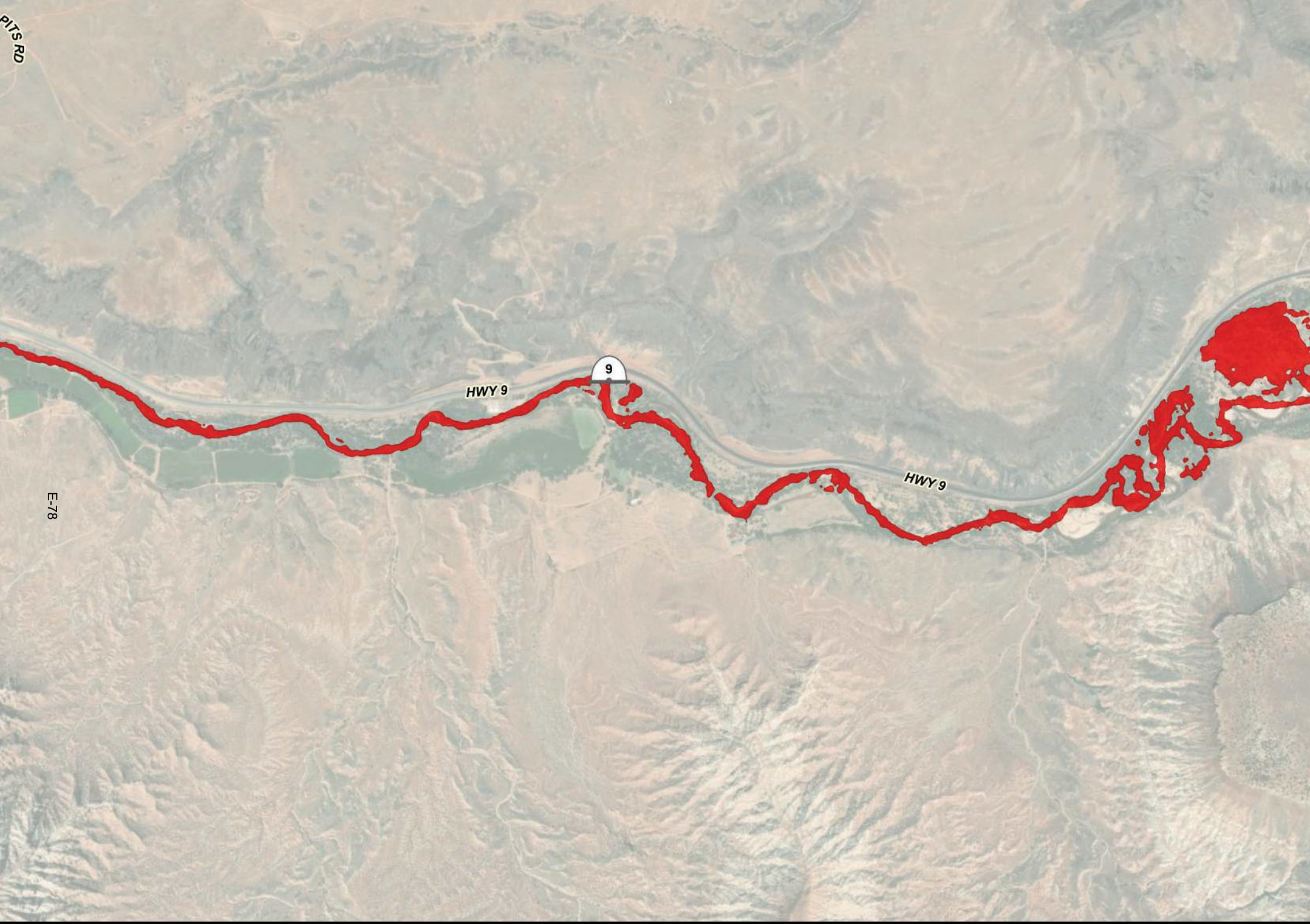
Cove Reserv



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Inundation Boundary (Rainy Day)

Cove Dam Structure

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Dam Breach Rainy I

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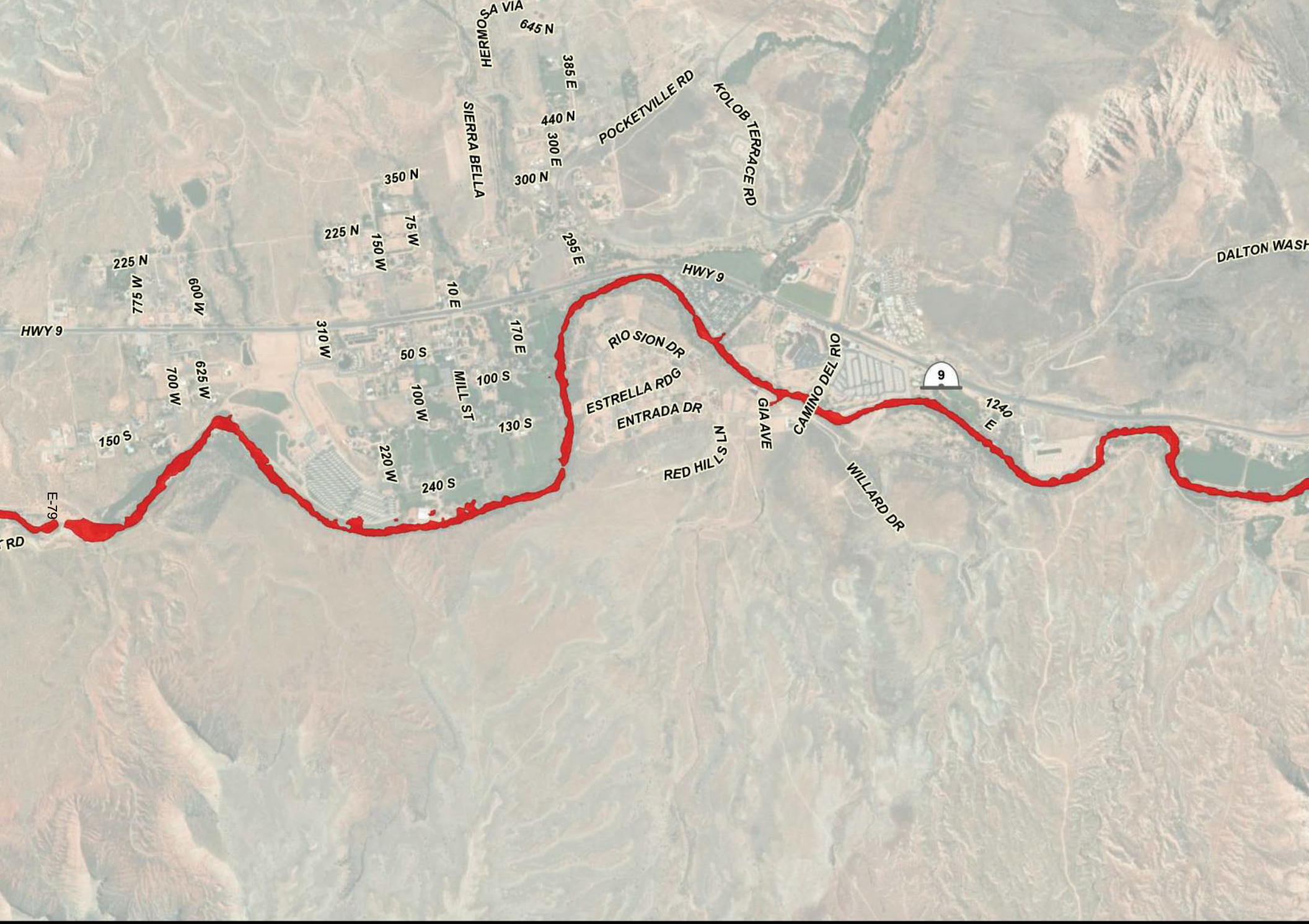

Legend

Inundation Boundary (Rainy Day)

Cove Dam Structure

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Dam Breach Rainy

Cove Reserv



Legend

- Inundation Boundary (Rainy Day)
- Cove Dam Structure

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Dam Breach Rainy

Cove Reserv



Legend

- Inundation Boundary (Rainy Day)
- Cove Dam Structure

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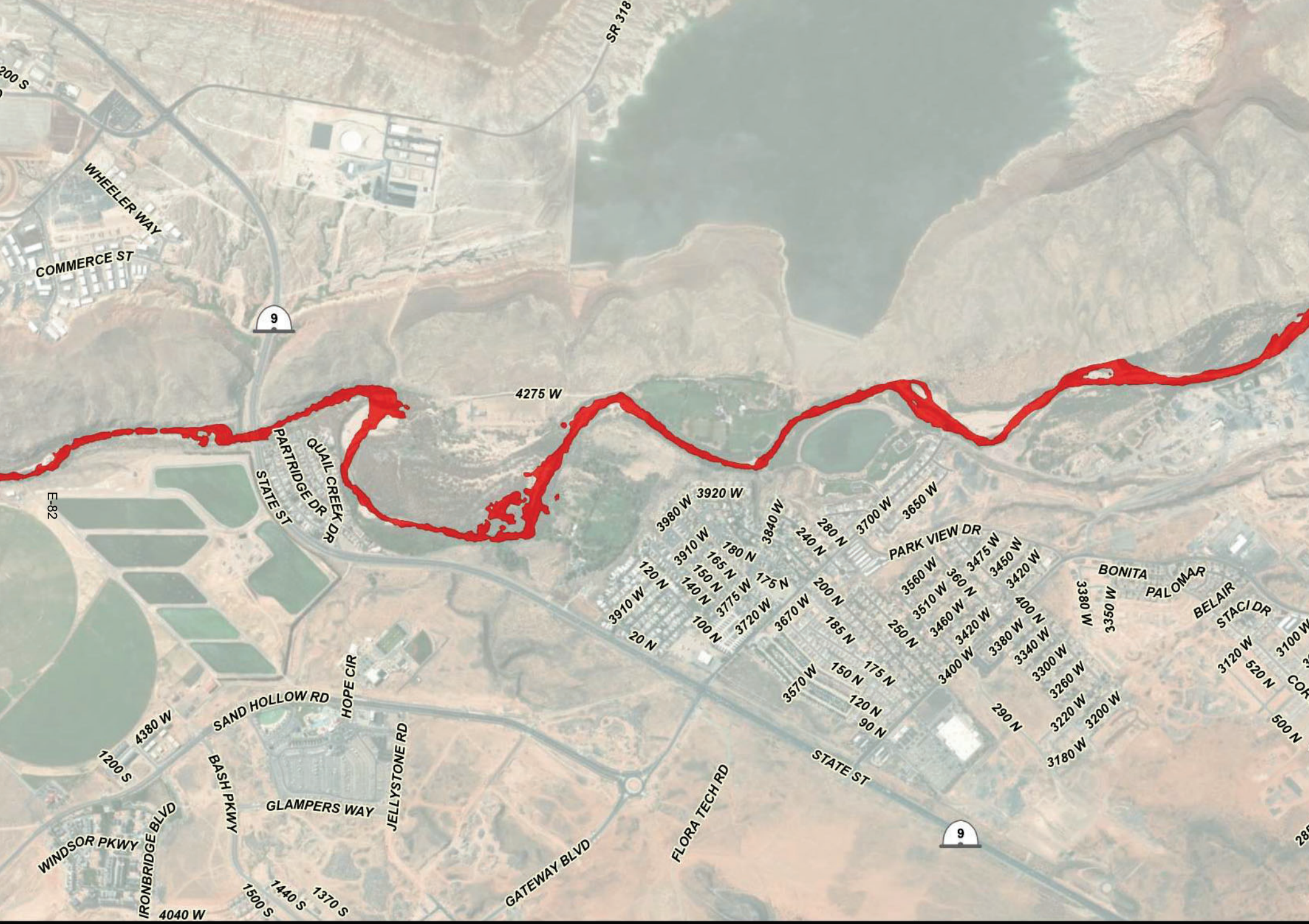
Dam Breach Rainy I

Cove Reserv



Legend

Inundation Boundary (Rainy Day)

Cove Dam Structure

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Dam Breach Rainy I

Cove Reserv



Legend

- Inundation Boundary (Rainy Day)
- Cove Dam Structure

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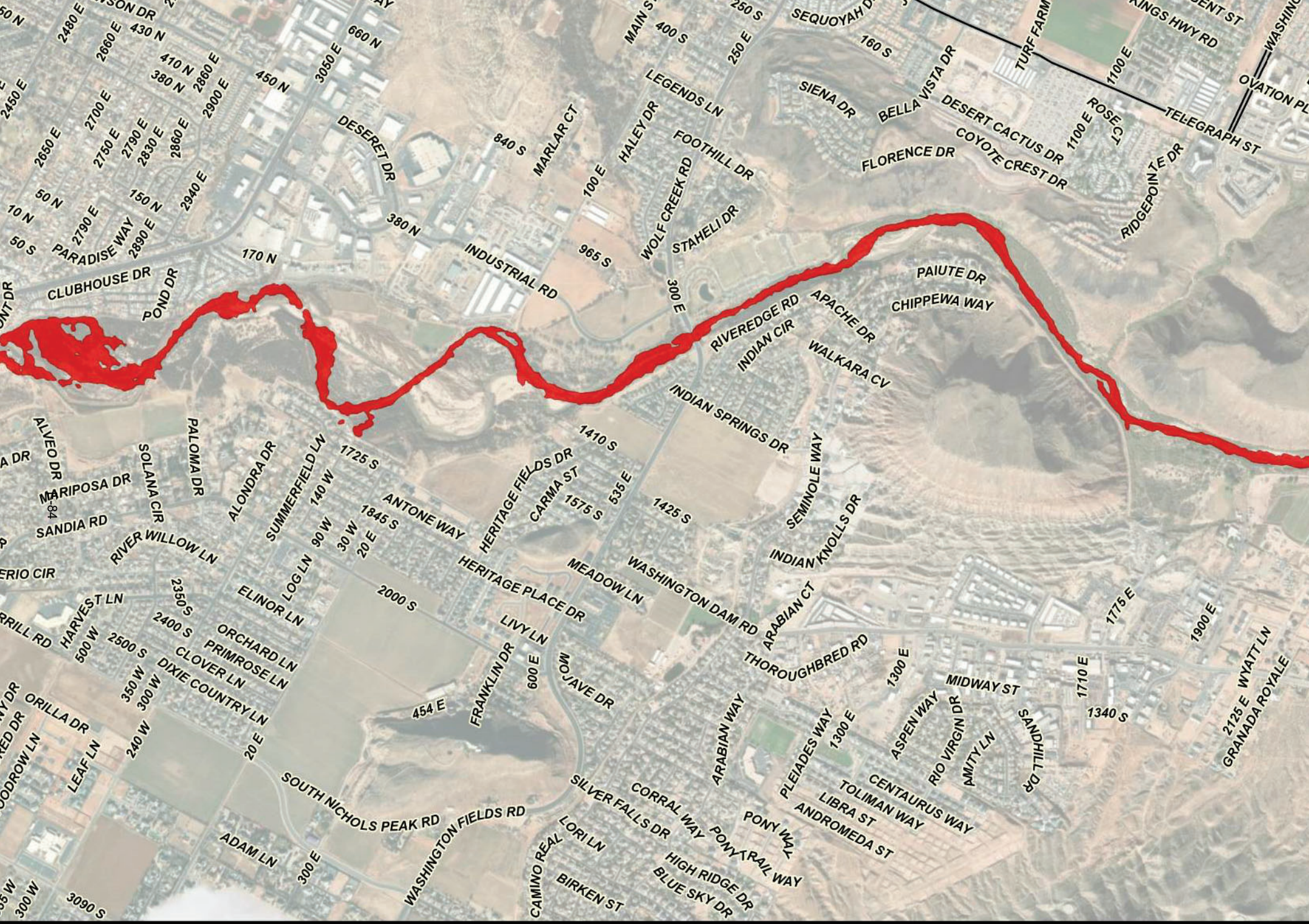
Dam Breach Rainy I

Cove Reserv


Legend
Inundation Boundary (Rainy Day)
Cove Dam Structure
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Dam Breach Rainy
Cove Reserv
CLUBHOUSE DR
POND DR
PARADISE WAY
INDUSTRIAL RD
DESERET DR
MARLAR CT
HALEY DR
LEGENDS LN
FOOTHILL DR
WOLF CREEK RD
STAHELI DR
SIENA DR
BELLA VISTA DR
DESERT CACTUS DR
COYOTE CREST DR
FLORENCE DR
ROSE CT
RIDGEPOINTE DR
TELEGRAPH ST
TURF FARM
OVATION PL
RIVEREDGE RD
INDIAN CIR
APACHE DR
CHIPPEWA WAY
PAIUTE DR
WALKARA CV
INDIAN SPRINGS DR
SEMINOLE WAY
INDIAN KNOLLS DR
ALVEO DR
MARIPOSA DR
SANDIA RD
SOLANA CIR
PALOMA DR
ALONDRA DR
SUMMERFIELD LN
ANTONE WAY
HERITAGE FIELDS DR
CARMA ST
RIVER WILLOW LN
ELINOR LOG LN
HERITAGE PLACE DR
MEADOW LN
WASHINGTON DAM RD
ARABIAN CT
THOROUGHBRED RD
HARVEST LN
ORCHARD LN
PRIMROSE LN
CLOVER LN
DIXIE COUNTRY LN
LIVY LN
FRANKLIN DR
MOJAVE DR
ARABIAN WAY
PLEIADES WAY
ASPEN WAY
RIO VIRGIN DR
AMITY LN
SANDHILL DR
MIDWAY ST
CENTAURUS WAY
TOLIMAN WAY
LIBRA ST
ANDROMEDA ST
PONY WAY
PONY TRAIL WAY
CORRAL WAY
SILVER FALLS DR
HIGH RIDGE DR
BLUE SKY DR
BIRKEN ST
CAMINO REAL
LORI LN
ADAM LN
WASHINGTON FIELDS RD
SOUTH NICHOLS PEAK RD
ORILLA DR
LEAF LN
GRANADA ROYALE
WYATT LN
WASHINGTON
KINGS HWY RD
400 S
250 S
250 E
160 S
1100 E
840 S
100 E
380 N
170 N
965 S
300 E
1410 S
1725 S
1575 S
535 E
1425 S
1845 S
140 W
90 W
30 W
20 E
2000 S
2350 S
2400 S
2500 S
500 W
350 W
300 W
240 W
20 E
454 E
600 E
1300 E
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1775 E
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3090 S
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3050 E
660 N
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410 N
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2450 E
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Legend

- Inundation Boundary (Rainy Day)
- Cove Dam Structure

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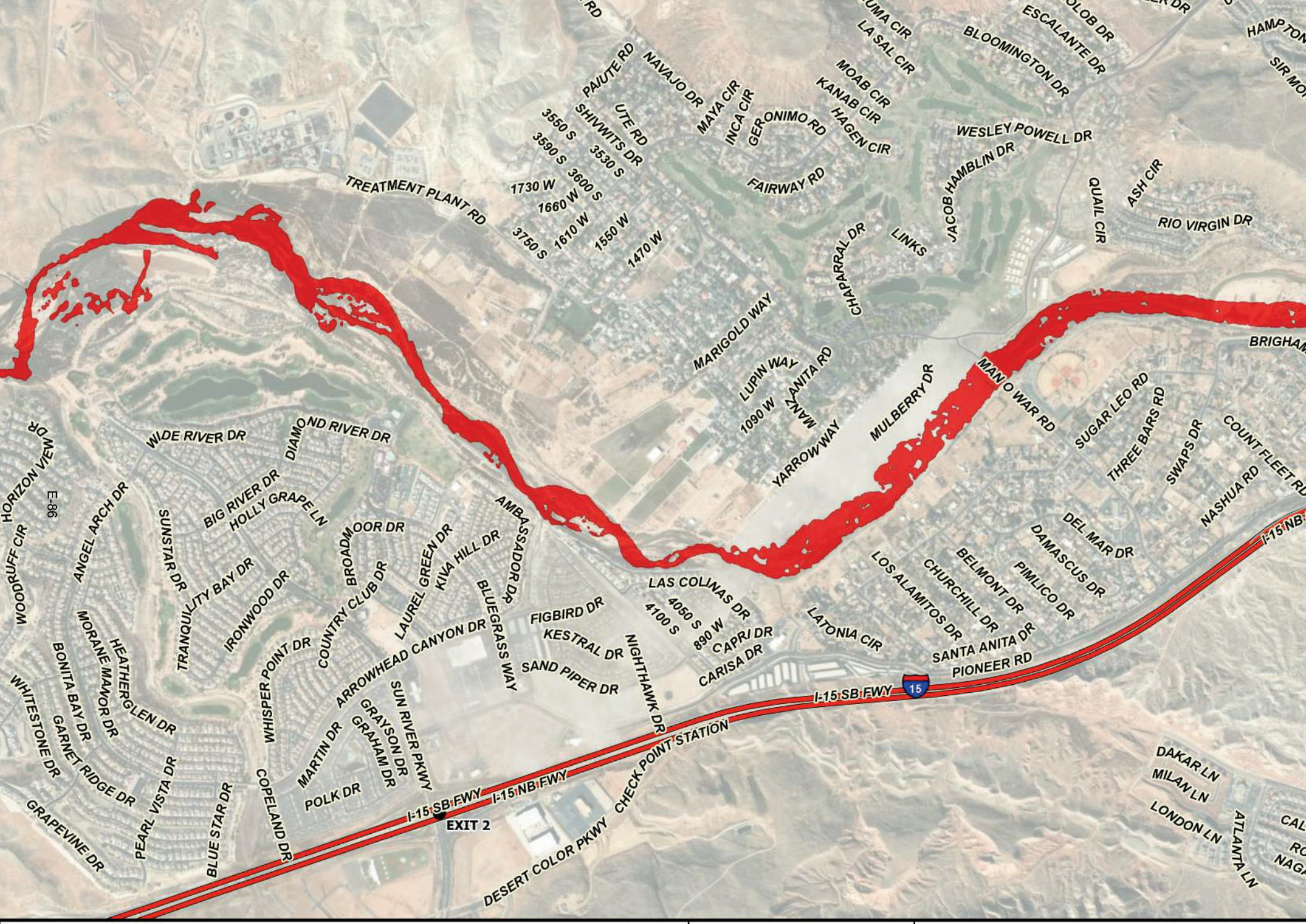
Dam Breach Rainy I

Cove Reserv



Legend

Inundation Boundary (Rainy Day)

Cove Dam Structure

Dam Breach Rainy I

Cove Reserv



Legend

Inundation Boundary (Rainy Day)

Cove Dam Structure

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Dam Breach Rainy I

Cove Reserv

Appendix B. Calculations

Section 1. Soil Data and Curve Numbers

Section 2. Storm Distributions

Section 3. Precipitation Values

Section 4. Wave Runup

Section 5. Emergency Drain

Section 1. Soil Data and Curve Numbers

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**********************************************************************
* Program written in ANSI-C by J. Heward                             *
* June 21 2018                                                       *
* Alpha Engineering                                                  *
* 43 S. 100 E.                                                       *
* St. George, Utah 84770                                             *
* 435-628-6500                                                       *
*                                                                    *
* Calculates curve number within basin                               *
* based on NLCD Data & Soil Data                                     *
*                                                                    *
* The following curve numbers are assumed for each                   *
* NLCD Landcover Class and Hydrologic Soil Group:                    *
*  NLCD  Group_A   Group_B   Group_C  Group_D                        *
*    11     98.0     98.0     98.0     98.0                         *
*    12     98.0     98.0     98.0     98.0                         *
*    21     68.0     79.0     86.0     89.0                         *
*    22     68.0     79.0     86.0     89.0                         *
*    23     61.0     75.0     83.0     87.0                         *
*    24     89.0     92.0     94.0     95.0                         *
*    31     55.0     72.0     81.0     86.0                         *
*    41     36.0     58.0     73.0     80.0                         *
*    42     58.0     75.0     85.0     89.0                         *
*    43     36.0     60.0     73.0     79.0                         *
*    51     35.0     56.0     70.0     77.0                         *
*    52     49.0     68.0     79.0     89.0                         *
*    71     39.0     61.0     74.0     80.0                         *
*    72     39.0     61.0     74.0     80.0                         *
*    73     39.0     61.0     74.0     80.0                         *
*    74     39.0     61.0     74.0     80.0                         *
*    81     49.0     69.0     79.0     84.0                         *
*    82     61.0     70.0     77.0     80.0                         *
*    90     30.0     55.0     70.0     77.0                         *
*    95     30.0     55.0     70.0     77.0                         *
**********************************************************************

<<Basin 1>>
       NLCD,  Soil_Group,  %_Watershed,    CN,  Weighted_CN
         41,           B,          4.5,  58.0,          2.6
         42,           A,          8.0,  58.0,          4.7
         42,           B,         85.9,  75.0,         64.4
         52,           B,          1.6,  68.0,          1.1
                                   Composite CN = **72.8**

<<Basin 2>>
       NLCD,  Soil_Group,  %_Watershed,    CN,  Weighted_CN
         42,           A,         14.5,  58.0,          8.4
         42,           B,         85.1,  75.0,         63.8
         52,           B,          0.4,  68.0,          0.3
                                   Composite CN = **72.5**

<<Basin 3>>
       NLCD,  Soil_Group,  %_Watershed,    CN,  Weighted_CN
         42,           A,         19.6,  58.0,         11.4
         42,           B,         71.4,  75.0,         53.6
         52,           B,          9.0,  68.0,          6.1
                                   Composite CN = **71.0**

<<Basin 4>>
```

NLCD	Soil_Group	%_Watershed	CN	Weighted_CN
31	C	0.0	81.0	0.0
31	D	1.8	86.0	1.6
42	A	38.7	58.0	22.5
42	B	19.0	75.0	14.2
42	C	7.9	85.0	6.7
42	D	18.2	89.0	16.2
52	A	0.3	49.0	0.2
52	B	0.4	68.0	0.3
52	C	4.5	79.0	3.6
52	D	9.2	89.0	8.2

Composite CN = **73.3**

<<Basin 5>>

NLCD	Soil_Group	%_Watershed	CN	Weighted_CN
31	C	0.0	81.0	0.0
31	D	0.9	86.0	0.8
42	A	25.5	58.0	14.8
42	B	38.5	75.0	28.8
42	C	10.3	85.0	8.8
42	D	12.9	89.0	11.5
52	A	0.0	49.0	0.0
52	B	4.1	68.0	2.8
52	C	3.1	79.0	2.4
52	D	4.7	89.0	4.2

Composite CN = **74.1**

<<Basin 6>>

NLCD	Soil_Group	%_Watershed	CN	Weighted_CN
42	A	0.5	58.0	0.3
42	C	49.2	85.0	41.8
42	D	23.0	89.0	20.4
52	A	3.0	49.0	1.5
52	C	13.9	79.0	11.0
52	D	10.3	89.0	9.2

Composite CN = **84.3**

<<Basin 7>>

NLCD	Soil_Group	%_Watershed	CN	Weighted_CN
31	C	0.0	81.0	0.0
31	D	2.6	86.0	2.3
42	A	41.1	58.0	23.8
42	C	7.4	85.0	6.3
42	D	29.4	89.0	26.2
52	A	0.0	49.0	0.0
52	C	1.7	79.0	1.4
52	D	17.7	89.0	15.7

Composite CN = **75.7**

<<Basin 8>>

NLCD	Soil_Group	%_Watershed	CN	Weighted_CN
21	C	0.0	86.0	0.0
42	A	0.0	58.0	0.0
42	C	26.9	85.0	22.9
42	D	10.5	89.0	9.3
52	A	0.0	49.0	0.0
52	C	39.4	79.0	31.1
52	D	23.2	89.0	20.6

Composite CN = **84.0**

<<Basin 9>>

NLCD	Soil_Group	%_Watershed	CN	Weighted_CN
42	A	0.6	58.0	0.3
42	C	20.7	85.0	17.6
42	D	27.7	89.0	24.7
52	A	3.7	49.0	1.8
52	C	10.4	79.0	8.2
52	D	36.9	89.0	32.8

Composite CN = **85.5**

<<Basin 10>>

NLCD	Soil_Group	%_Watershed	CN	Weighted_CN
42	C	27.5	85.0	23.4
42	D	32.1	89.0	28.5
52	C	12.4	79.0	9.8
52	D	28.1	89.0	25.0

Composite CN = **86.7**

<<Basin 11>>

NLCD	Soil_Group	%_Watershed	CN	Weighted_CN
42	A	0.2	58.0	0.1
42	C	9.1	85.0	7.7
42	D	18.0	89.0	16.0
52	A	0.0	49.0	0.0
52	C	37.4	79.0	29.5
52	D	35.3	89.0	31.4

Composite CN = **84.8**

<<Basin 12>>

NLCD	Soil_Group	%_Watershed	CN	Weighted_CN
21	C	0.1	86.0	0.0
22	C	0.4	86.0	0.4
42	C	35.0	85.0	29.7
52	C	64.0	79.0	50.6
52	D	0.5	89.0	0.5

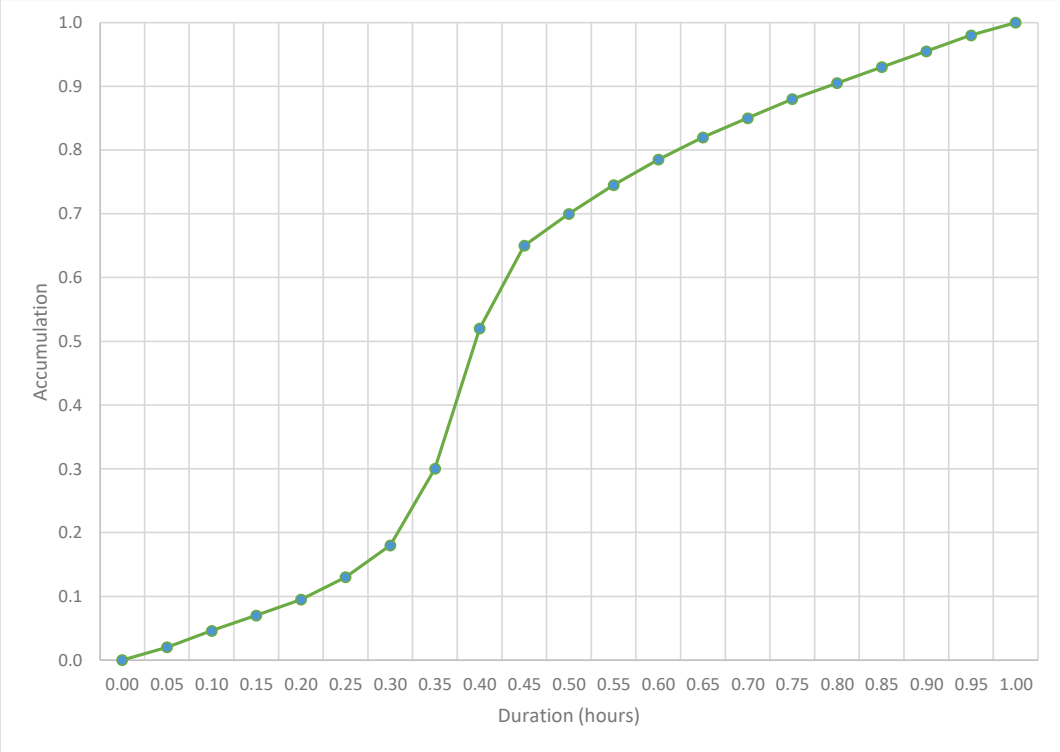
Composite CN = **81.2**

Section 2. Storm Distributions

Dimensionless Hydrograph

Hours	Accumulation
0.00	0.000
0.05	0.020
0.10	0.046
0.15	0.070
0.20	0.095
0.25	0.130
0.30	0.180
0.35	0.300
0.40	0.520
0.45	0.650
0.50	0.700
0.55	0.745
0.60	0.785
0.65	0.820
0.70	0.850
0.75	0.880
0.80	0.905
0.85	0.930
0.90	0.955
0.95	0.980
1.00	1.000

(NEH 630, Chapter 21, Figure 21-9)



PSH Hydrograph

Characteristics

Drainage Area	4.742	sq mi
Time of Concentration	1.88	hr
Ave. Annual Precipitation	15.6	in
Ave. Annual Temperature	51.2	°F
Curve Number	71.8	
100-yr, 24-hr Precipitation	3.51	in
100-yr, 10-day Precipitation	6.83	in
Structure Hazard Classification	High	
Climatic Index	0.6	

Principal Spillway Mass Curve

Adjusted Areal Rainfall

Not Applicable (<10 sq mi)

Adjusted 10-day Curve Numbers (Table 21-2)

$CN_{1\text{-day}}$	77.8	
$CN_{10\text{-day}}$	71.8	

Direct Runoff (NEH, Appendix 10A)

$Q_{1\text{-day}}$	1.49	in
$Q_{10\text{-day}}$	3.66	in

Net Runoff (Table 21-4)

Channel Loss Reduction Factor	0.84	
$Q_{1\text{-day net}}$	1.25	in
$Q_{10\text{-day net}}$	3.08	in

Mass Curve (Equation 21-2)

a	0.3903
Qd (1-hour)	0.3625

Time (days)	Qd (inches)	Inc. Volumes (inches)	Rank	Inc. Volume Ranked	Inc. Arrangement	Time (hrs)	Inc. Volumes Rearrange	PSMC	Dimensionless PSMC
0.0000	0.0000	-	-	-	-	0	-	0.0000	0.0000
0.0417	0.3624	0.3624	1	0.3624	239	1	0.0050	0.0050	0.0016
0.0833	0.4749	0.1126	2	0.1126	237	2	0.0051	0.0101	0.0033
0.1250	0.5564	0.0814	3	0.0814	235	3	0.0051	0.0152	0.0049
0.1667	0.6225	0.0661	4	0.0661	233	4	0.0051	0.0203	0.0066
0.2083	0.6792	0.0567	5	0.0567	231	5	0.0051	0.0254	0.0082
0.2500	0.7293	0.0501	6	0.0501	229	6	0.0052	0.0305	0.0099
0.2917	0.7745	0.0452	7	0.0452	227	7	0.0052	0.0357	0.0116
0.3333	0.8159	0.0414	8	0.0414	225	8	0.0052	0.0409	0.0133
0.3750	0.8543	0.0384	9	0.0384	223	9	0.0052	0.0462	0.0150
0.4167	0.8902	0.0359	10	0.0359	221	10	0.0053	0.0515	0.0167
0.4583	0.9239	0.0337	11	0.0337	219	11	0.0053	0.0568	0.0184
0.5000	0.9558	0.0319	12	0.0319	217	12	0.0053	0.0621	0.0202
0.5417	0.9862	0.0303	13	0.0303	215	13	0.0054	0.0674	0.0219
0.5833	1.0151	0.0289	14	0.0289	213	14	0.0054	0.0728	0.0237
0.6250	1.0428	0.0277	15	0.0277	211	15	0.0054	0.0783	0.0254

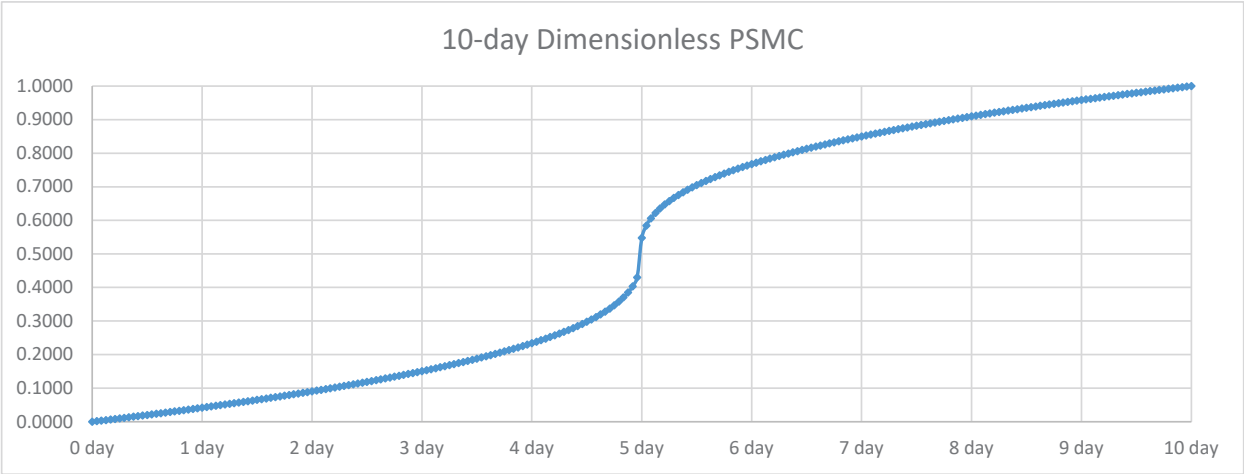
0.6667	1.0694	0.0266	16	0.0266	209	16	0.0055	0.0837	0.0272
0.7083	1.0950	0.0256	17	0.0256	207	17	0.0055	0.0892	0.0290
0.7500	1.1197	0.0247	18	0.0247	205	18	0.0055	0.0947	0.0308
0.7917	1.1436	0.0239	19	0.0239	203	19	0.0056	0.1003	0.0326
0.8333	1.1667	0.0231	20	0.0231	201	20	0.0056	0.1059	0.0344
0.8750	1.1892	0.0224	21	0.0224	199	21	0.0056	0.1115	0.0362
0.9167	1.2110	0.0218	22	0.0218	197	22	0.0057	0.1171	0.0381
0.9583	1.2322	0.0212	23	0.0212	195	23	0.0057	0.1228	0.0399
1.0000	1.2528	0.0206	24	0.0206	193	24	0.0057	0.1285	0.0418
1.0417	1.2729	0.0201	25	0.0201	191	25	0.0058	0.1343	0.0436
1.0833	1.2926	0.0196	26	0.0196	189	26	0.0058	0.1401	0.0455
1.1250	1.3117	0.0192	27	0.0192	187	27	0.0058	0.1459	0.0474
1.1667	1.3305	0.0188	28	0.0188	185	28	0.0059	0.1518	0.0493
1.2083	1.3488	0.0183	29	0.0183	183	29	0.0059	0.1577	0.0513
1.2500	1.3668	0.0180	30	0.0180	181	30	0.0060	0.1637	0.0532
1.2917	1.3844	0.0176	31	0.0176	179	31	0.0060	0.1697	0.0551
1.3333	1.4017	0.0173	32	0.0173	177	32	0.0060	0.1757	0.0571
1.3750	1.4186	0.0169	33	0.0169	175	33	0.0061	0.1818	0.0591
1.4167	1.4352	0.0166	34	0.0166	173	34	0.0061	0.1879	0.0611
1.4583	1.4516	0.0163	35	0.0163	171	35	0.0062	0.1941	0.0631
1.5000	1.4676	0.0160	36	0.0160	169	36	0.0062	0.2003	0.0651
1.5417	1.4834	0.0158	37	0.0158	167	37	0.0063	0.2065	0.0671
1.5833	1.4989	0.0155	38	0.0155	165	38	0.0063	0.2129	0.0692
1.6250	1.5142	0.0153	39	0.0153	163	39	0.0063	0.2192	0.0712
1.6667	1.5292	0.0150	40	0.0150	161	40	0.0064	0.2256	0.0733
1.7083	1.5441	0.0148	41	0.0148	159	41	0.0064	0.2320	0.0754
1.7500	1.5586	0.0146	42	0.0146	157	42	0.0065	0.2385	0.0775
1.7917	1.5730	0.0144	43	0.0144	155	43	0.0065	0.2451	0.0796
1.8333	1.5872	0.0142	44	0.0142	153	44	0.0066	0.2517	0.0818
1.8750	1.6012	0.0140	45	0.0140	151	45	0.0067	0.2583	0.0839
1.9167	1.6150	0.0138	46	0.0138	149	46	0.0067	0.2650	0.0861
1.9583	1.6286	0.0136	47	0.0136	147	47	0.0068	0.2718	0.0883
2.0000	1.6420	0.0134	48	0.0134	145	48	0.0068	0.2786	0.0905
2.0417	1.6553	0.0133	49	0.0133	143	49	0.0069	0.2855	0.0928
2.0833	1.6684	0.0131	50	0.0131	141	50	0.0069	0.2924	0.0950
2.1250	1.6814	0.0129	51	0.0129	139	51	0.0070	0.2994	0.0973
2.1667	1.6942	0.0128	52	0.0128	137	52	0.0071	0.3065	0.0996
2.2083	1.7068	0.0126	53	0.0126	135	53	0.0071	0.3136	0.1019
2.2500	1.7193	0.0125	54	0.0125	133	54	0.0072	0.3208	0.1042
2.2917	1.7317	0.0124	55	0.0124	131	55	0.0073	0.3281	0.1066
2.3333	1.7439	0.0122	56	0.0122	129	56	0.0073	0.3354	0.1090
2.3750	1.7560	0.0121	57	0.0121	127	57	0.0074	0.3428	0.1114
2.4167	1.7679	0.0120	58	0.0120	125	58	0.0075	0.3503	0.1138
2.4583	1.7798	0.0118	59	0.0118	123	59	0.0075	0.3578	0.1163
2.5000	1.7915	0.0117	60	0.0117	121	60	0.0076	0.3654	0.1187
2.5417	1.8031	0.0116	61	0.0116	119	61	0.0077	0.3731	0.1212
2.5833	1.8145	0.0115	62	0.0115	117	62	0.0078	0.3809	0.1238
2.6250	1.8259	0.0114	63	0.0114	115	63	0.0079	0.3888	0.1263
2.6667	1.8372	0.0113	64	0.0113	113	64	0.0079	0.3967	0.1289
2.7083	1.8483	0.0112	65	0.0112	111	65	0.0080	0.4047	0.1315
2.7500	1.8594	0.0110	66	0.0110	109	66	0.0081	0.4129	0.1341
2.7917	1.8703	0.0109	67	0.0109	107	67	0.0082	0.4211	0.1368
2.8333	1.8812	0.0108	68	0.0108	105	68	0.0083	0.4294	0.1395
2.8750	1.8919	0.0108	69	0.0108	103	69	0.0084	0.4378	0.1422
2.9167	1.9026	0.0107	70	0.0107	101	70	0.0085	0.4463	0.1450

2.9583	1.9131	0.0106	71	0.0106	99	71	0.0086	0.4549	0.1478
3.0000	1.9236	0.0105	72	0.0105	97	72	0.0087	0.4636	0.1506
3.0417	1.9340	0.0104	73	0.0104	95	73	0.0088	0.4725	0.1535
3.0833	1.9443	0.0103	74	0.0103	93	74	0.0090	0.4814	0.1564
3.1250	1.9545	0.0102	75	0.0102	91	75	0.0091	0.4905	0.1594
3.1667	1.9646	0.0101	76	0.0101	89	76	0.0092	0.4997	0.1624
3.2083	1.9747	0.0101	77	0.0101	87	77	0.0093	0.5090	0.1654
3.2500	1.9847	0.0100	78	0.0100	85	78	0.0095	0.5185	0.1685
3.2917	1.9946	0.0099	79	0.0099	83	79	0.0096	0.5281	0.1716
3.3333	2.0044	0.0098	80	0.0098	81	80	0.0097	0.5378	0.1747
3.3750	2.0141	0.0097	81	0.0097	79	81	0.0099	0.5477	0.1780
3.4167	2.0238	0.0097	82	0.0097	77	82	0.0101	0.5578	0.1812
3.4583	2.0334	0.0096	83	0.0096	75	83	0.0102	0.5680	0.1845
3.5000	2.0429	0.0095	84	0.0095	73	84	0.0104	0.5784	0.1879
3.5417	2.0524	0.0095	85	0.0095	71	85	0.0106	0.5889	0.1914
3.5833	2.0618	0.0094	86	0.0094	69	86	0.0108	0.5997	0.1948
3.6250	2.0711	0.0093	87	0.0093	67	87	0.0109	0.6106	0.1984
3.6667	2.0803	0.0093	88	0.0093	65	88	0.0112	0.6218	0.2020
3.7083	2.0895	0.0092	89	0.0092	63	89	0.0114	0.6331	0.2057
3.7500	2.0987	0.0091	90	0.0091	61	90	0.0116	0.6447	0.2095
3.7917	2.1077	0.0091	91	0.0091	59	91	0.0118	0.6566	0.2133
3.8333	2.1168	0.0090	92	0.0090	57	92	0.0121	0.6687	0.2173
3.8750	2.1257	0.0090	93	0.0090	55	93	0.0124	0.6810	0.2213
3.9167	2.1346	0.0089	94	0.0089	53	94	0.0126	0.6937	0.2254
3.9583	2.1434	0.0088	95	0.0088	51	95	0.0129	0.7066	0.2296
4.0000	2.1522	0.0088	96	0.0088	49	96	0.0133	0.7199	0.2339
4.0417	2.1609	0.0087	97	0.0087	47	97	0.0136	0.7335	0.2383
4.0833	2.1696	0.0087	98	0.0087	45	98	0.0140	0.7475	0.2429
4.1250	2.1782	0.0086	99	0.0086	43	99	0.0144	0.7618	0.2475
4.1667	2.1868	0.0086	100	0.0086	41	100	0.0148	0.7767	0.2524
4.2083	2.1953	0.0085	101	0.0085	39	101	0.0153	0.7919	0.2573
4.2500	2.2037	0.0085	102	0.0085	37	102	0.0158	0.8077	0.2624
4.2917	2.2122	0.0084	103	0.0084	35	103	0.0163	0.8240	0.2678
4.3333	2.2205	0.0084	104	0.0084	33	104	0.0169	0.8410	0.2733
4.3750	2.2288	0.0083	105	0.0083	31	105	0.0176	0.8586	0.2790
4.4167	2.2371	0.0083	106	0.0083	29	106	0.0183	0.8769	0.2849
4.4583	2.2453	0.0082	107	0.0082	27	107	0.0192	0.8961	0.2912
4.5000	2.2535	0.0082	108	0.0082	25	108	0.0201	0.9162	0.2977
4.5417	2.2616	0.0081	109	0.0081	23	109	0.0212	0.9374	0.3046
4.5833	2.2697	0.0081	110	0.0081	21	110	0.0224	0.9599	0.3119
4.6250	2.2777	0.0080	111	0.0080	19	111	0.0239	0.9838	0.3196
4.6667	2.2857	0.0080	112	0.0080	17	112	0.0256	1.0094	0.3280
4.7083	2.2936	0.0079	113	0.0079	15	113	0.0277	1.0371	0.3370
4.7500	2.3015	0.0079	114	0.0079	13	114	0.0303	1.0674	0.3468
4.7917	2.3094	0.0079	115	0.0079	11	115	0.0337	1.1011	0.3578
4.8333	2.3172	0.0078	116	0.0078	9	116	0.0384	1.1395	0.3703
4.8750	2.3250	0.0078	117	0.0078	7	117	0.0452	1.1848	0.3850
4.9167	2.3327	0.0077	118	0.0077	5	118	0.0567	1.2414	0.4034
4.9583	2.3404	0.0077	119	0.0077	3	119	0.0814	1.3229	0.4298
5.0000	2.3481	0.0077	120	0.0077	1	120	**0.3624**	1.6852	0.5476
5.0417	2.3557	0.0076	121	0.0076	2	121	0.1126	1.7978	0.5842
5.0833	2.3633	0.0076	122	0.0076	4	122	0.0661	1.8639	0.6056
5.1250	2.3708	0.0075	123	0.0075	6	123	0.0501	1.9140	0.6219
5.1667	2.3783	0.0075	124	0.0075	8	124	0.0414	1.9555	0.6354
5.2083	2.3858	0.0075	125	0.0075	10	125	0.0359	1.9913	0.6470

5.2500	2.3932	0.0074	126	0.0074	12	126	0.0319	2.0232	0.6574
5.2917	2.4006	0.0074	127	0.0074	14	127	0.0289	2.0522	0.6668
5.3333	2.4080	0.0074	128	0.0074	16	128	0.0266	2.0788	0.6755
5.3750	2.4153	0.0073	129	0.0073	18	129	0.0247	2.1035	0.6835
5.4167	2.4226	0.0073	130	0.0073	20	130	0.0231	2.1266	0.6910
5.4583	2.4298	0.0073	131	0.0073	22	131	0.0218	2.1484	0.6981
5.5000	2.4371	0.0072	132	0.0072	24	132	0.0206	2.1690	0.7048
5.5417	2.4443	0.0072	133	0.0072	26	133	0.0196	2.1887	0.7112
5.5833	2.4514	0.0072	134	0.0072	28	134	0.0188	2.2074	0.7173
5.6250	2.4585	0.0071	135	0.0071	30	135	0.0180	2.2254	0.7231
5.6667	2.4656	0.0071	136	0.0071	32	136	0.0173	2.2427	0.7287
5.7083	2.4727	0.0071	137	0.0071	34	137	0.0166	2.2593	0.7341
5.7500	2.4797	0.0070	138	0.0070	36	138	0.0160	2.2753	0.7393
5.7917	2.4867	0.0070	139	0.0070	38	139	0.0155	2.2909	0.7444
5.8333	2.4937	0.0070	140	0.0070	40	140	0.0150	2.3059	0.7493
5.8750	2.5006	0.0069	141	0.0069	42	141	0.0146	2.3205	0.7540
5.9167	2.5075	0.0069	142	0.0069	44	142	0.0142	2.3347	0.7586
5.9583	2.5144	0.0069	143	0.0069	46	143	0.0138	2.3485	0.7631
6.0000	2.5213	0.0068	144	0.0068	48	144	0.0134	2.3619	0.7675
6.0417	2.5281	0.0068	145	0.0068	50	145	0.0131	2.3750	0.7717
6.0833	2.5349	0.0068	146	0.0068	52	146	0.0128	2.3878	0.7759
6.1250	2.5416	0.0068	147	0.0068	54	147	0.0125	2.4003	0.7799
6.1667	2.5484	0.0067	148	0.0067	56	148	0.0122	2.4125	0.7839
6.2083	2.5551	0.0067	149	0.0067	58	149	0.0120	2.4245	0.7878
6.2500	2.5618	0.0067	150	0.0067	60	150	0.0117	2.4362	0.7916
6.2917	2.5684	0.0067	151	0.0067	62	151	0.0115	2.4477	0.7953
6.3333	2.5750	0.0066	152	0.0066	64	152	0.0113	2.4589	0.7990
6.3750	2.5816	0.0066	153	0.0066	66	153	0.0110	2.4700	0.8026
6.4167	2.5882	0.0066	154	0.0066	68	154	0.0108	2.4808	0.8061
6.4583	2.5948	0.0065	155	0.0065	70	155	0.0107	2.4915	0.8096
6.5000	2.6013	0.0065	156	0.0065	72	156	0.0105	2.5020	0.8130
6.5417	2.6078	0.0065	157	0.0065	74	157	0.0103	2.5123	0.8163
6.5833	2.6142	0.0065	158	0.0065	76	158	0.0101	2.5224	0.8196
6.6250	2.6207	0.0064	159	0.0064	78	159	0.0100	2.5324	0.8228
6.6667	2.6271	0.0064	160	0.0064	80	160	0.0098	2.5422	0.8260
6.7083	2.6335	0.0064	161	0.0064	82	161	0.0097	2.5519	0.8292
6.7500	2.6399	0.0064	162	0.0064	84	162	0.0095	2.5614	0.8323
6.7917	2.6462	0.0063	163	0.0063	86	163	0.0094	2.5708	0.8353
6.8333	2.6526	0.0063	164	0.0063	88	164	0.0093	2.5800	0.8383
6.8750	2.6589	0.0063	165	0.0063	90	165	0.0091	2.5892	0.8413
6.9167	2.6651	0.0063	166	0.0063	92	166	0.0090	2.5982	0.8442
6.9583	2.6714	0.0063	167	0.0063	94	167	0.0089	2.6071	0.8471
7.0000	2.6776	0.0062	168	0.0062	96	168	0.0088	2.6158	0.8500
7.0417	2.6838	0.0062	169	0.0062	98	169	0.0087	2.6245	0.8528
7.0833	2.6900	0.0062	170	0.0062	100	170	0.0086	2.6331	0.8556
7.1250	2.6962	0.0062	171	0.0062	102	171	0.0085	2.6415	0.8583
7.1667	2.7023	0.0061	172	0.0061	104	172	0.0084	2.6499	0.8610
7.2083	2.7085	0.0061	173	0.0061	106	173	0.0083	2.6582	0.8637
7.2500	2.7146	0.0061	174	0.0061	108	174	0.0082	2.6663	0.8664
7.2917	2.7206	0.0061	175	0.0061	110	175	0.0081	2.6744	0.8690
7.3333	2.7267	0.0061	176	0.0061	112	176	0.0080	2.6824	0.8716
7.3750	2.7327	0.0060	177	0.0060	114	177	0.0079	2.6903	0.8741
7.4167	2.7387	0.0060	178	0.0060	116	178	0.0078	2.6981	0.8767
7.4583	2.7447	0.0060	179	0.0060	118	179	0.0077	2.7058	0.8792
7.5000	2.7507	0.0060	180	0.0060	120	180	0.0077	2.7135	0.8817

7.5417	2.7567	0.0060	181	0.0060	122	181	0.0076	2.7211	0.8842
7.5833	2.7626	0.0059	182	0.0059	124	182	0.0075	2.7286	0.8866
7.6250	2.7685	0.0059	183	0.0059	126	183	0.0074	2.7360	0.8890
7.6667	2.7744	0.0059	184	0.0059	128	184	0.0074	2.7434	0.8914
7.7083	2.7803	0.0059	185	0.0059	130	185	0.0073	2.7507	0.8938
7.7500	2.7861	0.0059	186	0.0059	132	186	0.0072	2.7579	0.8961
7.7917	2.7920	0.0058	187	0.0058	134	187	0.0072	2.7650	0.8984
7.8333	2.7978	0.0058	188	0.0058	136	188	0.0071	2.7721	0.9007
7.8750	2.8036	0.0058	189	0.0058	138	189	0.0070	2.7792	0.9030
7.9167	2.8094	0.0058	190	0.0058	140	190	0.0070	2.7861	0.9053
7.9583	2.8151	0.0058	191	0.0058	142	191	0.0069	2.7930	0.9075
8.0000	2.8209	0.0057	192	0.0057	144	192	0.0068	2.7999	0.9098
8.0417	2.8266	0.0057	193	0.0057	146	193	0.0068	2.8067	0.9120
8.0833	2.8323	0.0057	194	0.0057	148	194	0.0067	2.8134	0.9142
8.1250	2.8380	0.0057	195	0.0057	150	195	0.0067	2.8201	0.9163
8.1667	2.8437	0.0057	196	0.0057	152	196	0.0066	2.8267	0.9185
8.2083	2.8493	0.0057	197	0.0057	154	197	0.0066	2.8333	0.9206
8.2500	2.8550	0.0056	198	0.0056	156	198	0.0065	2.8398	0.9227
8.2917	2.8606	0.0056	199	0.0056	158	199	0.0065	2.8463	0.9248
8.3333	2.8662	0.0056	200	0.0056	160	200	0.0064	2.8527	0.9269
8.3750	2.8718	0.0056	201	0.0056	162	201	0.0064	2.8591	0.9290
8.4167	2.8774	0.0056	202	0.0056	164	202	0.0063	2.8654	0.9311
8.4583	2.8829	0.0056	203	0.0056	166	203	0.0063	2.8717	0.9331
8.5000	2.8884	0.0055	204	0.0055	168	204	0.0062	2.8779	0.9351
8.5417	2.8940	0.0055	205	0.0055	170	205	0.0062	2.8841	0.9371
8.5833	2.8995	0.0055	206	0.0055	172	206	0.0061	2.8903	0.9391
8.6250	2.9049	0.0055	207	0.0055	174	207	0.0061	2.8964	0.9411
8.6667	2.9104	0.0055	208	0.0055	176	208	0.0061	2.9024	0.9431
8.7083	2.9159	0.0055	209	0.0055	178	209	0.0060	2.9084	0.9450
8.7500	2.9213	0.0054	210	0.0054	180	210	0.0060	2.9144	0.9470
8.7917	2.9267	0.0054	211	0.0054	182	211	0.0059	2.9203	0.9489
8.8333	2.9321	0.0054	212	0.0054	184	212	0.0059	2.9262	0.9508
8.8750	2.9375	0.0054	213	0.0054	186	213	0.0059	2.9321	0.9527
8.9167	2.9429	0.0054	214	0.0054	188	214	0.0058	2.9379	0.9546
8.9583	2.9483	0.0054	215	0.0054	190	215	0.0058	2.9437	0.9565
9.0000	2.9536	0.0053	216	0.0053	192	216	0.0057	2.9494	0.9584
9.0417	2.9589	0.0053	217	0.0053	194	217	0.0057	2.9551	0.9602
9.0833	2.9642	0.0053	218	0.0053	196	218	0.0057	2.9608	0.9620
9.1250	2.9695	0.0053	219	0.0053	198	219	0.0056	2.9664	0.9639
9.1667	2.9748	0.0053	220	0.0053	200	220	0.0056	2.9720	0.9657
9.2083	2.9801	0.0053	221	0.0053	202	221	0.0056	2.9776	0.9675
9.2500	2.9854	0.0053	222	0.0053	204	222	0.0055	2.9832	0.9693
9.2917	2.9906	0.0052	223	0.0052	206	223	0.0055	2.9887	0.9711
9.3333	2.9958	0.0052	224	0.0052	208	224	0.0055	2.9941	0.9729
9.3750	3.0010	0.0052	225	0.0052	210	225	0.0054	2.9996	0.9746
9.4167	3.0062	0.0052	226	0.0052	212	226	0.0054	3.0050	0.9764
9.4583	3.0114	0.0052	227	0.0052	214	227	0.0054	3.0103	0.9781
9.5000	3.0166	0.0052	228	0.0052	216	228	0.0053	3.0157	0.9799
9.5417	3.0218	0.0052	229	0.0052	218	229	0.0053	3.0210	0.9816
9.5833	3.0269	0.0051	230	0.0051	220	230	0.0053	3.0263	0.9833
9.6250	3.0320	0.0051	231	0.0051	222	231	0.0053	3.0315	0.9850
9.6667	3.0371	0.0051	232	0.0051	224	232	0.0052	3.0368	0.9867
9.7083	3.0423	0.0051	233	0.0051	226	233	0.0052	3.0420	0.9884
9.7500	3.0473	0.0051	234	0.0051	228	234	0.0052	3.0471	0.9901
9.7917	3.0524	0.0051	235	0.0051	230	235	0.0051	3.0523	0.9918

9.8333	3.0575	0.0051	236	0.0051	232	236	0.0051	3.0574	0.9934
9.8750	3.0625	0.0051	237	0.0051	234	237	0.0051	3.0625	0.9951
9.9167	3.0676	0.0050	238	0.0050	236	238	0.0051	3.0676	0.9967
9.9583	3.0726	0.0050	239	0.0050	238	239	0.0050	3.0726	0.9984
10.0000	3.0776	0.0050	240	0.0050	240	240	0.0050	3.0776	1.0000



Unit Hydrograph

Unit Storm Duration

ΔD 0.25 hr << 0.2-hr time increments are used

Time to Peak

Tp 1.25 hr << rounded to 1.0 hr

Unit Hydrograph Peak Discharge

qp 2295 cfs

Time Ratio	Discharge Ratio	Time (hr)	q (cfs)
0.0	0.000	0.000	0
0.1	0.030	0.100	69
0.2	0.100	0.200	230
0.3	0.190	0.300	436
0.4	0.310	0.400	711
0.5	0.470	0.500	1079
0.6	0.660	0.600	1515
0.7	0.820	0.700	1882
0.8	0.930	0.800	2134
0.9	0.990	0.900	2272
1.0	1.000	1.000	2295
1.1	0.990	1.100	2272
1.2	0.930	1.200	2134
1.3	0.860	1.300	1974
1.4	0.780	1.400	1790
1.5	0.680	1.500	1561
1.6	0.560	1.600	1285
1.7	0.460	1.700	1056
1.8	0.390	1.800	895

Time (hr)	q (cfs)
0	**0**
0.30	230
0.60	711
0.90	1515
1.20	2134
1.50	**2295**
1.80	2134
2.10	1790
2.40	1285
2.70	895
3.00	**643**
3.30	475
3.60	337
3.90	246
4.20	177
4.50	**126**
4.80	92
5.10	67
5.40	48

1.9	0.330	1.900	757
2.0	0.280	2.000	643
2.2	0.207	2.200	475
2.4	0.147	2.400	337
2.6	0.107	2.600	246
2.8	0.077	2.800	177
3.0	0.055	3.000	126
3.2	0.040	3.200	92
3.4	0.029	3.400	67
3.6	0.021	3.600	48
3.8	0.015	3.800	34
4.0	0.011	4.000	25
4.5	0.005	4.500	11
5.0	0.000	5.000	0

5.70	34
6.00	**25**
6.30	19
6.60	14
6.90	9
7.20	5
7.50	**0**
7.80	0
8.10	0
8.40	0
8.70	0
9.00	**0**
9.30	0
9.60	0

Sum	4592 cfs-h

Check

Unit Hydrograph (per 1 in. Unit Runoff) 3060.2 cfs-h

Variance -50.05%

Principal Spillway Hydrograph

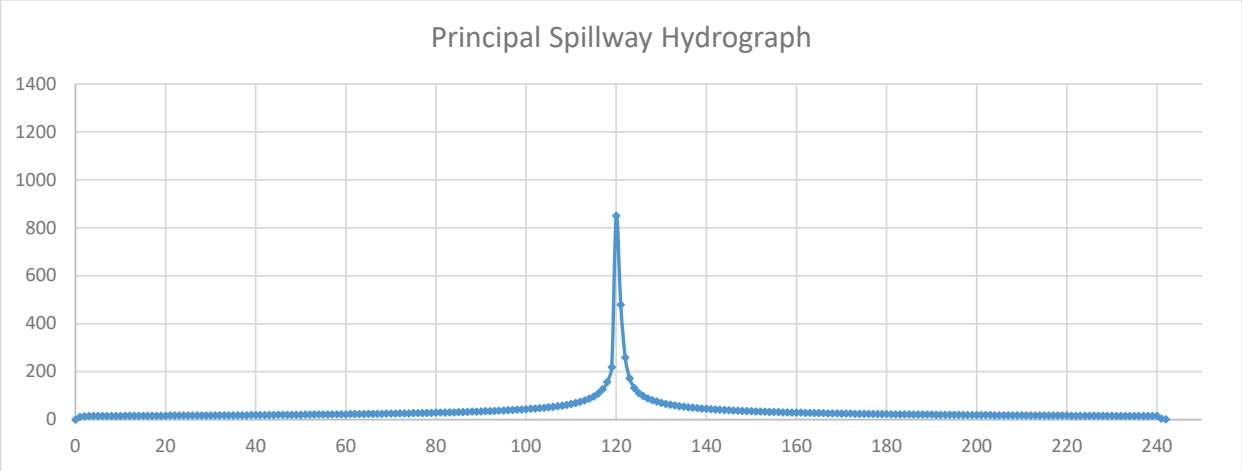
Time (hrs)	Inc. Volumes Rearranged	q (cfs)	Composite PSH (cfs)
0.0	0.0000	0	0
1.0	0.0050	2186	11
2.0	0.0051	612	14
3.0	0.0051	120	15
4.0	0.0051	24	15
5.0	0.0051	0	15
6.0	0.0052		15
7.0	0.0052		15
8.0	0.0052		15
9.0	0.0052		15
10.0	0.0053		15
11.0	0.0053		16
12.0	0.0053		16
13.0	0.0054		16
14.0	0.0054		16
15.0	0.0054		16
16.0	0.0055		16
17.0	0.0055		16
18.0	0.0055		16
19.0	0.0056		16
20.0	0.0056		16
21.0	0.0056		17
22.0	0.0057		17
23.0	0.0057		17
24.0	0.0057		17
25.0	0.0058		17
26.0	0.0058		17
27.0	0.0058		17
28.0	0.0059		17
29.0	0.0059		17

30.0	0.0060		17
31.0	0.0060		18
32.0	0.0060		18
33.0	0.0061		18
34.0	0.0061		18
35.0	0.0062		18
36.0	0.0062		18
37.0	0.0063		18
38.0	0.0063		18
39.0	0.0063		19
40.0	0.0064		19
41.0	0.0064		19
42.0	0.0065		19
43.0	0.0065		19
44.0	0.0066		19
45.0	0.0067		20
46.0	0.0067		20
47.0	0.0068		20
48.0	0.0068		20
49.0	0.0069		20
50.0	0.0069		20
51.0	0.0070		21
52.0	0.0071		21
53.0	0.0071		21
54.0	0.0072		21
55.0	0.0073		21
56.0	0.0073		21
57.0	0.0074		22
58.0	0.0075		22
59.0	0.0075		22
60.0	0.0076		22
61.0	0.0077		23
62.0	0.0078		23
63.0	0.0079		23
64.0	0.0079		23
65.0	0.0080		24
66.0	0.0081		24
67.0	0.0082		24
68.0	0.0083		24
69.0	0.0084		25
70.0	0.0085		25
71.0	0.0086		25
72.0	0.0087		26
73.0	0.0088		26
74.0	0.0090		26
75.0	0.0091		27
76.0	0.0092		27
77.0	0.0093		27
78.0	0.0095		28
79.0	0.0096		28
80.0	0.0097		29
81.0	0.0099		29
82.0	0.0101		29
83.0	0.0102		30
84.0	0.0104		30

85.0	0.0106		31
86.0	0.0108		31
87.0	0.0109		32
88.0	0.0112		33
89.0	0.0114		33
90.0	0.0116		34
91.0	0.0118		35
92.0	0.0121		35
93.0	0.0124		36
94.0	0.0126		37
95.0	0.0129		38
96.0	0.0133		39
97.0	0.0136		40
98.0	0.0140		41
99.0	0.0144		42
100.0	0.0148		43
101.0	0.0153		45
102.0	0.0158		46
103.0	0.0163		48
104.0	0.0169		49
105.0	0.0176		51
106.0	0.0183		53
107.0	0.0192		56
108.0	0.0201		58
109.0	0.0212		61
110.0	0.0224		65
111.0	0.0239		69
112.0	0.0256		74
113.0	0.0277		80
114.0	0.0303		87
115.0	0.0337		96
116.0	0.0384		109
117.0	0.0452		127
118.0	0.0567		157
119.0	0.0814		219
120.0	0.3624		850
121.0	0.1126		479
122.0	0.0661		259
123.0	0.0501		172
124.0	0.0414		132
125.0	0.0359		111
126.0	0.0319		98
127.0	0.0289		88
128.0	0.0266		81
129.0	0.0247		75
130.0	0.0231		70
131.0	0.0218		65
132.0	0.0206		62
133.0	0.0196		59
134.0	0.0188		56
135.0	0.0180		54
136.0	0.0173		51
137.0	0.0166		50
138.0	0.0160		48
139.0	0.0155		46

140.0	0.0150		45
141.0	0.0146		43
142.0	0.0142		42
143.0	0.0138		41
144.0	0.0134		40
145.0	0.0131		39
146.0	0.0128		38
147.0	0.0125		37
148.0	0.0122		36
149.0	0.0120		35
150.0	0.0117		35
151.0	0.0115		34
152.0	0.0113		33
153.0	0.0110		33
154.0	0.0108		32
155.0	0.0107		32
156.0	0.0105		31
157.0	0.0103		30
158.0	0.0101		30
159.0	0.0100		29
160.0	0.0098		29
161.0	0.0097		29
162.0	0.0095		28
163.0	0.0094		28
164.0	0.0093		27
165.0	0.0091		27
166.0	0.0090		27
167.0	0.0089		26
168.0	0.0088		26
169.0	0.0087		26
170.0	0.0086		25
171.0	0.0085		25
172.0	0.0084		25
173.0	0.0083		24
174.0	0.0082		24
175.0	0.0081		24
176.0	0.0080		24
177.0	0.0079		23
178.0	0.0078		23
179.0	0.0077		23
180.0	0.0077		23
181.0	0.0076		22
182.0	0.0075		22
183.0	0.0074		22
184.0	0.0074		22
185.0	0.0073		22
186.0	0.0072		21
187.0	0.0072		21
188.0	0.0071		21
189.0	0.0070		21
190.0	0.0070		21
191.0	0.0069		20
192.0	0.0068		20
193.0	0.0068		20
194.0	0.0067		20

195.0	0.0067		20
196.0	0.0066		20
197.0	0.0066		19
198.0	0.0065		19
199.0	0.0065		19
200.0	0.0064		19
201.0	0.0064		19
202.0	0.0063		19
203.0	0.0063		19
204.0	0.0062		18
205.0	0.0062		18
206.0	0.0061		18
207.0	0.0061		18
208.0	0.0061		18
209.0	0.0060		18
210.0	0.0060		18
211.0	0.0059		17
212.0	0.0059		17
213.0	0.0059		17
214.0	0.0058		17
215.0	0.0058		17
216.0	0.0057		17
217.0	0.0057		17
218.0	0.0057		17
219.0	0.0056		17
220.0	0.0056		17
221.0	0.0056		16
222.0	0.0055		16
223.0	0.0055		16
224.0	0.0055		16
225.0	0.0054		16
226.0	0.0054		16
227.0	0.0054		16
228.0	0.0053		16
229.0	0.0053		16
230.0	0.0053		16
231.0	0.0053		15
232.0	0.0052		15
233.0	0.0052		15
234.0	0.0052		15
235.0	0.0051		15
236.0	0.0051		15
237.0	0.0051		15
238.0	0.0051		15
239.0	0.0050		15
240.0	0.0050		15
241.0	0.0000		4
242.0	0.0000		1



Results

Peak Hydrograph Flow	850	cfs
Total Volume	749	ac-ft

ASH-L Hydrograph

Characteristics

Drainage Area	4.742	sq mi
Time of Concentration	1.58	hr
Curve Number	77.8	
Structure Hazard Classification	High	
Initial Abstraction	0.57	in
Maximum Potential Retention	2.85	in
Precipitation	4.03	in
ΔD	0.05	hr

5-Point Rainfall Distribution

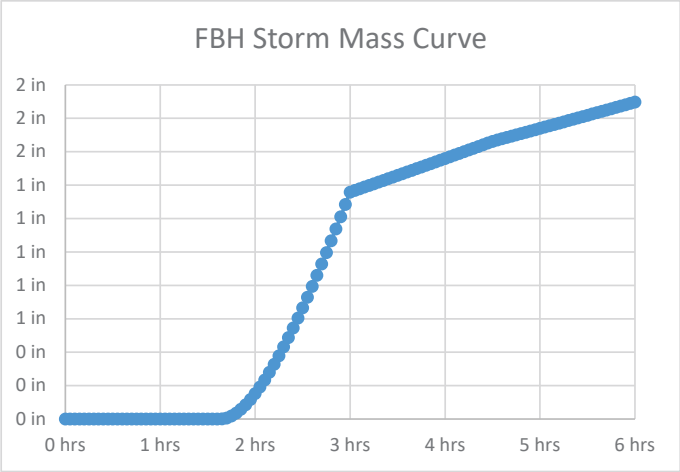
Time Increment	Incremental Rainfall	Rainfall Fractions for Each Time Increment		5 Point Rainfall Distribution	
0 to 1.5	0.299 in	0.074		0.074	
1.5 to 3	3.032 in	0.752		0.827	
2 to 4.5	0.400 in	0.099		0.926	
4.5 to 6	0.299 in	0.074		1.000	

Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution
0.00	0.000	1.50	0.074	3.00	0.827	4.50	0.926
0.05	0.002	1.55	0.099	3.05	0.830	4.55	0.928
0.10	0.005	1.60	0.124	3.10	0.833	4.60	0.931
0.15	0.007	1.65	0.149	3.15	0.836	4.65	0.933
0.20	0.010	1.70	0.175	3.20	0.840	4.70	0.936
0.25	0.012	1.75	0.200	3.25	0.843	4.75	0.938
0.30	0.015	1.80	0.225	3.30	0.846	4.80	0.941
0.35	0.017	1.85	0.250	3.35	0.850	4.85	0.943
0.40	0.020	1.90	0.275	3.40	0.853	4.90	0.946
0.45	0.022	1.95	0.300	3.45	0.856	4.95	0.948
0.50	0.025	2.00	0.325	3.50	0.860	5.00	0.951
0.55	0.027	2.05	0.350	3.55	0.863	5.05	0.953
0.60	0.030	2.10	0.375	3.60	0.866	5.10	0.955
0.65	0.032	2.15	0.400	3.65	0.870	5.15	0.958
0.70	0.035	2.20	0.425	3.70	0.873	5.20	0.960
0.75	0.037	2.25	0.450	3.75	0.876	5.25	0.963
0.80	0.040	2.30	0.475	3.80	0.879	5.30	0.965
0.85	0.042	2.35	0.501	3.85	0.883	5.35	0.968
0.90	0.045	2.40	0.526	3.90	0.886	5.40	0.970
0.95	0.047	2.45	0.551	3.95	0.889	5.45	0.973
1.00	0.049	2.50	0.576	4.00	0.893	5.50	0.975
1.05	0.052	2.55	0.601	4.05	0.896	5.55	0.978
1.10	0.054	2.60	0.626	4.10	0.899	5.60	0.980
1.15	0.057	2.65	0.651	4.15	0.903	5.65	0.983
1.20	0.059	2.70	0.676	4.20	0.906	5.70	0.985
1.25	0.062	2.75	0.701	4.25	0.909	5.75	0.988
1.30	0.064	2.80	0.726	4.30	0.913	5.80	0.990
1.35	0.067	2.85	0.751	4.35	0.916	5.85	0.993
1.40	0.069	2.90	0.776	4.40	0.919	5.90	0.995
1.45	0.072	2.95	0.801	4.45	0.922	5.95	0.998
						6.00	1.000

Time (hr)	Rainfall Distribution	Total Rainfall (in)	Acc. Mass Curve of Runoff (in)	Inc. Mass Curve of Runoff (in)
0.00	0.000	0.000	0.000	0.000
0.05	0.002	0.010	0.000	0.000
0.10	0.005	0.020	0.000	0.000
0.15	0.007	0.030	0.000	0.000
0.20	0.010	0.040	0.000	0.000
0.25	0.012	0.050	0.000	0.000
0.30	0.015	0.060	0.000	0.000
0.35	0.017	0.070	0.000	0.000
0.40	0.020	0.080	0.000	0.000
0.45	0.022	0.090	0.000	0.000
0.50	0.025	0.100	0.000	0.000
0.55	0.027	0.110	0.000	0.000
0.60	0.030	0.120	0.000	0.000
0.65	0.032	0.130	0.000	0.000
0.70	0.035	0.140	0.000	0.000
0.75	0.037	0.150	0.000	0.000
0.80	0.040	0.159	0.000	0.000
0.85	0.042	0.169	0.000	0.000
0.90	0.045	0.179	0.000	0.000
0.95	0.047	0.189	0.000	0.000
1.00	0.049	0.199	0.000	0.000
1.05	0.052	0.209	0.000	0.000
1.10	0.054	0.219	0.000	0.000
1.15	0.057	0.229	0.000	0.000
1.20	0.059	0.239	0.000	0.000
1.25	0.062	0.249	0.000	0.000
1.30	0.064	0.259	0.000	0.000
1.35	0.067	0.269	0.000	0.000
1.40	0.069	0.279	0.000	0.000
1.45	0.072	0.289	0.000	0.000
1.50	0.074	0.299	0.000	0.000
1.55	0.099	0.400	0.000	0.000
1.60	0.124	0.501	0.000	0.000
1.65	0.149	0.602	0.000	0.000
1.70	0.175	0.703	0.006	0.006
1.75	0.200	0.804	0.018	0.012
1.80	0.225	0.905	0.035	0.018
1.85	0.250	1.006	0.058	0.023
1.90	0.275	1.108	0.085	0.027
1.95	0.300	1.209	0.117	0.032
2.00	0.325	1.310	0.152	0.036
2.05	0.350	1.411	0.192	0.039
2.10	0.375	1.512	0.234	0.042
2.15	0.400	1.613	0.279	0.045
2.20	0.425	1.714	0.328	0.048
2.25	0.450	1.815	0.379	0.051
2.30	0.475	1.916	0.432	0.053
2.35	0.501	2.017	0.487	0.056

2.40	0.526	2.118	0.545	0.058
2.45	0.551	2.219	0.605	0.060
2.50	0.576	2.320	0.666	0.061
2.55	0.601	2.421	0.729	0.063
2.60	0.626	2.522	0.794	0.065
2.65	0.651	2.624	0.860	0.066
2.70	0.676	2.725	0.928	0.068
2.75	0.701	2.826	0.997	0.069
2.80	0.726	2.927	1.067	0.070
2.85	0.751	3.028	1.138	0.071
2.90	0.776	3.129	1.211	0.072
2.95	0.801	3.230	1.284	0.074
3.00	0.827	3.331	1.359	0.075
3.05	0.830	3.344	1.369	0.010
3.10	0.833	3.358	1.378	0.010
3.15	0.836	3.371	1.388	0.010
3.20	0.840	3.384	1.398	0.010
3.25	0.843	3.398	1.408	0.010
3.30	0.846	3.411	1.418	0.010
3.35	0.850	3.424	1.428	0.010
3.40	0.853	3.438	1.438	0.010
3.45	0.856	3.451	1.448	0.010
3.50	0.860	3.464	1.458	0.010
3.55	0.863	3.478	1.468	0.010
3.60	0.866	3.491	1.478	0.010
3.65	0.870	3.504	1.489	0.010
3.70	0.873	3.518	1.499	0.010
3.75	0.876	3.531	1.509	0.010
3.80	0.879	3.544	1.519	0.010
3.85	0.883	3.558	1.529	0.010
3.90	0.886	3.571	1.539	0.010
3.95	0.889	3.584	1.549	0.010
4.00	0.893	3.598	1.560	0.010
4.05	0.896	3.611	1.570	0.010
4.10	0.899	3.624	1.580	0.010
4.15	0.903	3.638	1.590	0.010
4.20	0.906	3.651	1.600	0.010
4.25	0.909	3.664	1.611	0.010
4.30	0.913	3.678	1.621	0.010
4.35	0.916	3.691	1.631	0.010
4.40	0.919	3.704	1.642	0.010
4.45	0.922	3.718	1.652	0.010
4.50	0.926	3.731	1.662	0.010
4.55	0.928	3.741	1.670	0.008
4.60	0.931	3.751	1.678	0.008
4.65	0.933	3.761	1.685	0.008
4.70	0.936	3.771	1.693	0.008
4.75	0.938	3.781	1.701	0.008
4.80	0.941	3.791	1.709	0.008
4.85	0.943	3.801	1.717	0.008
4.90	0.946	3.811	1.724	0.008
4.95	0.948	3.821	1.732	0.008
5.00	0.951	3.831	1.740	0.008
5.05	0.953	3.841	1.748	0.008
5.10	0.955	3.851	1.756	0.008

5.15	0.958	3.861	1.763	0.008
5.20	0.960	3.871	1.771	0.008
5.25	0.963	3.881	1.779	0.008
5.30	0.965	3.890	1.787	0.008
5.35	0.968	3.900	1.795	0.008
5.40	0.970	3.910	1.803	0.008
5.45	0.973	3.920	1.810	0.008
5.50	0.975	3.930	1.818	0.008
5.55	0.978	3.940	1.826	0.008
5.60	0.980	3.950	1.834	0.008
5.65	0.983	3.960	1.842	0.008
5.70	0.985	3.970	1.850	0.008
5.75	0.988	3.980	1.858	0.008
5.80	0.990	3.990	1.866	0.008
5.85	0.993	4.000	1.873	0.008
5.90	0.995	4.010	1.881	0.008
5.95	0.998	4.020	1.889	0.008
6.00	1.000	4.030	1.897	0.008



Unit Hydrograph

Unit Storm Duration

ΔD 0.05

Time to Peak

Tp 0.99 << rounded to 1.0 hr

Unit Hydrograph Peak Discharge

qp 2295

Time Ratio	Discharge Ratio	Time (hr)	q (cfs)
0.0	0.000	0.000	0
0.1	0.030	0.100	69
0.2	0.100	0.200	230
0.3	0.190	0.300	436
0.4	0.310	0.400	711
0.5	0.470	0.500	1079
0.6	0.660	0.600	1515

Time (hr)	q (cfs)
0	**0**
0.05	230
0.10	711
0.15	1515
0.20	2134
0.25	**2295**
0.30	2134

0.7	0.820	0.700	1882
0.8	0.930	0.800	2134
0.9	0.990	0.900	2272
1.0	1.000	1.000	2295
1.1	0.990	1.100	2272
1.2	0.930	1.200	2134
1.3	0.860	1.300	1974
1.4	0.780	1.400	1790
1.5	0.680	1.500	1561
1.6	0.560	1.600	1285
1.7	0.460	1.700	1056
1.8	0.390	1.800	895
1.9	0.330	1.900	757
2.0	0.280	2.000	643
2.2	0.207	2.200	475
2.4	0.147	2.400	337
2.6	0.107	2.600	246
2.8	0.077	2.800	177
3.0	0.055	3.000	126
3.2	0.040	3.200	92
3.4	0.029	3.400	67
3.6	0.021	3.600	48
3.8	0.015	3.800	34
4.0	0.011	4.000	25
4.5	0.005	4.500	11
5.0	0.000	5.000	0

0.35	1790
0.40	1285
0.45	895
0.50	**643**
0.55	475
0.60	337
0.65	246
0.70	177
0.75	**126**
0.80	92
0.85	67
0.90	48
0.95	34
1.00	**25**
1.05	19
1.10	14
1.15	9
1.20	5
1.25	**0**
1.30	0
1.35	0
1.40	0
1.45	0
1.50	**0**
1.55	0
1.60	0

Sum	1531 cfs-h

Check

Unit Hydrograph (per 1 in. Unit Runoff)	3060.2
Variance	49.98%

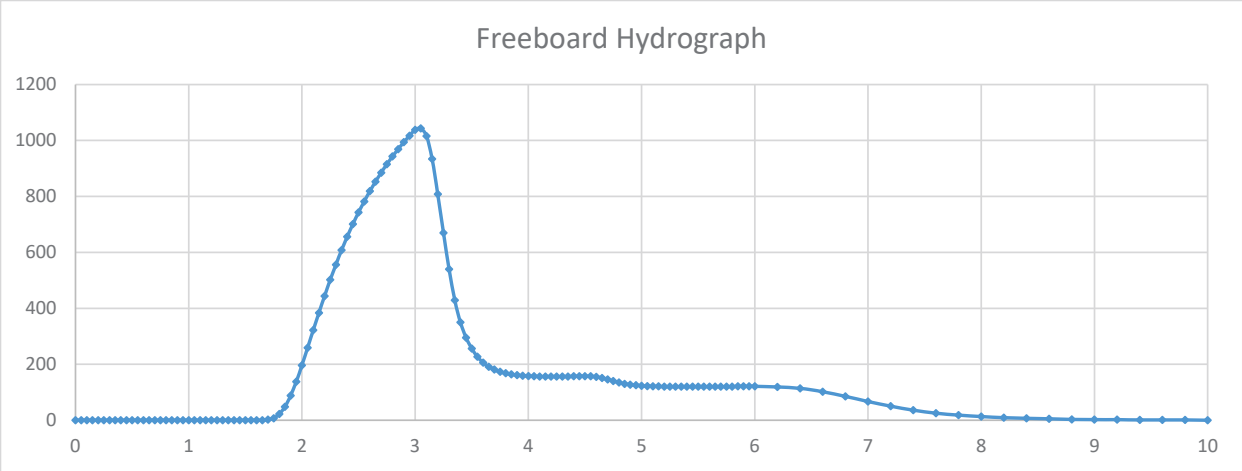
Freeboard Hydrograph

Time (hrs)	Inc. Runoff	q (cfs)	Composite FBH (cfs)
0.0	0.0000	0	0
0.1	0.0000	230	0
0.1	0.0000	711	0
0.2	0.0000	1515	0
0.2	0.0000	2134	0
0.3	0.0000	2295	0
0.3	0.0000	2134	0
0.4	0.0000	1790	0
0.4	0.0000	1285	0
0.5	0.0000	895	0
0.5	0.0000	643	0
0.6	0.0000	475	0
0.6	0.0000	337	0

0.7	0.0000	246	0
0.7	0.0000	177	0
0.8	0.0000	126	0
0.8	0.0000	92	0
0.9	0.0000	67	0
0.9	0.0000	48	0
1.0	0.0000	34	0
1.0	0.0000	25	0
1.1	0.0000	19	0
1.1	0.0000	14	0
1.2	0.0000	9	0
1.2	0.0000	5	0
1.3	0.0000	0	0
1.3	0.0000		0
1.4	0.0000		0
1.4	0.0000		0
1.5	0.0000		0
1.5	0.0000		0
1.6	0.0000		0
1.6	0.0000		0
1.7	0.0004		0
1.7	0.0056		2
1.8	0.0119		7
1.8	0.0175		22
1.9	0.0227		48
1.9	0.0273		88
2.0	0.0316		138
2.0	0.0355		196
2.1	0.0391		259
2.1	0.0424		322
2.2	0.0455		384
2.2	0.0483		444
2.3	0.0509		502
2.3	0.0533		556
2.4	0.0555		608
2.4	0.0576		656
2.5	0.0596		701
2.5	0.0614		743
2.6	0.0631		782
2.6	0.0647		819
2.7	0.0662		853
2.7	0.0676		885
2.8	0.0689		915
2.8	0.0702		943
2.9	0.0714		969
2.9	0.0725		994
3.0	0.0735		1017
3.0	0.0745		1038
3.1	0.0099		1043
3.1	0.0099		1016
3.2	0.0099		934
3.2	0.0099		808
3.3	0.0100		670
3.3	0.0100		540
3.4	0.0100		429

3.4	0.0100		350
3.5	0.0100		295
3.5	0.0100		256
3.6	0.0101		227
3.6	0.0101		206
3.7	0.0101		191
3.7	0.0101		181
3.7	0.0101		173
3.8	0.0101		168
3.8	0.0101		164
3.9	0.0102		161
3.9	0.0102		159
4.0	0.0102		158
4.0	0.0102		157
4.1	0.0102		156
4.1	0.0102		156
4.2	0.0102		156
4.2	0.0103		156
4.3	0.0103		156
4.3	0.0103		156
4.4	0.0103		157
4.4	0.0103		157
4.5	0.0103		157
4.5	0.0077		157
4.6	0.0077		155
4.6	0.0077		151
4.7	0.0078		146
4.7	0.0078		140
4.8	0.0078		135
4.8	0.0078		130
4.9	0.0078		127
4.9	0.0078		125
5.0	0.0078		123
5.0	0.0078		122
5.1	0.0078		121
5.1	0.0078		121
5.2	0.0078		120
5.2	0.0078		120
5.3	0.0078		120
5.3	0.0078		120
5.4	0.0079		120
5.4	0.0079		120
5.5	0.0079		120
5.5	0.0079		120
5.6	0.0079		120
5.6	0.0079		120
5.7	0.0079		120
5.7	0.0079		120
5.8	0.0079		120
5.8	0.0079		121
5.9	0.0079		121
5.9	0.0079		121
6.0	0.0079		121
6.2			119
6.4			114

6.6			102
6.8			85
7.0			67
7.2			50
7.4			36
7.6			25
7.8			18
8.0			13
8.2			9
8.4			7
8.6			5
8.8			3
9.0			2
9.2			2
9.4			1
9.6			1
9.8			1
10.0			0
10.2			0
10.4			0



Results

Peak Hydrograph Flow	1043	cfs
Total Volume	480	ac-ft

ASH-G Hydrograph

Characteristics

Drainage Area	4.742	sq mi	
Time of Concentration	1.58	hr	
Curve Number	77.8		
Structure Hazard Classification	High		
Initial Abstraction	0.57	in	
Maximum Potential Retention	2.85	in	
Precipitation	5.85	in	
ΔD	0.21	hr	<< 0.2-hr time increments are used

5-Point Rainfall Distribution

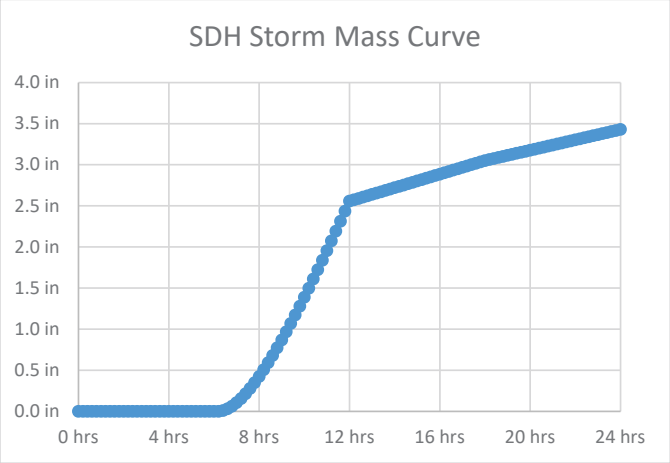
Time Increment	Incremental Rainfall		Rainfall Fractions for Each Time Increment		5 Point Rainfall Distribution	
0 to 6	0.436	in	0.075		0.075	
6 to 12	4.399	in	0.752		0.826	
12 to 18	0.580	in	0.099		0.926	
18 to 24	0.435	in	0.074		1.000	

Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution
0.00	0.000	6.00	0.075	12.00	0.826	18.00	0.926
0.20	0.002	6.20	0.100	12.20	0.830	18.20	0.928
0.40	0.005	6.40	0.125	12.40	0.833	18.40	0.931
0.60	0.007	6.60	0.150	12.60	0.836	18.60	0.933
0.80	0.010	6.80	0.175	12.80	0.840	18.80	0.936
1.00	0.012	7.00	0.200	13.00	0.843	19.00	0.938
1.20	0.015	7.20	0.225	13.20	0.846	19.20	0.941
1.40	0.017	7.40	0.250	13.40	0.850	19.40	0.943
1.60	0.020	7.60	0.275	13.60	0.853	19.60	0.945
1.80	0.022	7.80	0.300	13.80	0.856	19.80	0.948
2.00	0.025	8.00	0.325	14.00	0.860	20.00	0.950
2.20	0.027	8.20	0.350	14.20	0.863	20.20	0.953
2.40	0.030	8.40	0.375	14.40	0.866	20.40	0.955
2.60	0.032	8.60	0.400	14.60	0.869	20.60	0.958
2.80	0.035	8.80	0.425	14.80	0.873	20.80	0.960
3.00	0.037	9.00	0.451	15.00	0.876	21.00	0.963
3.20	0.040	9.20	0.476	15.20	0.879	21.20	0.965
3.40	0.042	9.40	0.501	15.40	0.883	21.40	0.968
3.60	0.045	9.60	0.526	15.60	0.886	21.60	0.970
3.80	0.047	9.80	0.551	15.80	0.889	21.80	0.973
4.00	0.050	10.00	0.576	16.00	0.893	22.00	0.975
4.20	0.052	10.20	0.601	16.20	0.896	22.20	0.978
4.40	0.055	10.40	0.626	16.40	0.899	22.40	0.980
4.60	0.057	10.60	0.651	16.60	0.903	22.60	0.983
4.80	0.060	10.80	0.676	16.80	0.906	22.80	0.985
5.00	0.062	11.00	0.701	17.00	0.909	23.00	0.988
5.20	0.065	11.20	0.726	17.20	0.912	23.20	0.990
5.40	0.067	11.40	0.751	17.40	0.916	23.40	0.993
5.60	0.070	11.60	0.776	17.60	0.919	23.60	0.995
5.80	0.072	11.80	0.801	17.80	0.922	23.80	0.998
						24.00	1.000

Time (hr)	Rainfall Distribution	Total Rainfall (in)	Acc. Mass Curve of Runoff (in)	Inc. Mass Curve of Runoff (in)
0.00	0.000	0.000	0.000	0.000
0.20	0.002	0.015	0.000	0.000
0.40	0.005	0.029	0.000	0.000
0.60	0.007	0.044	0.000	0.000
0.80	0.010	0.058	0.000	0.000
1.00	0.012	0.073	0.000	0.000
1.20	0.015	0.087	0.000	0.000
1.40	0.017	0.102	0.000	0.000
1.60	0.020	0.116	0.000	0.000
1.80	0.022	0.131	0.000	0.000
2.00	0.025	0.145	0.000	0.000
2.20	0.027	0.160	0.000	0.000
2.40	0.030	0.174	0.000	0.000
2.60	0.032	0.189	0.000	0.000
2.80	0.035	0.203	0.000	0.000
3.00	0.037	0.218	0.000	0.000
3.20	0.040	0.233	0.000	0.000
3.40	0.042	0.247	0.000	0.000
3.60	0.045	0.262	0.000	0.000
3.80	0.047	0.276	0.000	0.000
4.00	0.050	0.291	0.000	0.000
4.20	0.052	0.305	0.000	0.000
4.40	0.055	0.320	0.000	0.000
4.60	0.057	0.334	0.000	0.000
4.80	0.060	0.349	0.000	0.000
5.00	0.062	0.363	0.000	0.000
5.20	0.065	0.378	0.000	0.000
5.40	0.067	0.392	0.000	0.000
5.60	0.070	0.407	0.000	0.000
5.80	0.072	0.421	0.000	0.000
6.00	0.075	0.436	0.000	0.000
6.20	0.100	0.583	0.000	0.000
6.40	0.125	0.729	0.008	0.008
6.60	0.150	0.876	0.030	0.021
6.80	0.175	1.023	0.062	0.032
7.00	0.200	1.169	0.104	0.042
7.20	0.225	1.316	0.155	0.051
7.40	0.250	1.462	0.213	0.058
7.60	0.275	1.609	0.278	0.065
7.80	0.300	1.756	0.348	0.071
8.00	0.325	1.902	0.424	0.076
8.20	0.350	2.049	0.505	0.081
8.40	0.375	2.196	0.590	0.085
8.60	0.400	2.342	0.680	0.089
8.80	0.425	2.489	0.772	0.093
9.00	0.451	2.636	0.868	0.096
9.20	0.476	2.782	0.967	0.099
9.40	0.501	2.929	1.068	0.101
9.60	0.526	3.075	1.172	0.104
9.80	0.551	3.222	1.278	0.106
10.00	0.576	3.369	1.387	0.108

10.20	0.601	3.515	1.497	0.110
10.40	0.626	3.662	1.609	0.112
10.60	0.651	3.809	1.723	0.114
10.80	0.676	3.955	1.838	0.115
11.00	0.701	4.102	1.955	0.117
11.20	0.726	4.248	2.073	0.118
11.40	0.751	4.395	2.192	0.119
11.60	0.776	4.542	2.312	0.120
11.80	0.801	4.688	2.434	0.122
12.00	0.826	4.835	2.557	0.123
12.20	0.830	4.854	2.573	0.016
12.40	0.833	4.874	2.589	0.016
12.60	0.836	4.893	2.605	0.016
12.80	0.840	4.912	2.622	0.016
13.00	0.843	4.932	2.638	0.016
13.20	0.846	4.951	2.654	0.016
13.40	0.850	4.970	2.671	0.016
13.60	0.853	4.990	2.687	0.016
13.80	0.856	5.009	2.703	0.016
14.00	0.860	5.028	2.720	0.016
14.20	0.863	5.048	2.736	0.016
14.40	0.866	5.067	2.753	0.016
14.60	0.869	5.086	2.769	0.016
14.80	0.873	5.106	2.785	0.016
15.00	0.876	5.125	2.802	0.016
15.20	0.879	5.144	2.818	0.016
15.40	0.883	5.164	2.835	0.016
15.60	0.886	5.183	2.851	0.017
15.80	0.889	5.202	2.868	0.017
16.00	0.893	5.222	2.884	0.017
16.20	0.896	5.241	2.901	0.017
16.40	0.899	5.260	2.918	0.017
16.60	0.903	5.280	2.934	0.017
16.80	0.906	5.299	2.951	0.017
17.00	0.909	5.318	2.967	0.017
17.20	0.912	5.338	2.984	0.017
17.40	0.916	5.357	3.001	0.017
17.60	0.919	5.376	3.017	0.017
17.80	0.922	5.396	3.034	0.017
18.00	0.926	5.415	3.051	0.017
18.20	0.928	5.430	3.063	0.013
18.40	0.931	5.444	3.076	0.013
18.60	0.933	5.459	3.088	0.013
18.80	0.936	5.473	3.101	0.013
19.00	0.938	5.488	3.113	0.013
19.20	0.941	5.502	3.126	0.013
19.40	0.943	5.517	3.138	0.013
19.60	0.945	5.531	3.151	0.013
19.80	0.948	5.546	3.163	0.013
20.00	0.950	5.560	3.176	0.013
20.20	0.953	5.575	3.189	0.013
20.40	0.955	5.589	3.201	0.013
20.60	0.958	5.604	3.214	0.013
20.80	0.960	5.618	3.226	0.013
21.00	0.963	5.633	3.239	0.013
21.20	0.965	5.647	3.252	0.013

21.40	0.968	5.662	3.264	0.013
21.60	0.970	5.676	3.277	0.013
21.80	0.973	5.691	3.290	0.013
22.00	0.975	5.705	3.302	0.013
22.20	0.978	5.720	3.315	0.013
22.40	0.980	5.734	3.328	0.013
22.60	0.983	5.749	3.340	0.013
22.80	0.985	5.763	3.353	0.013
23.00	0.988	5.778	3.366	0.013
23.20	0.990	5.792	3.378	0.013
23.40	0.993	5.807	3.391	0.013
23.60	0.995	5.821	3.404	0.013
23.80	0.998	5.836	3.416	0.013
24.00	1.000	5.850	3.429	0.013



Unit Hydrograph

Unit Storm Duration

ΔD 0.21 << 0.2-hr time increments are used

Time to Peak

Tp 1.05 << rounded to 1.0 hr

Unit Hydrograph Peak Discharge

qp 2295

Time Ratio	Discharge Ratio	Time (hr)	q (cfs)
0.0	0.000	0.000	0
0.1	0.030	0.100	69
0.2	0.100	0.200	230
0.3	0.190	0.300	436
0.4	0.310	0.400	711
0.5	0.470	0.500	1079
0.6	0.660	0.600	1515
0.7	0.820	0.700	1882
0.8	0.930	0.800	2134
0.9	0.990	0.900	2272
1.0	1.000	1.000	2295
1.1	0.990	1.100	2272

Time (hr)	q (cfs)
0	**0**
0.20	230
0.40	711
0.60	1515
0.80	2134
1.00	**2295**
1.20	2134
1.40	1790
1.60	1285
1.80	895
2.00	**643**
2.20	475

1.2	0.930	1.200	2134
1.3	0.860	1.300	1974
1.4	0.780	1.400	1790
1.5	0.680	1.500	1561
1.6	0.560	1.600	1285
1.7	0.460	1.700	1056
1.8	0.390	1.800	895
1.9	0.330	1.900	757
2.0	0.280	2.000	643
2.2	0.207	2.200	475
2.4	0.147	2.400	337
2.6	0.107	2.600	246
2.8	0.077	2.800	177
3.0	0.055	3.000	126
3.2	0.040	3.200	92
3.4	0.029	3.400	67
3.6	0.021	3.600	48
3.8	0.015	3.800	34
4.0	0.011	4.000	25
4.5	0.005	4.500	11
5.0	0.000	5.000	0

2.40	337
2.60	246
2.80	177
3.00	**126**
3.20	92
3.40	67
3.60	48
3.80	34
4.00	**25**
4.20	19
4.40	14
4.60	9
4.80	5
5.00	**0**
5.20	0
5.40	0
5.60	0
5.80	0
6.00	**0**
6.20	0
6.40	0

Sum	3061 cfs-h

Check

Unit Hydrograph (per 1 in. Unit Runoff)	3060.2
Variance	-0.04%

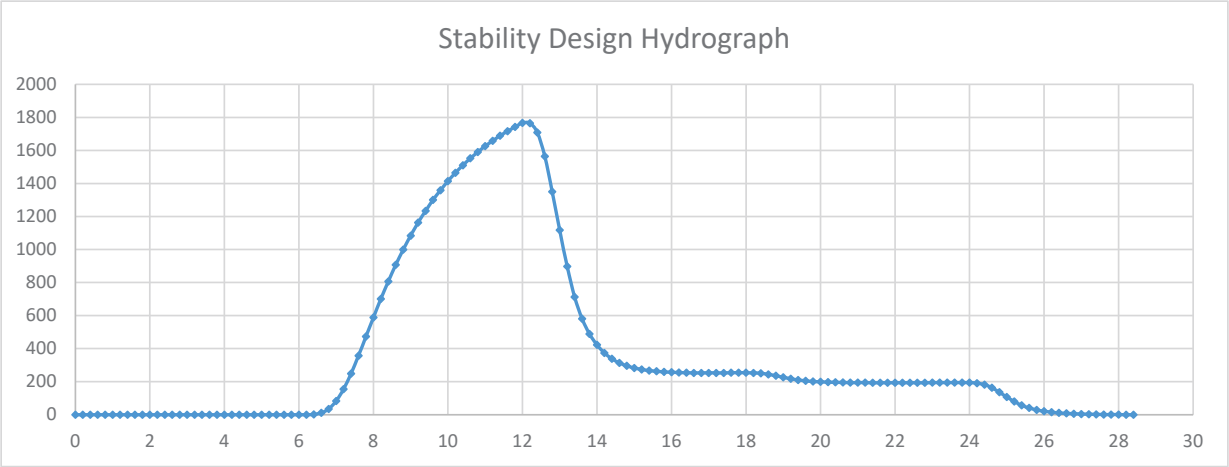
Stability Design Hydrograph

Time (hrs)	Inc. Runoff	q (cfs)	Composite SDH (cfs)
0.0	0.0000	0	0
0.2	0.0000	230	0
0.4	0.0000	711	0
0.6	0.0000	1515	0
0.8	0.0000	2134	0
1.0	0.0000	2295	0
1.2	0.0000	2134	0
1.4	0.0000	1790	0
1.6	0.0000	1285	0
1.8	0.0000	895	0
2.0	0.0000	643	0
2.2	0.0000	475	0
2.4	0.0000	337	0
2.6	0.0000	246	0
2.8	0.0000	177	0
3.0	0.0000	126	0
3.2	0.0000	92	0
3.4	0.0000	67	0
3.6	0.0000	48	0
3.8	0.0000	34	0
4.0	0.0000	25	0
4.2	0.0000	19	0
4.4	0.0000	14	0
4.6	0.0000	9	0

4.8	0.0000	5	0
5.0	0.0000	0	0
5.2	0.0000		0
5.4	0.0000		0
5.6	0.0000		0
5.8	0.0000		0
6.0	0.0000		0
6.2	0.0001		0
6.4	0.0084		2
6.6	0.0212		11
6.8	0.0324		35
7.0	0.0421		83
7.2	0.0506		155
7.4	0.0581		249
7.6	0.0648		357
7.8	0.0707		473
8.0	0.0761		589
8.2	0.0808		701
8.4	0.0852		807
8.6	0.0891		907
8.8	0.0926		999
9.0	0.0958		1084
9.2	0.0988		1163
9.4	0.1015		1234
9.6	0.1039		1300
9.8	0.1062		1359
10.0	0.1083		1414
10.2	0.1103		1464
10.4	0.1120		1510
10.6	0.1137		1552
10.8	0.1153		1590
11.0	0.1167		1626
11.2	0.1180		1658
11.4	0.1193		1689
11.6	0.1205		1716
11.8	0.1216		1742
12.0	0.1226		1766
12.2	0.0162		1764
12.4	0.0163		1708
12.6	0.0163		1564
12.8	0.0163		1350
13.0	0.0163		1117
13.2	0.0163		898
13.4	0.0163		713
13.6	0.0164		581
13.8	0.0164		489
14.0	0.0164		423
14.2	0.0164		374
14.4	0.0164		339
14.6	0.0164		314
14.8	0.0164		296
15.0	0.0165		283
15.2	0.0165		274
15.4	0.0165		267
15.6	0.0165		263
15.8	0.0165		259

16.0	0.0165		257
16.2	0.0166		255
16.4	0.0166		254
16.6	0.0166		253
16.8	0.0166		253
17.0	0.0166		253
17.2	0.0166		253
17.4	0.0166		253
17.6	0.0166		254
17.8	0.0167		254
18.0	0.0167		254
18.2	0.0125		253
18.4	0.0125		251
18.6	0.0125		244
18.8	0.0125		236
19.0	0.0125		226
19.2	0.0126		218
19.4	0.0126		210
19.6	0.0126		205
19.8	0.0126		201
20.0	0.0126		199
20.2	0.0126		197
20.4	0.0126		196
20.6	0.0126		195
20.8	0.0126		194
21.0	0.0126		194
21.2	0.0126		194
21.4	0.0126		193
21.6	0.0126		193
21.8	0.0126		193
22.0	0.0126		193
22.2	0.0127		193
22.4	0.0127		193
22.6	0.0127		193
22.8	0.0127		193
23.0	0.0127		194
23.2	0.0127		194
23.4	0.0127		194
23.6	0.0127		194
23.8	0.0127		194
24.0	0.0127		194
24.2			191
24.4			182
24.6			163
24.8			136
25.0			107
25.2			80
25.4			57
25.6			41
25.8			29
26.0			21
26.2			15
26.4			11
26.6			8
26.8			6
27.0			4

27.2			3
27.4			2
27.6			1
27.8			1
28.0			1
28.2			0
28.4			0



Results

Peak Hydrograph Flow	1766 cfs
Total Volume	868 ac-ft

FBH-L Hydrograph

Characteristics

Drainage Area	4.742	sq mi
Time of Concentration	1.58	hr
Curve Number	77.8	
Structure Hazard Classification	High	
Initial Abstraction	0.57	in
Maximum Potential Retention	2.85	in
$PMP_{6\text{-}hr}$	7.67	in
$PMP_{12\text{-}hr}$	8.68	in
$PMP_{24\text{-}hr}$	10.2	in
$PMP_{72\text{-}hr}$	12.5	in
ΔD	0.05	hr

5-Point Rainfall Distribution

Time Increment	Incremental Rainfall	Rainfall Fractions for Each Time Increment		5 Point Rainfall Distribution	
0 to 1.5	0.57 in	0.074		0.074	
1.5 to 3	5.77 in	0.752		0.827	
2 to 4.5	0.76 in	0.099		0.926	
4.5 to 6	0.57 in	0.074		1.000	

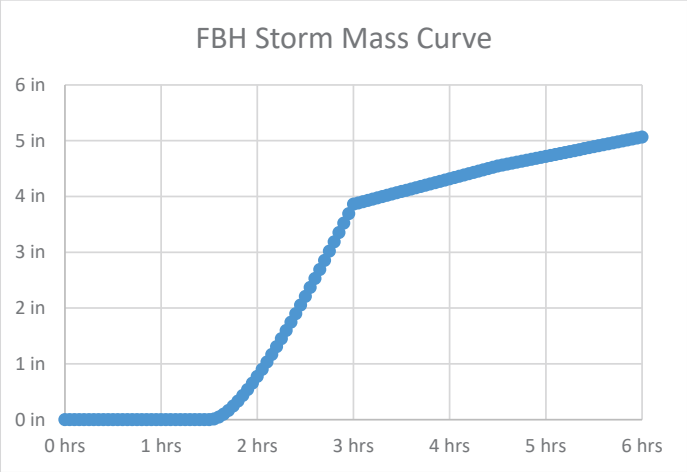
Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution
0.00	0.000	1.50	0.074	3.00	0.827	4.50	0.926
0.05	0.002	1.55	0.099	3.05	0.830	4.55	0.928
0.10	0.005	1.60	0.124	3.10	0.833	4.60	0.931
0.15	0.007	1.65	0.150	3.15	0.837	4.65	0.933
0.20	0.010	1.70	0.175	3.20	0.840	4.70	0.936
0.25	0.012	1.75	0.200	3.25	0.843	4.75	0.938
0.30	0.015	1.80	0.225	3.30	0.846	4.80	0.941
0.35	0.017	1.85	0.250	3.35	0.850	4.85	0.943
0.40	0.020	1.90	0.275	3.40	0.853	4.90	0.946
0.45	0.022	1.95	0.300	3.45	0.856	4.95	0.948
0.50	0.025	2.00	0.325	3.50	0.860	5.00	0.950
0.55	0.027	2.05	0.350	3.55	0.863	5.05	0.953
0.60	0.030	2.10	0.375	3.60	0.866	5.10	0.955
0.65	0.032	2.15	0.400	3.65	0.870	5.15	0.958
0.70	0.035	2.20	0.425	3.70	0.873	5.20	0.960
0.75	0.037	2.25	0.450	3.75	0.876	5.25	0.963
0.80	0.040	2.30	0.476	3.80	0.879	5.30	0.965
0.85	0.042	2.35	0.501	3.85	0.883	5.35	0.968
0.90	0.045	2.40	0.526	3.90	0.886	5.40	0.970
0.95	0.047	2.45	0.551	3.95	0.889	5.45	0.973
1.00	0.050	2.50	0.576	4.00	0.893	5.50	0.975
1.05	0.052	2.55	0.601	4.05	0.896	5.55	0.978
1.10	0.054	2.60	0.626	4.10	0.899	5.60	0.980
1.15	0.057	2.65	0.651	4.15	0.903	5.65	0.983
1.20	0.059	2.70	0.676	4.20	0.906	5.70	0.985
1.25	0.062	2.75	0.701	4.25	0.909	5.75	0.988
1.30	0.064	2.80	0.726	4.30	0.912	5.80	0.990

1.35	0.067	2.85	0.751	4.35	0.916	5.85	0.993
1.40	0.069	2.90	0.776	4.40	0.919	5.90	0.995
1.45	0.072	2.95	0.802	4.45	0.922	5.95	0.998
						6.00	1.000

Time (hr)	Rainfall Distribution	Total Rainfall (in)	Acc. Mass Curve of Runoff (in)	Inc. Mass Curve of Runoff (in)
0.00	0.000	0.000	0.000	0.000
0.05	0.002	0.019	0.000	0.000
0.10	0.005	0.038	0.000	0.000
0.15	0.007	0.057	0.000	0.000
0.20	0.010	0.076	0.000	0.000
0.25	0.012	0.095	0.000	0.000
0.30	0.015	0.114	0.000	0.000
0.35	0.017	0.133	0.000	0.000
0.40	0.020	0.152	0.000	0.000
0.45	0.022	0.171	0.000	0.000
0.50	0.025	0.190	0.000	0.000
0.55	0.027	0.209	0.000	0.000
0.60	0.030	0.228	0.000	0.000
0.65	0.032	0.247	0.000	0.000
0.70	0.035	0.266	0.000	0.000
0.75	0.037	0.285	0.000	0.000
0.80	0.040	0.304	0.000	0.000
0.85	0.042	0.323	0.000	0.000
0.90	0.045	0.342	0.000	0.000
0.95	0.047	0.361	0.000	0.000
1.00	0.050	0.380	0.000	0.000
1.05	0.052	0.399	0.000	0.000
1.10	0.054	0.418	0.000	0.000
1.15	0.057	0.437	0.000	0.000
1.20	0.059	0.456	0.000	0.000
1.25	0.062	0.475	0.000	0.000
1.30	0.064	0.494	0.000	0.000
1.35	0.067	0.513	0.000	0.000
1.40	0.069	0.532	0.000	0.000
1.45	0.072	0.551	0.000	0.000
1.50	0.074	0.570	0.000	0.000
1.55	0.099	0.762	0.012	0.012
1.60	0.124	0.955	0.046	0.034
1.65	0.150	1.147	0.097	0.051
1.70	0.175	1.339	0.164	0.066
1.75	0.200	1.532	0.243	0.079
1.80	0.225	1.724	0.333	0.090
1.85	0.250	1.916	0.432	0.099
1.90	0.275	2.109	0.539	0.108
1.95	0.300	2.301	0.654	0.115
2.00	0.325	2.493	0.775	0.121
2.05	0.350	2.686	0.901	0.126
2.10	0.375	2.878	1.033	0.131
2.15	0.400	3.070	1.168	0.136
2.20	0.425	3.263	1.308	0.140
2.25	0.450	3.455	1.451	0.143
2.30	0.476	3.647	1.598	0.146
2.35	0.501	3.840	1.747	0.149

2.40	0.526	4.032	1.899	0.152
2.45	0.551	4.224	2.053	0.154
2.50	0.576	4.417	2.210	0.156
2.55	0.601	4.609	2.368	0.158
2.60	0.626	4.801	2.528	0.160
2.65	0.651	4.994	2.690	0.162
2.70	0.676	5.186	2.854	0.164
2.75	0.701	5.378	3.019	0.165
2.80	0.726	5.571	3.185	0.166
2.85	0.751	5.763	3.353	0.168
2.90	0.776	5.955	3.522	0.169
2.95	0.802	6.148	3.691	0.170
3.00	0.827	6.340	3.862	0.171
3.05	0.830	6.365	3.885	0.023
3.10	0.833	6.391	3.907	0.023
3.15	0.837	6.416	3.930	0.023
3.20	0.840	6.441	3.953	0.023
3.25	0.843	6.467	3.975	0.023
3.30	0.846	6.492	3.998	0.023
3.35	0.850	6.517	4.021	0.023
3.40	0.853	6.543	4.043	0.023
3.45	0.856	6.568	4.066	0.023
3.50	0.860	6.593	4.089	0.023
3.55	0.863	6.619	4.111	0.023
3.60	0.866	6.644	4.134	0.023
3.65	0.870	6.669	4.157	0.023
3.70	0.873	6.695	4.180	0.023
3.75	0.876	6.720	4.203	0.023
3.80	0.879	6.745	4.225	0.023
3.85	0.883	6.771	4.248	0.023
3.90	0.886	6.796	4.271	0.023
3.95	0.889	6.821	4.294	0.023
4.00	0.893	6.847	4.317	0.023
4.05	0.896	6.872	4.340	0.023
4.10	0.899	6.897	4.362	0.023
4.15	0.903	6.923	4.385	0.023
4.20	0.906	6.948	4.408	0.023
4.25	0.909	6.973	4.431	0.023
4.30	0.912	6.999	4.454	0.023
4.35	0.916	7.024	4.477	0.023
4.40	0.919	7.049	4.500	0.023
4.45	0.922	7.075	4.523	0.023
4.50	0.926	7.100	4.546	0.023
4.55	0.928	7.119	4.563	0.017
4.60	0.931	7.138	4.580	0.017
4.65	0.933	7.157	4.598	0.017
4.70	0.936	7.176	4.615	0.017
4.75	0.938	7.195	4.632	0.017
4.80	0.941	7.214	4.650	0.017
4.85	0.943	7.233	4.667	0.017
4.90	0.946	7.252	4.684	0.017
4.95	0.948	7.271	4.701	0.017
5.00	0.950	7.290	4.719	0.017
5.05	0.953	7.309	4.736	0.017
5.10	0.955	7.328	4.753	0.017

5.15	0.958	7.347	4.771	0.017
5.20	0.960	7.366	4.788	0.017
5.25	0.963	7.385	4.805	0.017
5.30	0.965	7.404	4.823	0.017
5.35	0.968	7.423	4.840	0.017
5.40	0.970	7.442	4.857	0.017
5.45	0.973	7.461	4.875	0.017
5.50	0.975	7.480	4.892	0.017
5.55	0.978	7.499	4.910	0.017
5.60	0.980	7.518	4.927	0.017
5.65	0.983	7.537	4.944	0.017
5.70	0.985	7.556	4.962	0.017
5.75	0.988	7.575	4.979	0.017
5.80	0.990	7.594	4.997	0.017
5.85	0.993	7.613	5.014	0.017
5.90	0.995	7.632	5.031	0.017
5.95	0.998	7.651	5.049	0.017
6.00	1.000	7.670	5.066	0.017



Unit Hydrograph

Unit Storm Duration

ΔD 0.05

Time to Peak

Tp 0.99 << rounded to 1.0 hr

Unit Hydrograph Peak Discharge

qp 2295

Time Ratio	Discharge Ratio	Time (hr)	q (cfs)
0.0	0.000	0.000	0
0.1	0.030	0.100	69
0.2	0.100	0.200	230
0.3	0.190	0.300	436
0.4	0.310	0.400	711
0.5	0.470	0.500	1079
0.6	0.660	0.600	1515
0.7	0.820	0.700	1882
0.8	0.930	0.800	2134
0.9	0.990	0.900	2272
1.0	1.000	1.000	2295
1.1	0.990	1.100	2272
1.2	0.930	1.200	2134
1.3	0.860	1.300	1974
1.4	0.780	1.400	1790
1.5	0.680	1.500	1561
1.6	0.560	1.600	1285
1.7	0.460	1.700	1056
1.8	0.390	1.800	895
1.9	0.330	1.900	757
2.0	0.280	2.000	643
2.2	0.207	2.200	475
2.4	0.147	2.400	337
2.6	0.107	2.600	246
2.8	0.077	2.800	177
3.0	0.055	3.000	126
3.2	0.040	3.200	92
3.4	0.029	3.400	67
3.6	0.021	3.600	48
3.8	0.015	3.800	34
4.0	0.011	4.000	25
4.5	0.005	4.500	11
5.0	0.000	5.000	0

Time (hr)	q (cfs)
0	**0**
0.05	230
0.10	711
0.15	1515
0.20	2134
0.25	**2295**
0.30	2134
0.35	1790
0.40	1285
0.45	895
0.50	**643**
0.55	475
0.60	337
0.65	246
0.70	177
0.75	**126**
0.80	92
0.85	67
0.90	48
0.95	34
1.00	**25**
1.05	19
1.10	14
1.15	9
1.20	5
1.25	**0**
1.30	0
1.35	0
1.40	0
1.45	0
1.50	**0**
1.55	0
1.60	0

Sum	1531 cfs-h

Check

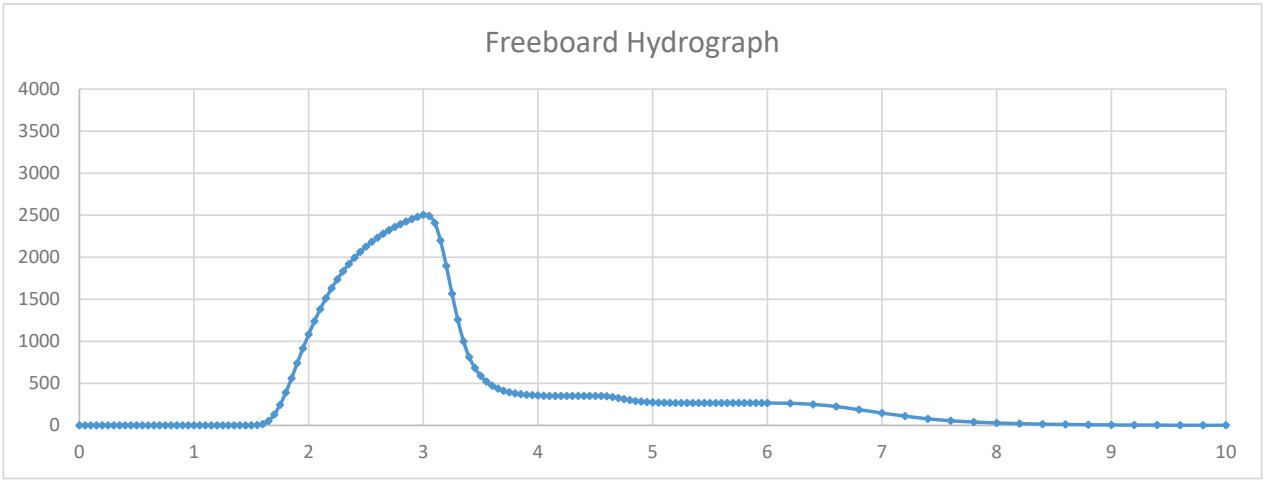
Unit Hydrograph (per 1 in. Unit Runoff)	3060.2
Variance	49.98%

Freeboard Hydrograph

Time (hrs)	Inc. Runoff	q (cfs)	Composite FBH (cfs)
0.0	0.0000	0	0
0.1	0.0000	230	0
0.1	0.0000	711	0
0.2	0.0000	1515	0
0.2	0.0000	2134	0
0.3	0.0000	2295	0
0.3	0.0000	2134	0
0.4	0.0000	1790	0
0.4	0.0000	1285	0
0.5	0.0000	895	0
0.5	0.0000	643	0
0.6	0.0000	475	0
0.6	0.0000	337	0
0.7	0.0000	246	0
0.7	0.0000	177	0
0.8	0.0000	126	0
0.8	0.0000	92	0
0.9	0.0000	67	0
0.9	0.0000	48	0
1.0	0.0000	34	0
1.0	0.0000	25	0
1.1	0.0000	19	0
1.1	0.0000	14	0
1.2	0.0000	9	0
1.2	0.0000	5	0
1.3	0.0000	0	0
1.3	0.0000		0
1.4	0.0000		0
1.4	0.0000		0
1.5	0.0000		0
1.5	0.0000		0
1.6	0.0122		3
1.6	0.0336		16
1.7	0.0514		54
1.7	0.0664		129
1.8	0.0791		243
1.8	0.0900		390
1.9	0.0994		560
1.9	0.1075		738
2.0	0.1146		915
2.0	0.1209		1082
2.1	0.1264		1238
2.1	0.1313		1382
2.2	0.1357		1512
2.2	0.1397		1630
2.3	0.1432		1736
2.3	0.1464		1832

2.4	0.1493		1918
2.4	0.1519		1995
2.5	0.1543		2064
2.5	0.1565		2126
2.6	0.1585		2182
2.6	0.1603		2233
2.7	0.1620		2279
2.7	0.1636		2321
2.8	0.1650		2359
2.8	0.1663		2393
2.9	0.1676		2425
2.9	0.1687		2453
3.0	0.1698		2480
3.0	0.1708		2504
3.1	0.0226		2492
3.1	0.0226		2407
3.2	0.0226		2199
3.2	0.0226		1897
3.3	0.0226		1567
3.3	0.0227		1258
3.4	0.0227		999
3.4	0.0227		812
3.5	0.0227		683
3.5	0.0227		590
3.6	0.0227		521
3.6	0.0227		472
3.7	0.0228		437
3.7	0.0228		411
3.7	0.0228		393
3.8	0.0228		380
3.8	0.0228		371
3.9	0.0228		364
3.9	0.0228		359
4.0	0.0229		356
4.0	0.0229		353
4.1	0.0229		351
4.1	0.0229		350
4.2	0.0229		350
4.2	0.0229		350
4.3	0.0229		350
4.3	0.0229		350

4.4	0.0230		350
4.4	0.0230		351
4.5	0.0230		351
4.5	0.0172		350
4.6	0.0173		346
4.6	0.0173		337
4.7	0.0173		325
4.7	0.0173		312
4.8	0.0173		300
4.8	0.0173		290
4.9	0.0173		283
4.9	0.0173		278
5.0	0.0173		274
5.0	0.0173		271
5.1	0.0173		270
5.1	0.0173		268
5.2	0.0173		267
5.2	0.0173		267
5.3	0.0174		266
5.3	0.0174		266
5.4	0.0174		266
5.4	0.0174		266
5.5	0.0174		266
5.5	0.0174		266
5.6	0.0174		266
5.6	0.0174		266
5.7	0.0174		266
5.7	0.0174		266
5.8	0.0174		266
5.8	0.0174		266
5.9	0.0174		266
5.9	0.0174		266
6.0	0.0174		266
6.2			262
6.4			250
6.6			224
6.8			187
7.0			147
7.2			110
7.4			78
7.6			56
7.8			40
8.0			29
8.2			21
8.4			15
8.6			11
8.8			8
9.0			5
9.2			4
9.4			3
9.6			2
9.8			1
10.0			1
10.2			0
10.4			0



Results

Peak Hydrograph Flow	2504 cfs
Total Volume	1282 ac-ft

FBH-G Hydrograph

Characteristics

Drainage Area	4.742	sq mi	
Time of Concentration	1.58	hr	
Curve Number	77.8		
Structure Hazard Classification	High		
Initial Abstraction	0.57	in	
Maximum Potential Retention	2.85	in	
$PMP_{6\text{-hr}}$	7.67	in	
$PMP_{12\text{-hr}}$	8.68	in	
$PMP_{24\text{-hr}}$	10.2	in	
$PMP_{72\text{-hr}}$	12.5	in	
ΔD	0.21	hr	<< 0.2-hr time increments are used

5-Point Rainfall Distribution

Time Increment	Incremental Rainfall	Rainfall Fractions for Each Time Increment		5 Point Rainfall Distribution	
0 to 6	0.76 in	0.075		0.075	
6 to 12	7.67 in	0.752		0.826	
12 to 18	1.01 in	0.099		0.925	
18 to 24	0.76 in	0.075		1.000	

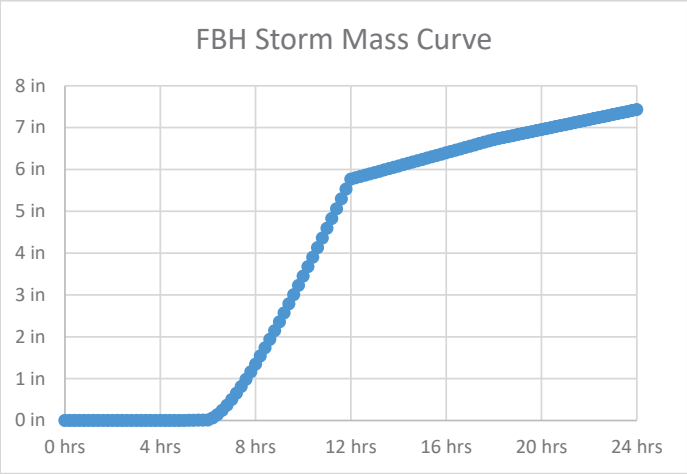
Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution
0.00	0.000	6.00	0.075	12.00	0.826	18.00	0.925
0.20	0.002	6.20	0.100	12.20	0.830	18.20	0.928
0.40	0.005	6.40	0.125	12.40	0.833	18.40	0.930
0.60	0.007	6.60	0.150	12.60	0.836	18.60	0.933
0.80	0.010	6.80	0.175	12.80	0.840	18.80	0.935
1.00	0.012	7.00	0.200	13.00	0.843	19.00	0.938
1.20	0.015	7.20	0.225	13.20	0.846	19.20	0.940
1.40	0.017	7.40	0.250	13.40	0.850	19.40	0.943
1.60	0.020	7.60	0.275	13.60	0.853	19.60	0.945
1.80	0.022	7.80	0.300	13.80	0.856	19.80	0.948
2.00	0.025	8.00	0.325	14.00	0.859	20.00	0.950
2.20	0.027	8.20	0.350	14.20	0.863	20.20	0.953
2.40	0.030	8.40	0.375	14.40	0.866	20.40	0.955
2.60	0.032	8.60	0.400	14.60	0.869	20.60	0.958
2.80	0.035	8.80	0.425	14.80	0.873	20.80	0.960
3.00	0.037	9.00	0.450	15.00	0.876	21.00	0.963
3.20	0.040	9.20	0.476	15.20	0.879	21.20	0.965
3.40	0.042	9.40	0.501	15.40	0.883	21.40	0.968
3.60	0.045	9.60	0.526	15.60	0.886	21.60	0.970
3.80	0.047	9.80	0.551	15.80	0.889	21.80	0.973
4.00	0.050	10.00	0.576	16.00	0.892	22.00	0.975
4.20	0.052	10.20	0.601	16.20	0.896	22.20	0.978
4.40	0.055	10.40	0.626	16.40	0.899	22.40	0.980
4.60	0.057	10.60	0.651	16.60	0.902	22.60	0.983
4.80	0.060	10.80	0.676	16.80	0.906	22.80	0.985
5.00	0.062	11.00	0.701	17.00	0.909	23.00	0.988
5.20	0.065	11.20	0.726	17.20	0.912	23.20	0.990

5.40	0.067	11.40	0.751	17.40	0.916	23.40	0.993
5.60	0.070	11.60	0.776	17.60	0.919	23.60	0.995
5.80	0.072	11.80	0.801	17.80	0.922	23.80	0.998
						24.00	1.000

Time (hr)	Rainfall Distribution	Total Rainfall (in)	Acc. Mass Curve of Runoff (in)	Inc. Mass Curve of Runoff (in)
0.00	0.000	0.000	0.000	0.000
0.20	0.002	0.025	0.000	0.000
0.40	0.005	0.051	0.000	0.000
0.60	0.007	0.076	0.000	0.000
0.80	0.010	0.101	0.000	0.000
1.00	0.012	0.127	0.000	0.000
1.20	0.015	0.152	0.000	0.000
1.40	0.017	0.177	0.000	0.000
1.60	0.020	0.203	0.000	0.000
1.80	0.022	0.228	0.000	0.000
2.00	0.025	0.253	0.000	0.000
2.20	0.027	0.279	0.000	0.000
2.40	0.030	0.304	0.000	0.000
2.60	0.032	0.329	0.000	0.000
2.80	0.035	0.355	0.000	0.000
3.00	0.037	0.380	0.000	0.000
3.20	0.040	0.405	0.000	0.000
3.40	0.042	0.431	0.000	0.000
3.60	0.045	0.456	0.000	0.000
3.80	0.047	0.481	0.000	0.000
4.00	0.050	0.507	0.000	0.000
4.20	0.052	0.532	0.000	0.000
4.40	0.055	0.557	0.000	0.000
4.60	0.057	0.583	0.000	0.000
4.80	0.060	0.608	0.001	0.000
5.00	0.062	0.633	0.001	0.001
5.20	0.065	0.659	0.003	0.001
5.40	0.067	0.684	0.004	0.002
5.60	0.070	0.709	0.006	0.002
5.80	0.072	0.735	0.009	0.003
6.00	0.075	0.760	0.012	0.003
6.20	0.100	1.016	0.060	0.048
6.40	0.125	1.271	0.139	0.078
6.60	0.150	1.527	0.241	0.102
6.80	0.175	1.783	0.362	0.121
7.00	0.200	2.038	0.499	0.137
7.20	0.225	2.294	0.650	0.151
7.40	0.250	2.550	0.811	0.162
7.60	0.275	2.805	0.983	0.171
7.80	0.300	3.061	1.162	0.179
8.00	0.325	3.317	1.348	0.186
8.20	0.350	3.572	1.540	0.192
8.40	0.375	3.828	1.738	0.198
8.60	0.400	4.084	1.940	0.202

8.80	0.425	4.339	2.146	0.206
9.00	0.450	4.595	2.356	0.210
9.20	0.476	4.851	2.570	0.213
9.40	0.501	5.106	2.786	0.216
9.60	0.526	5.362	3.005	0.219
9.80	0.551	5.618	3.226	0.221
10.00	0.576	5.873	3.450	0.223
10.20	0.601	6.129	3.675	0.225
10.40	0.626	6.385	3.902	0.227
10.60	0.651	6.640	4.131	0.229
10.80	0.676	6.896	4.361	0.230
11.00	0.701	7.152	4.593	0.232
11.20	0.726	7.407	4.826	0.233
11.40	0.751	7.663	5.060	0.234
11.60	0.776	7.919	5.295	0.235
11.80	0.801	8.174	5.531	0.236
12.00	0.826	8.430	5.768	0.237
12.20	0.830	8.464	5.800	0.031
12.40	0.833	8.497	5.831	0.031
12.60	0.836	8.531	5.862	0.031
12.80	0.840	8.565	5.894	0.031
13.00	0.843	8.598	5.925	0.031
13.20	0.846	8.632	5.956	0.031
13.40	0.850	8.666	5.988	0.031
13.60	0.853	8.699	6.019	0.031
13.80	0.856	8.733	6.051	0.031
14.00	0.859	8.767	6.082	0.031
14.20	0.863	8.800	6.113	0.031
14.40	0.866	8.834	6.145	0.031
14.60	0.869	8.868	6.176	0.031
14.80	0.873	8.901	6.208	0.031
15.00	0.876	8.935	6.239	0.031
15.20	0.879	8.969	6.271	0.031
15.40	0.883	9.002	6.302	0.032
15.60	0.886	9.036	6.334	0.032
15.80	0.889	9.070	6.365	0.032
16.00	0.892	9.103	6.397	0.032
16.20	0.896	9.137	6.428	0.032
16.40	0.899	9.171	6.460	0.032
16.60	0.902	9.204	6.492	0.032
16.80	0.906	9.238	6.523	0.032
17.00	0.909	9.272	6.555	0.032
17.20	0.912	9.305	6.586	0.032
17.40	0.916	9.339	6.618	0.032
17.60	0.919	9.373	6.650	0.032
17.80	0.922	9.406	6.681	0.032
18.00	0.925	9.440	6.713	0.032
18.20	0.928	9.465	6.737	0.024
18.40	0.930	9.491	6.761	0.024
18.60	0.933	9.516	6.785	0.024
18.80	0.935	9.541	6.808	0.024
19.00	0.938	9.567	6.832	0.024
19.20	0.940	9.592	6.856	0.024
19.40	0.943	9.617	6.880	0.024
19.60	0.945	9.643	6.904	0.024

19.80	0.948	9.668	6.928	0.024
20.00	0.950	9.693	6.952	0.024
20.20	0.953	9.719	6.976	0.024
20.40	0.955	9.744	7.000	0.024
20.60	0.958	9.769	7.023	0.024
20.80	0.960	9.795	7.047	0.024
21.00	0.963	9.820	7.071	0.024
21.20	0.965	9.845	7.095	0.024
21.40	0.968	9.871	7.119	0.024
21.60	0.970	9.896	7.143	0.024
21.80	0.973	9.921	7.167	0.024
22.00	0.975	9.947	7.191	0.024
22.20	0.978	9.972	7.215	0.024
22.40	0.980	9.997	7.239	0.024
22.60	0.983	10.023	7.263	0.024
22.80	0.985	10.048	7.287	0.024
23.00	0.988	10.073	7.311	0.024
23.20	0.990	10.099	7.335	0.024
23.40	0.993	10.124	7.359	0.024
23.60	0.995	10.149	7.383	0.024
23.80	0.998	10.175	7.407	0.024
24.00	1.000	10.200	7.431	0.024



Unit Hydrograph

Unit Storm Duration

ΔD — 0.21 << 0.2-hr time increments are used

Time to Peak

Tp — 1.05 << rounded to 1.0 hr

Unit Hydrograph Peak Discharge

qp — 2295

Time Ratio	Discharge Ratio	Time (hr)	q (cfs)
0.0	0.000	0.000	0
0.1	0.030	0.100	69
0.2	0.100	0.200	230

Time (hr)	q (cfs)
0	**0**
0.20	230
0.40	711

0.3	0.190	0.300	436
0.4	0.310	0.400	711
0.5	0.470	0.500	1079
0.6	0.660	0.600	1515
0.7	0.820	0.700	1882
0.8	0.930	0.800	2134
0.9	0.990	0.900	2272
1.0	1.000	1.000	2295
1.1	0.990	1.100	2272
1.2	0.930	1.200	2134
1.3	0.860	1.300	1974
1.4	0.780	1.400	1790
1.5	0.680	1.500	1561
1.6	0.560	1.600	1285
1.7	0.460	1.700	1056
1.8	0.390	1.800	895
1.9	0.330	1.900	757
2.0	0.280	2.000	643
2.2	0.207	2.200	475
2.4	0.147	2.400	337
2.6	0.107	2.600	246
2.8	0.077	2.800	177
3.0	0.055	3.000	126
3.2	0.040	3.200	92
3.4	0.029	3.400	67
3.6	0.021	3.600	48
3.8	0.015	3.800	34
4.0	0.011	4.000	25
4.5	0.005	4.500	11
5.0	0.000	5.000	0

0.60	1515
0.80	2134
1.00	**2295**
1.20	2134
1.40	1790
1.60	1285
1.80	895
2.00	**643**
2.20	475
2.40	337
2.60	246
2.80	177
3.00	**126**
3.20	92
3.40	67
3.60	48
3.80	34
4.00	**25**
4.20	19
4.40	14
4.60	9
4.80	5
5.00	**0**
5.20	0
5.40	0
5.60	0
5.80	0
6.00	**0**
6.20	0
6.40	0

Sum	3061 cfs-h

Check

Unit Hydrograph (per 1 in. Unit Runoff)	3060.2
Variance	-0.04%

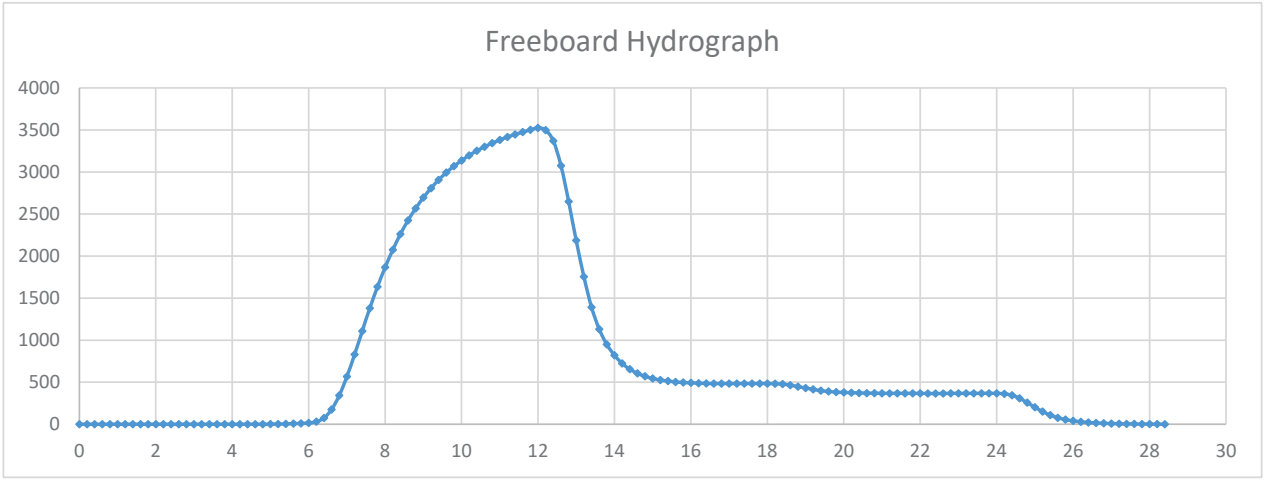
Freeboard Hydrograph

Time (hrs)	Inc. Runoff	q (cfs)	Composite FBH (cfs)
0.0	0.0000	0	0
0.2	0.0000	230	0
0.4	0.0000	711	0
0.6	0.0000	1515	0
0.8	0.0000	2134	0
1.0	0.0000	2295	0
1.2	0.0000	2134	0
1.4	0.0000	1790	0
1.6	0.0000	1285	0
1.8	0.0000	895	0
2.0	0.0000	643	0
2.2	0.0000	475	0
2.4	0.0000	337	0
2.6	0.0000	246	0

2.8	0.0000	177	0
3.0	0.0000	126	0
3.2	0.0000	92	0
3.4	0.0000	67	0
3.6	0.0000	48	0
3.8	0.0000	34	0
4.0	0.0000	25	0
4.2	0.0000	19	0
4.4	0.0000	14	0
4.6	0.0001	9	0
4.8	0.0004	5	0
5.0	0.0009	0	1
5.2	0.0013		2
5.4	0.0017		4
5.6	0.0021		7
5.8	0.0025		10
6.0	0.0029		15
6.2	0.0484		30
6.4	0.0782		74
6.6	0.1021		175
6.8	0.1214		342
7.0	0.1373		567
7.2	0.1505		829
7.4	0.1617		1108
7.6	0.1711		1380
7.8	0.1792		1634
8.0	0.1862		1866
8.2	0.1923		2074
8.4	0.1976		2260
8.6	0.2022		2424
8.8	0.2064		2568
9.0	0.2100		2696
9.2	0.2133		2807
9.4	0.2162		2906
9.6	0.2189		2993
9.8	0.2213		3069
10.0	0.2234		3137
10.2	0.2254		3198
10.4	0.2272		3252
10.6	0.2288		3300
10.8	0.2303		3343
11.0	0.2317		3381
11.2	0.2329		3416
11.4	0.2341		3447
11.6	0.2352		3475
11.8	0.2362		3501
12.0	0.2371		3524
12.2	0.0313		3498
12.4	0.0313		3371
12.6	0.0313		3075
12.8	0.0313		2649
13.0	0.0313		2187
13.2	0.0314		1755
13.4	0.0314		1392
13.6	0.0314		1131

13.8	0.0314		950
14.0	0.0314		820
14.2	0.0314		724
14.4	0.0314		655
14.6	0.0315		606
14.8	0.0315		570
15.0	0.0315		545
15.2	0.0315		526
15.4	0.0315		513
15.6	0.0315		503
15.8	0.0315		496
16.0	0.0316		492
16.2	0.0316		488
16.4	0.0316		485
16.6	0.0316		483
16.8	0.0316		483
17.0	0.0316		483
17.2	0.0316		483
17.4	0.0316		483
17.6	0.0316		483
17.8	0.0317		484
18.0	0.0317		484
18.2	0.0238		482
18.4	0.0238		477
18.6	0.0239		465
18.8	0.0239		448
19.0	0.0239		431
19.2	0.0239		414
19.4	0.0239		400
19.6	0.0239		390
19.8	0.0239		383
20.0	0.0239		378
20.2	0.0239		375
20.4	0.0239		372
20.6	0.0239		370
20.8	0.0239		369
21.0	0.0239		368
21.2	0.0239		368
21.4	0.0239		367
21.6	0.0239		367
21.8	0.0239		367
22.0	0.0240		367
22.2	0.0240		366
22.4	0.0240		366
22.6	0.0240		366
22.8	0.0240		367
23.0	0.0240		367
23.2	0.0240		367
23.4	0.0240		367
23.6	0.0240		367
23.8	0.0240		367
24.0	0.0240		367
24.2			362
24.4			345
24.6			308

24.8			257
25.0			202
25.2			151
25.4			108
25.6			77
25.8			56
26.0			40
26.2			29
26.4			21
26.6			15
26.8			11
27.0			8
27.2			5
27.4			4
27.6			3
27.8			2
28.0			1
28.2			1
28.4			0



Results

Peak Hydrograph Flow	3524 cfs
Total Volume	1880 ac-ft

Section 3. Precipitation Values

Precipitation Value - Limited Frequency Hydrographs (Storm Events 01-09 and 12)

Description: The NOAA Precipitation Value is taken from the NOAA Precipitation Frequency Data Server (PFDS). As outlined in NOAA Atlas 2 and Atlas 14, an average precipitation value for entire the basin area is calculated by deriving the values on a grid throughout the drainage basin and taking the average of these values. The exhibit on the following page, *NOAA Atlas 14 Precipitation Grid Exhibit* , shows the grid points where the point precipitation values were taken and averaged out.

NOAA Point Precipitation Value:

	6-hour	24-hour							10-day
	100-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	100-yr
	3.71	1.62	2.02	2.36	2.81	3.16	3.54	4.73	6.86
	3.69	1.62	2.02	2.35	2.80	3.16	3.53	4.72	6.85
	3.68	1.61	2.01	2.34	2.79	3.15	3.52	4.70	6.84
	3.67	1.61	2.01	2.33	2.79	3.14	3.51	4.69	6.83
	3.67	1.60	2.00	2.33	2.78	3.14	3.51	4.69	6.83
	3.66	1.60	2.00	2.33	2.78	3.13	3.50	4.68	6.82
	3.66	1.60	2.00	2.33	2.78	3.13	3.50	4.68	6.82
	3.65	1.60	1.99	2.32	2.77	3.13	3.49	4.66	6.82
	3.66	1.60	2.00	2.32	2.77	3.13	3.50	4.68	6.82
	3.67	1.60	2.00	2.33	2.78	3.13	3.51	4.69	6.83
	3.67	1.61	2.01	2.34	2.79	3.14	3.51	4.69	6.83
	3.67	1.61	2.01	2.34	2.79	3.14	3.51	4.69	6.83
	3.69	1.62	2.02	2.35	2.80	3.15	3.53	4.72	6.85
	3.69	1.62	2.01	2.35	2.80	3.15	3.53	4.72	6.85
Average >>	**3.68**	**1.61**	**2.01**	**2.34**	**2.79**	**3.14**	**3.51**	**4.69**	**6.83**

(*NOAA Atlas 14*)

Precipitation Value - Local SEP Hydrograph (Storm Event 10)

Description: The Local SEP Value is the Probable Maximum Precipitation to occur ever for a period of 6 hours. It involves evaluation of the average PMP and the areal distribution of the PMP within the drainage area using methods outlined in HMR 49. Donald T. Jensen with Utah State University was commissioned to provide an update to HMR 49 resulting in the *Probable Maximum Precipitation Estimates for Short-Duration, Small-Area Storms in Utah* . The study uses the 1-hour Point PMP Value for 1 mi^2, taken from HMR 49, and applies updated reduction factors for elevation, duration, and area to adjust the value to match the characteristics of the drainage basin.

Local SEP

Initial Precipitation Value (1-hr, 1-mi^2):

9.5 in (Fig. 4.5. *HMR 49* , 1984)

Elevation Variation:

Mean Elevation: 6271'

93.6% (Section 4.3.2, *HMR 49* , 1984)

Adjusted Value 8.90 in

Duration and Areal Variation:

Duration: 6 hrs

Area: 5 sq mi

86.15% (Table 15. *Probable Maximum Precipitation for Short-Duration, Short-Area Storms in Utah* , Jensen. 1995, 2002)

Adjusted Value 7.67 in

Total Local SEP	**7.67 in**

Precipitation Value - General SEP Hydrograph (Storm Event 11)

Description

The General SEP Value is the Probable Maximum Precipitation to occur ever for a period of 72 hours. It involves evaluation of the Convergance PMP (precipitation resulting from atmospheric processes not affected by terrain) and the Orographic PMP (precipitation resulting from atmospheric processes affected by terrain) using methods outlined in HMR 49. Convergance and orographic precipitation can occur simultaneously. Donald T. Jensen with Utah State University was commissioned to provide an update to HMR 49 resulting in the *2002 Update for Probable Maximum Precipitation, Utah, 72-Hour Estimates, Areas to 5,000 mi*^{2}. The study updates the 72-hour Point PMP Value for 10 mi^2, as shown in Figure 1 of the said study, from which the SEP value is calculated. This point value includes adjustments from barrier and elevation variations and the orographic component. An area reduction factor is applied to adjust the value to match the size of the drainage basin.

General SEP

Point PMP 72-hr Precipitation Value:

12.5 in (Fig. 1. *2002 Update for Probably Maximum Precipitation, Utah, 72-Hour Estimates, Areas to 5,000 mi*^{2}, Jensen. 2003)

Total General PMP	12.50 in

Areal Variation:

Area: 5 sq mi

100.00% (Table 1. *2002 Update for Probably Maximum Precipitation, Utah, 72-Hour Estimates, Areas to 5,000 mi*^{2}, Jensen. 2003)

Total General SEP	**12.50 in**
Total General SEP Used	**12.50 in**

Precipitation Value - Auxiliary Spillway Hydrographs (Storm Events 13 and 14)

Description The ASH Storm Events are the maximum precipitation events used to design the auxiliary spillway and top of dam elevation as determined by the equations set forth in TR-60, Table Figure 2-2, using the PMP precipitation value and the 100-year precipitation value.

Local ASH

P100:	2.75 in	< 100-yr, 6-hr NWS	(TR-60, Figure 2-2)
PMP:	7.67 in	< Local SEP	

ASH-L Precipitation Value	**4.03 in**

General ASH

P100:	3.51 in	< 100-yr, 24-hr NWS	(TR-60, Figure 2-2)
PMP:	12.50 in	< General SEP	

ASH-G Precipitation Value	**5.85 in**

Precipitation Value - Freeboard Hydrographs (Storm Events 15 and 16)

Description The FBH Storm Events are the maximum precipitation events used to design the spillway and top of dam elevation as determined by the equations set forth in TR-60, Table Figure 2-2, using the PMP precipitation value (and applying a duration reduction factor for the 24-hour General FBH).

Local FBH PMP: 7.67 in < Local (6-hr) SEP (TR-60, Figure 2-2)

FBH-L Precipitation Value	**7.67 in**

General FBH PMP: 12.50 in < Local (72-hr) SEP (TR-60, Figure 2-2)

24-hour Duration Reduction Factor:
81.6%

FBH-G Precipitation Value	**10.20 in**

Section 4. Wave Runup

Wave Runup - 50 mph Wind

Design Wind

Fastest Mile Wind:
50 mph

Maximum 1-hr wind
45 mph (Fig. 6, McCartney)

Fetch (F) Length:
0.42 miles (see attached *Fetch Length Exhibit*)

Water-Land Velocity Ratio:
1.07 (Page 11, McCartney)

Note: 120-minute velocity is calculated by multiplying the 60-minute velocity by 0.95.

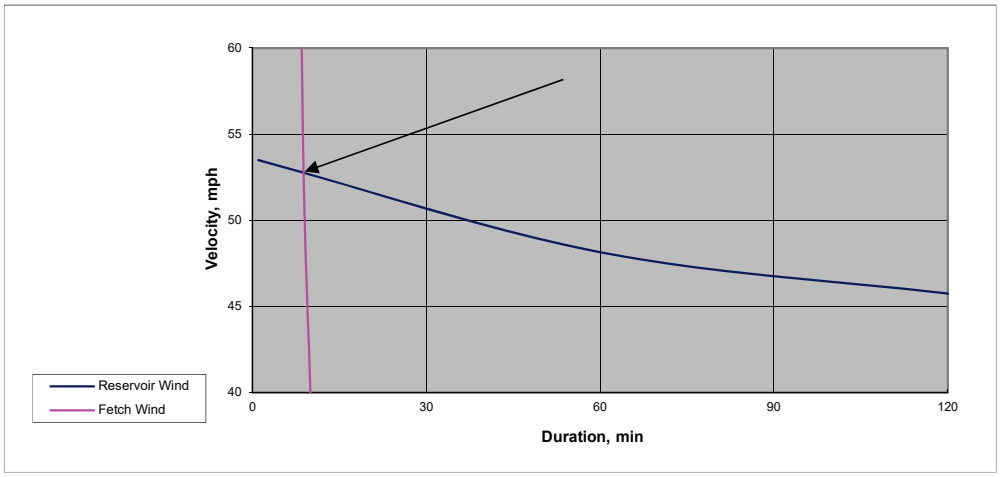
Reservoir Wind:

Duration	Velocity (Land)	Velocity (Water)
min	mph	mph
1	50	53.5
60	45	48.2
120	43	45.7

0.42-mi. Fetch Wind:

Duration	Velocity (Land)	Velocity (Water)
min	mph	mph
10	-	40
9	-	50
8.5	-	60

Note: Duration taken from Fig. 11, McCartney.



The Design Wind is taken from the intersection of the curves in the above chart:

U = 52.8 mph for 8.8 min.

Design Wave

Using a Design Wind of 52.8 mph for 8.8 minutes, the Design Wave is:

H_s = 1.40 ft (Fig. 11, McCartney)

Design Wave Significant Time Period

Using a Design Wind of 52.8 mph over a 0.42-mi. fetch, the Design Wave Significant Period is:

T_s = 2.2 sec (Fig. 12, McCartney)

Wave Runup - 50 mph Wind (cont.)

Wave Runup

Wave Runup, $\mathbf{R_s}$, is calculated using the following equation:

$$\frac{R_s}{H_s} \quad \frac{1}{0.4 + \left(\frac{H_s}{L_o}\right)^{1/2} \cot\theta}$$

where:

H_s =		1.40 ft
L_o =	$5.12(T_s)^2$ =	24.8 ft
cotθ =		1.5

Therefore:

R_s = 1.85 ft

Maximum Wave Runup, $\mathbf{R_{max}}$, is calculated using the following equation:

$$R_{\max} \quad R_s \times 1.5$$

Therefore:

R_{max} = 2.78 ft

Wind Setup

Wind Setup, **S**, is calculated using the following equation:

$$S \quad \frac{2U^2F}{1400D}$$

where:

U =	52.8 mph
F =	0.42 mi
D (ave. water depth) =	50 ft

Therefore:

S = 0.03 ft

Required Freeboard

The required amount of freeboard is the sum of the maximum wave runup and the wind setup.

Required Freeboard = 2.81 ft

Wave Runup - 100 mph Wind

Design Wind

Fastest Mile Wind:
100 mph

Maximum 1-hr wind
45 mph (Fig. 6, McCartney)

Fetch (F) Length:
0.42 miles (see attached *Fetch Length Exhibit*)

Water-Land Velocity Ratio:
1.07 (Page 11, McCartney)

Note: 120-minute velocity is calculated by multiplying the 60-minute velocity by 0.95.

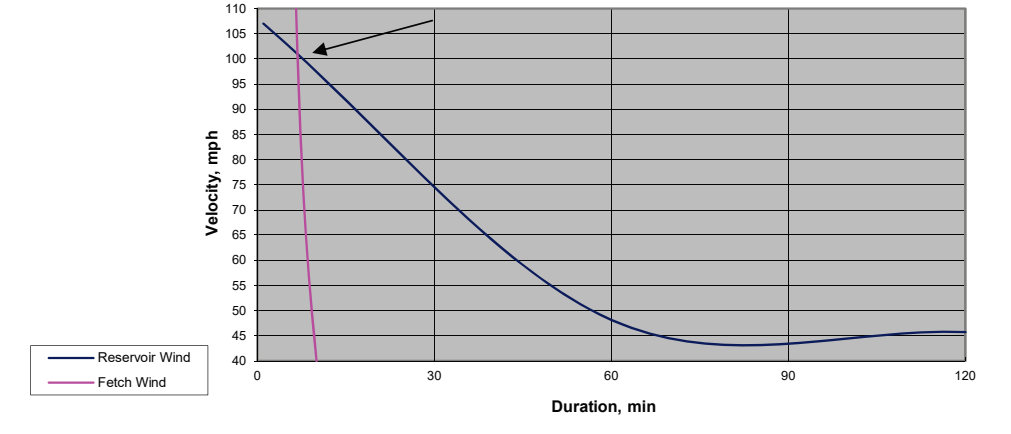
Reservoir Wind:

Duration	Velocity (Land)	Velocity (Water)
min	mph	mph
1	100	107.0
60	45	48.2
120	43	45.7

0.42-mi. Fetch Wind:

Duration	Velocity (Land)	Velocity (Water)
min	mph	mph
10	-	40
8.5	-	60
7.5	-	80
6.8	-	100
6.3	-	120

Note: Duration taken from Fig. 11, McCartney.



The Design Wind is taken from the intersection of the curves in the above chart:

U = 101 mph for 7.0 min.

Design Wave

Using a Design Wind of 101 mph for 7.0 minutes, the Design Wave is:

H_s = 3.10 ft (Fig. 11, McCartney)

Design Wave Significant Time Period

Using a Design Wind of 101 mph over a 0.42-mi. fetch, the Design Wave Significant Period is:

T_s = 2.9 sec (Fig. 12, McCartney)

Wave Runup - 100 mph Wind (cont.)

Wave Runup

Wave Runup, $\mathbf{R_s}$, is calculated using the following equation:

$$\frac{R_s}{H_s} \quad \frac{1}{0.4 + \left(\frac{H_s}{L_o}\right)^{1/2} \cot\theta}$$

where:

H_s =		3.10 ft
L_o =	$5.12(T_s)^2$ =	43.1 ft
cotθ =		1.5

Therefore:

R_s = 3.86 ft

Maximum Wave Runup, $\mathbf{R_{max}}$, is calculated using the following equation:

$$R_{max} \quad R_s \times 1.5$$

Therefore:

R_{max} = 5.79 ft

Wind Setup

Wind Setup, **S**, is calculated using the following equation:

$$S \quad \frac{2U^2F}{1400D}$$

where:

U =		101 mph
F =		0.42 mi
D (ave. water depth) =		50 ft

Therefore:

S = 0.12 ft

Required Freeboard

The required amount of freeboard is the sum of the maximum wave runup and the wind setup.

Required Freeboard = 5.92 ft

Wave Action

Wave Action

Fetch (F) Length:		
	0.42 miles	see attached *Fetch Length Exhibit*
Maximum Land Wind Velocity:		
	81 mph	TR-56, Figure 4)
Water-Land Velocity Ratio:		
	1.07	TR-56, Figure 5)
Overwater Wind Velocity		
	87 mph	TR-56, Equation 2)
Significant Wave Height		
	1.75 ft	TR-56, Equation 3)

Section 5. Emergency Drain

Emergency Drain Pipeline Design

OUTLET WORKS	
24" DI Pipe Inner Diameter (in)	24
Pipe Cross-Section Area (sf)	3.1
Pipe Circumference (ft)	6.3.
Pipe Length (ft)	375
Trash Loss Coefficient, K_t	1.23
Trash Rack Gross-Net Area Ratio	0.3
Trash Rack Area (sf)	100
Entrance Loss Coefficient, K_e	0.5
Friction Loss Coefficient, K_f	4.05
Manning's Coefficient	0.012

EMERGENCY DRAIN	
30" DI Pipe Inner Diameter (in)	30
Pipe Cross-Section Area (sf)	5.7
Pipe Circumference (ft)	8.5
Pipe Length (ft)	300
Bend Loss Coefficient, K_b	0.7
45° Bend Loss Coefficient	0.7
Friction Loss Coefficient, Kf	2.38
Manning's Coefficient	0.012
Discharge Loss Coefficient, Kd	1
Pipe Discharge Elevation (ft)	5450

Water Surface Elev (ft)	Water Storage (ac-ft)	Discharge Volume (ac-ft)	Cum. Discharge Vol. (ac-ft)	Height (ft)	Velocity (fps)	Discharge (cfs)	Discharge (ac-ft/day)	Discharge Time (days)	Cum. Discharge Time (days)
5546									
5545.5	6055		0	95.8	26.7	131.0	259.9		
5545	5916	139	139	95.3	26.7	130.7	259.2	0.536	0.5
5544	5777	139	278	94.5	26.6	130.2	258.2	0.538	1.1
5542	5419	179	636	92.5	26.3	128.8	255.5	0.701	2.5
5540	5074	173	981	90.5	26.0	127.4	252.7	0.685	3.8
5538	4742	166	1313	88.5	25.7	126.0	249.9	0.664	5.2
5536	4423	160	1632	86.5	25.4	124.5	247.0	0.648	6.4
5534	4116	154	1939	84.5	25.1	123.1	244.2	0.631	7.7
5532	3823	147	2232	82.5	24.8	121.6	241.3	0.609	8.9
5530	3542	141	2513	80.5	24.5	120.1	238.3	0.592	10.1
5528	3274	134	2781	78.5	24.2	118.6	235.3	0.569	11.2
5526	3018	128	3037	76.5	23.9	117.1	232.3	0.551	12.3
5524	2773	123	3282	74.5	23.6	115.6	229.3	0.537	13.4
5522	2542	116	3513	72.5	23.3	114.0	226.2	0.513	14.4
5520	2323	110	3732	70.5	22.9	112.4	223.0	0.493	15.4
5518	2117	103	3938	68.5	22.6	110.8	219.8	0.469	16.3
5516	1922	98	4133	66.5	22.3	109.2	216.6	0.452	17.2
5514	1737	93	4318	64.5	21.9	107.5	213.3	0.436	18.1
5512	1563	87	4492	62.5	21.6	105.9	210.0	0.414	18.9
5508	1248	76	4807	58.5	20.9	102.4	203.2	0.374	20.4
5506	1106	71	4949	56.5	20.5	100.7	199.7	0.356	21.1
5504	973	67	5082	54.5	20.2	98.9	196.1	0.342	21.8
5502	851	61	5204	52.5	19.8	97.0	192.5	0.317	22.4
5500	738	57	5317	50.5	19.4	95.2	188.8	0.302	23.0
5498	634	52	5421	48.5	19.0	93.3	185.0	0.281	23.6
5497	587	47	5468	47.5	18.8	92.3	183.1	0.257	23.9
5496	539	48	5516	46.5	18.6	91.3	181.1	0.265	24.1

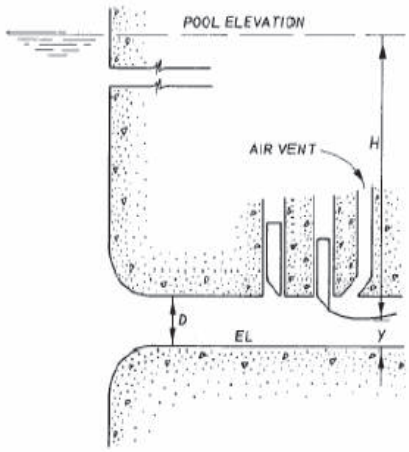
RESULTS	
Water Surface Elevation @ 24 Days	5497
Vol. Drained @ 24 Days (ac-ft)	5468
% Drained @ 24 Days	90%
Vol. Remaining @ 24 Days (ac-ft)	587
Average Flow Rate (cfs)	117

Air Vent Design

This program is to aid in the design of air vents for low level outlet works of medium size dams. The design assumption is that 80 percent gate opening the maximum air requirement will occur. Also, the maximum air velocity is not to exceed 150 fps. Although both parameters can be defined by the user. The method used below was developed by the U.S. Army Corps of Engineers in 1946.

User Defined Parameters

Gravity (ft/s)	32.2
Elev. Sluice Invert at Gate (ft)	5493.00
Design Pool Elevation (ft)	5517.00
Diameter (ft)	2.50
Discharge Coefficient	0.60
Gate Opening (%)	80%
Maximum Air Velocity (ft/s)	150.00



Slope of Outlet	0.007
Pipe Length (ft)	675
Cu	1.486
Manning's n	0.012

Calculated Parameters

Depth of Water at Vena Contracta (y) in (ft) = 1.200

y = Discharge Coefficient x Gate Opening x Diameter (D)

a (radians) =1.531 $\quad a = a\cos\left(1 - \frac{Y}{R}\right)$

Area at Vena Contracta (ft^2) = 2.329 $\quad A_{vc} = R^2 \cdot (\alpha - \cos\alpha \cdot \sin\alpha)$

Effective Head (H) in (ft) = 22.800

H = Design Pool Elev.- Elev. Sluice Invert at Gate – Depth of Water at Vena Contracta (y)

Water Discharge (Q_W) in (ft^3/s) = 89.260 $\quad Q = A_{vc}\sqrt{2 \cdot g \cdot H}$

Water Velocity (V_W) in (ft/s) = 38.319 $\quad V_w = \frac{Q_w}{A_{vc}}$

Froude Number at Vena Contracta = 6.164 $\quad F_r = \frac{V_w}{\sqrt{g \cdot y}}$

$\beta = 0.171$ $\quad \beta = 0.03(F_r - 1)^{1.06}$

Air Discharge (Q_a) in (ft^3/s) = 15.261 $\quad Q_a = \beta \cdot Q_w$

Area of Air Vent Required (ft^2) = 0.102 $A_v = \frac{Q_a}{Maximum_Air_Velocity}$

Diameter for Circular Vent (ft) = 0.360 $D_v = \sqrt{\frac{A_v \cdot 4}{\pi}}$

Normal Depth (Y_n) in (ft) = Full Pipe

Vent Ring Design

Air Vent Diameter (in) = 6.0

Air Vent Area (in^2) = 28.27

Combined Req'd Area of Vent Ring Holes (in^2) = 56.55

Vent Ring Hole Diameter (in) = 1

Vent Ring Hole Area (in^2) = 0.79

Req'd Number of Vent Rings Holes = 36.0

Appendix C. Model Output

Storm Event 1. 2-year, 24-hour [HEC-1]

Storm Event 2. 5-year, 24-hour [HEC-1]

Storm Event 3. 10-year, 24-hour [HEC-1]

Storm Event 4. 25-year, 24-hour [HEC-1]

Storm Event 5. 50-year, 24-hour [HEC-1]

Storm Event 6. 100-year, 24-hour [HEC-1]

Storm Event 7. 500-year, 24-hour [HEC-1]

Storm Event 8. 100-year, 6-hour AMC III [HEC-1]

Storm Event 9. 100-year, 24-hour AMC III [HEC-1]

Storm Event 10. Local SEP Hydrograph [HEC-1]

Storm Event 11. General SEP Hydrograph [HEC-1]

Storm Event 12. Principal Spillway Hydrograph [HEC-1]

Storm Event 13. Local Auxiliary Spillway Hydrograph [HEC-1]

Storm Event 14. General Auxiliary Spillway Hydrograph [HEC-1]

Storm Event 15. Local Freeboard Hydrograph [HEC-1]

Storm Event 16. General Freeboard Hydrograph [HEC-1]

Spillway Analysis [SITES]

Breach Analysis [HEC-RAS]

Storm Event 1. 2-year, 24-hour

```
1****************************************                                  ****************************************
 *                                      *                                  *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                  *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                  *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1               *                                  *         609 SECOND STREET            *
 *                                      *                                  *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   06AUG20  TIME  02:50:18  *                                  *           (916) 756-1104             *
 *                                      *                                  *                                      *
 ****************************************                                  ****************************************

                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X       X     X         XX
                                                X     X  X       X               X
                                                XXXXXXX  XXXX    X       XXXXX   X
                                                X     X  X       X               X
                                                X     X  X       X     X         X
                                                X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   2-YR, 24-HR, AMC II
           13           ID
                        *Diagram
           14           JR    PREC     1.0
           15           IT      72       0       0      50
           16           IO       0
           17           IN      72
                        *

           18           KK   B1
           19           KM   Runoff from Basin 1
           20           BA   0.503
           21           PB    1.61
           22           PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
           23           PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
           24           PC   1.000
           25           LS       0    72.8
           26           UD    0.51
                        *

           27           KK   RB1
           28           KM   Route B1
           29           RD    4928    .045    .050           TRAP      20      20
                        *

           30           KK   B2
           31           KM   Runoff from Basin 2
           32           BA   0.436
           33           LS       0    72.5
           34           UD    0.52
                        *

           35           KK   B3
           36           KM   Runoff from Basin 3
           37           BA   0.279
           38           LS       0    71.0
           39           UD    0.39
                        *
1                                                HEC-1 INPUT                                                PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
 40          KK   C1
 41          KM   Combine RB1, B2, B3
 42          HC       3
             *

 43          KK   RC1
 44          KM   Route RC1
 45          RD    7255    .060    .030           TRAP      20      20
             *

 46          KK   B4
 47          KM   Runoff from Basin 4
 48          BA   0.453
 49          LS       0    73.3
 50          UD    0.48
             *

 51          KK   B5
 52          KM   Runoff from Basin 5
 53          BA   0.805
 54          LS       0    74.1
 55          UD    0.63
             *

 56          KK   C2
 57          KM   Combine RC1, B4, B5
 58          HC       3
             *

 59          KK   RC2
 60          KM   Route C2
 61          RD    2380    .039    .030           TRAP      40       2
             *

 62          KK   B6
 63          KM   Runoff from Basin 6
 64          BA   0.150
 65          LS       0    84.3
 66          UD    0.19
             *

 67          KK   B7
 68          KM   Runoff from Basin 7
 69          BA   0.327
 70          LS       0    75.7
 71          UD    0.46
             *

 72          KK   C3
 73          KM   Combine RC2, B6, B7
 74          HC       3
             *
1                                        HEC-1 INPUT                                          PAGE  3

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 75          KK   RC3
 76          KM   Route C3
 77          RD   11323    .023    .030           TRAP      40      20
             *

 78          KK   B8
 79          KM   Runoff from Basin 8
 80          BA   1.012
 81          LS       0    84.0
 82          UD    0.67
             *

 83          KK   B9
 84          KM   Runoff from Basin 9
 85          BA   0.242
 86          LS       0    85.5
 87          UD    0.26
             *

 88          KK   B10
 89          KM   Runoff from Basin 10
 90          BA   0.129
 91          LS       0    86.7
 92          UD    0.18
             *

 93          KK   C4
 94          KM   Combine B9, B10
 95          HC       2
             *

 96          KK   RC4
 97          KM   Route C4
 98          RD    3380    .037    .030           TRAP      40      20
             *
```

```
             99           KK   B11
            100           KM   Runoff from Basin 11
            101           BA   0.279
            102           LS       0    84.8
            103           UD    0.39
                          *

            104           KK   C5
            105           KM   Combine RC3, B8, RC4, B11
            106           HC       4
                          *

            107           KK   B12
            108           KM   Runoff from Basin 12
            109           BA   0.127
            110           LS       0    81.2
            111           UD    0.40
                          *
1                                              HEC-1 INPUT                                                PAGE  4

           LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

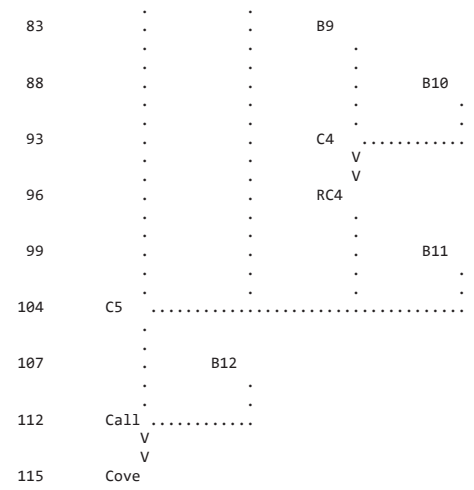

            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            115           KK   Cove Reservoir
            116           KM   Routing through Res'v
            117           RS       1    ELEV  5545.5
            118           SV       0      19      95     240     453     738    1105    1563    2217    2773
            119           SV    3542    4423    5419    6149    7347    8000
            120           SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
            121           SE    5530    5536    5542    5548    5552    5558
            122           SL  5545.5   4.909     0.6     0.5
            123           SS  5549.2      30    2.67     1.5
            124           ST  5552.0    1892     2.9     1.5
                          *
            125           ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK

 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

    NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     18       B1
                  V
                  V
     27       RB1
                  .
                  .
     30           .       B2
                  .           .
                  .           .
     35           .           .       B3
                  .           .           .
                  .           .           .
     40       C1   ........................
                  V
                  V
     43       RC1
                  .
                  .
     46           .       B4
                  .           .
                  .           .
     51           .           .       B5
                  .           .           .
                  .           .           .
     56       C2   ........................
                  V
                  V
     59       RC2
                  .
                  .
     62           .       B6
                  .           .
                  .           .
     67           .           .       B7
                  .           .           .
                  .           .           .
     72       C3   ........................
                  V
                  V
     75       RC3
                  .
                  .
     78           .       B8
                  .           .
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************                    *****************************************
 *                                       *                    *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *    U.S. ARMY CORPS OF ENGINEERS       *
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 *                                       *                    *                                       *
 *****************************************                    *****************************************
```

HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

2-YR, 24-HR, AMC II

```
  16 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           0  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN          72  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ          50  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      3    0  ENDING DATE
                     NDTIME        1048  ENDING TIME
                     ICENT           19  CENTURY MARK

                  COMPUTATION INTERVAL    1.20 HOURS
                       TOTAL TIME BASE   58.80 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                       NPLAN           1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                    1.00


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
```

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 112 KK    *     Call   *
           *            *
           **************
                        Combine C5, B12

 114 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

*****************************************************************************************************************************************

                                                HYDROGRAPH AT STATION    Call
                                                     SUM OF  2 HYDROGRAPHS
                                                    PLAN 1,   RATIO =  1.00

*****************************************************************************************************************************************
                                *                                *                                *
   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW
                                *                                *                                *
     1     0000    1        0.   *    1     1536   14       56.   *    2     0712   27        0.   *    2     2248   40        0.
     1     0112    2        0.   *    1     1648   15       52.   *    2     0824   28        0.   *    3     0000   41        0.
     1     0224    3        0.   *    1     1800   16       50.   *    2     0936   29        0.   *    3     0112   42        0.
     1     0336    4        0.   *    1     1912   17       47.   *    2     1048   30        0.   *    3     0224   43        0.
     1     0448    5        0.   *    1     2024   18       45.   *    2     1200   31        0.   *    3     0336   44        0.
     1     0600    6        0.   *    1     2136   19       45.   *    2     1312   32        0.   *    3     0448   45        0.
     1     0712    7        0.   *    1     2248   20       46.   *    2     1424   33        0.   *    3     0600   46        0.
     1     0824    8        4.   *    2     0000   21       43.   *    2     1536   34        0.   *    3     0712   47        0.
     1     0936    9       59.   *    2     0112   22       25.   *    2     1648   35        0.   *    3     0824   48        0.
     1     1048   10       89.   *    2     0224   23       10.   *    2     1800   36        0.   *    3     0936   49        0.
     1     1200   11       78.   *    2     0336   24        5.   *    2     1912   37        0.   *    3     1048   50        0.
     1     1312   12       65.   *    2     0448   25        2.   *    2     2024   38        0.   *
     1     1424   13       60.   *    2     0600   26        1.   *    2     2136   39        0.   *
                                *                                *                                *
*****************************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR       72-HR     58.80-HR
+   (CFS)       (HR)
                        (CFS)
+      89.     10.80                    70.         39.         16.          16.
                       (INCHES)       .137        .306        .306         .306
                        (AC-FT)        35.         77.         77.          77.

                        CUMULATIVE AREA =    4.74 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 115 KK    *     Cove   *     Reservoir
           *            *
           **************
                        Routing through Res'v

              HYDROGRAPH ROUTING DATA

 117 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC     5545.50  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

 118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                 3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

 120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                               5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

 122 SL          LOW-LEVEL OUTLET
                       ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                       CAREA        4.91  CROSS-SECTIONAL AREA
                        COQL         .60  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

 123 SS          SPILLWAY
                        CREL     5549.20  SPILLWAY CREST ELEVATION
                       SPWID       30.00  SPILLWAY WIDTH
                        COQW        2.67  WEIR COEFFICIENT
                        EXPW        1.50  EXPONENT OF HEAD

 124 ST          TOP OF DAM
```

TOPEL	5552.00	ELEVATION AT TOP OF DAM
DAMWID	1892.00	DAM WIDTH
COQD	2.90	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1	0000		1	0.	5844.8	5545.5	1		2024	18	15.	5892.4	5545.9	2		1648	35	14.	5886.3	5545.8
1	0112		2	0.	5844.8	5545.5	1		2136	19	15.	5895.4	5545.9	2		1800	36	14.	5884.9	5545.8
1	0224		3	0.	5844.8	5545.5	1		2248	20	16.	5898.4	5545.9	2		1912	37	13.	5883.6	5545.8
1	0336		4	0.	5844.8	5545.5	2		0000	21	16.	5901.2	5546.0	2		2024	38	13.	5882.3	5545.8
1	0448		5	0.	5844.8	5545.5	2		0112	22	16.	5902.9	5546.0	2		2136	39	13.	5881.0	5545.8
1	0600		6	0.	5844.8	5545.5	2		0224	23	16.	5903.0	5546.0	2		2248	40	13.	5879.8	5545.8
1	0712		7	0.	5844.8	5545.5	2		0336	24	16.	5902.1	5546.0	3		0000	41	12.	5878.5	5545.8
1	0824		8	1.	5845.0	5545.5	2		0448	25	16.	5900.9	5546.0	3		0112	42	12.	5877.3	5545.8
1	0936		9	4.	5847.9	5545.5	2		0600	26	16.	5899.4	5545.9	3		0224	43	12.	5876.1	5545.8
1	1048		10	7.	5854.8	5545.6	2		0712	27	16.	5897.9	5545.9	3		0336	44	12.	5874.9	5545.7
1	1200		11	9.	5862.2	5545.6	2		0824	28	15.	5896.4	5545.9	3		0448	45	12.	5873.8	5545.7
1	1312		12	10.	5868.4	5545.7	2		0936	29	15.	5894.9	5545.9	3		0600	46	11.	5872.6	5545.7
1	1424		13	11.	5873.5	5545.7	2		1048	30	15.	5893.4	5545.9	3		0712	47	11.	5871.5	5545.7
1	1536		14	12.	5878.0	5545.8	2		1200	31	15.	5891.9	5545.9	3		0824	48	11.	5870.4	5545.7
1	1648		15	13.	5882.1	5545.8	2		1312	32	14.	5890.5	5545.9	3		0936	49	11.	5869.4	5545.7
1	1800		16	14.	5885.9	5545.8	2		1424	33	14.	5889.1	5545.9	3		1048	50	10.	5868.3	5545.7
1	1912		17	14.	5889.3	5545.9	2		1536	34	14.	5887.7	5545.9							

PEAK OUTFLOW IS 16. AT TIME 26.40 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	58.80-HR
+ (CFS)	(HR)				
		(CFS)			
+ 16.	26.40	16.	15.	11.	11.
		(INCHES) .032	.119	.214	.214
		(AC-FT) 8.	30.	54.	54.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (AC-FT)	(HR)				
5903.	26.40	5902.	5895.	5878.	5878.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (FEET)	(HR)				
5545.98	26.40	5545.97	5545.91	5545.77	5545.77

CUMULATIVE AREA = 4.74 SQ MI

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1
					1.00
HYDROGRAPH AT					
+	B1	.50	1	FLOW	4.
				TIME	10.80
ROUTED TO					
+	RB1	.50	1	FLOW	4.
				TIME	12.00
HYDROGRAPH AT					
+	B2	.44	1	FLOW	3.
				TIME	10.80
HYDROGRAPH AT					
+	B3	.28	1	FLOW	2.
				TIME	22.80
3 COMBINED AT					
+	C1	1.22	1	FLOW	9.
				TIME	14.40
ROUTED TO					
+	RC1	1.22	1	FLOW	9.
				TIME	14.40
HYDROGRAPH AT					
+	B4	.45	1	FLOW	4.
				TIME	10.80
HYDROGRAPH AT					
+	B5	.81	1	FLOW	9.
				TIME	10.80
3 COMBINED AT					
+	C2	2.48	1	FLOW	19.
				TIME	14.40
ROUTED TO					
+	RC2	2.48	1	FLOW	19.
				TIME	14.40
HYDROGRAPH AT					
+	B6	.15	1	FLOW	7.
				TIME	10.80
HYDROGRAPH AT					
+	B7	.33	1	FLOW	5.
				TIME	10.80
3 COMBINED AT					
+	C3	2.95	1	FLOW	27.
				TIME	10.80
ROUTED TO					
+	RC3	2.95	1	FLOW	27.
				TIME	12.00
HYDROGRAPH AT					
+	B8	1.01	1	FLOW	43.
				TIME	10.80
HYDROGRAPH AT					
+	B9	.24	1	FLOW	12.
				TIME	10.80
HYDROGRAPH AT					
+	B10	.13	1	FLOW	7.
				TIME	10.80
2 COMBINED AT					
+	C4	.37	1	FLOW	19.
				TIME	10.80
ROUTED TO					
+	RC4	.37	1	FLOW	19.
				TIME	10.80
HYDROGRAPH AT					
+	B11	.28	1	FLOW	13.
				TIME	10.80
4 COMBINED AT					
+	C5	4.61	1	FLOW	85.
				TIME	10.80

```
 HYDROGRAPH AT
+                  B12          .13     1   FLOW           4.
                                            TIME        10.80

  2 COMBINED AT
+                  Call        4.74     1   FLOW          89.
                                            TIME        10.80

 ROUTED TO
+                  Cove        4.74     1   FLOW          16.
                                            TIME        26.40

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     5545.98
                                            TIME        26.40
1
                                            SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                                (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                    INTERPOLATED TO
                                                                                 COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

           FOR PLAN = 1  RATIO=  .00
              RB1    MANE         7.20      4.28    691.20       .16     72.00      3.95    720.00         .16


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .4342E+01 EXCESS= .0000E+00 OUTFLOW= .4342E+01 BASIN STORAGE= .3500E-02 PERCENT ERROR=   -.1


           FOR PLAN = 1  RATIO=  .00
              RC1    MANE        14.40      8.59    763.20       .15     72.00      8.52    864.00         .15


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .9892E+01 EXCESS= .0000E+00 OUTFLOW= .9895E+01 BASIN STORAGE= .3327E-02 PERCENT ERROR=   -.1


           FOR PLAN = 1  RATIO=  .00
              RC2    MANE        10.57     19.01    856.25       .17     72.00     19.01    864.00         .17


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2218E+02 EXCESS= .0000E+00 OUTFLOW= .2218E+02 BASIN STORAGE= .2800E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC3    MANE        10.80     27.32    702.00       .19     72.00     26.74    720.00         .19


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3011E+02 EXCESS= .0000E+00 OUTFLOW= .3013E+02 BASIN STORAGE= .8425E-02 PERCENT ERROR=   -.1


           FOR PLAN = 1  RATIO=  .00
              RC4    MANE        10.80     18.94    658.80       .56     72.00     18.68    648.00         .57


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1115E+02 EXCESS= .0000E+00 OUTFLOW= .1115E+02 BASIN STORAGE= .2705E-02 PERCENT ERROR=    .0


1                                SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                               (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


      PLAN  1 .............                    INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                  ELEVATION        5545.50           5549.20          5552.00
                                  STORAGE             5845.             6508.            7347.
                                  OUTFLOW                0.               45.              435.


                        RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                          OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                         PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                        1.00      5545.98         .00       5903.        16.       .00        26.40         .00


 *** NORMAL END OF HEC-1 ***
```

Storm Event 2. 5-year, 24-hour

```
1*************************************                                  *************************************
 *                                   *                                  *                                   *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                              *    U.S. ARMY CORPS OF ENGINEERS     *
 *              JUN   1998           *                                  *    HYDROLOGIC ENGINEERING CENTER    *
 *            VERSION 4.1            *                                  *         609 SECOND STREET           *
 *                                   *                                  *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   06AUG20  TIME  02:51:41   *                              *           (916) 756-1104            *
 *                                   *                                  *                                   *
 *************************************                                  *************************************

                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X        X     X         XX
                                                X     X  X        X               X
                                                XXXXXXX  XXXX     X        XXXXX  X
                                                X     X  X        X               X
                                                X     X  X        X     X         X
                                                X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                              HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   5-YR, 24-HR, AMC II
           13           ID
                        *Diagram
           14           JR    PREC     1.0
           15           IT      72       0       0      50
           16           IO       0
           17           IN      72
                        *

           18           KK   B1
           19           KM   Runoff from Basin 1
           20           BA   0.503
           21           PB    2.01
           22           PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
           23           PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
           24           PC   1.000
           25           LS       0    72.8
           26           UD    0.51
                        *

           27           KK   RB1
           28           KM   Route B1
           29           RD    4928    .045    .050           TRAP      20      20
                        *

           30           KK   B2
           31           KM   Runoff from Basin 2
           32           BA   0.436
           33           LS       0    72.5
           34           UD    0.52
                        *

           35           KK   B3
           36           KM   Runoff from Basin 3
           37           BA   0.279
           38           LS       0    71.0
           39           UD    0.39
                        *
1                                              HEC-1 INPUT                                                PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
 40          KK   C1
 41          KM   Combine RB1, B2, B3
 42          HC       3
             *

 43          KK   RC1
 44          KM   Route RC1
 45          RD    7255    .060    .030           TRAP      20      20
             *

 46          KK   B4
 47          KM   Runoff from Basin 4
 48          BA   0.453
 49          LS       0    73.3
 50          UD    0.48
             *

 51          KK   B5
 52          KM   Runoff from Basin 5
 53          BA   0.805
 54          LS       0    74.1
 55          UD    0.63
             *

 56          KK   C2
 57          KM   Combine RC1, B4, B5
 58          HC       3
             *

 59          KK   RC2
 60          KM   Route C2
 61          RD    2380    .039    .030           TRAP      40       2
             *

 62          KK   B6
 63          KM   Runoff from Basin 6
 64          BA   0.150
 65          LS       0    84.3
 66          UD    0.19
             *

 67          KK   B7
 68          KM   Runoff from Basin 7
 69          BA   0.327
 70          LS       0    75.7
 71          UD    0.46
             *

 72          KK   C3
 73          KM   Combine RC2, B6, B7
 74          HC       3
             *
1                                        HEC-1 INPUT                                          PAGE  3

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 75          KK   RC3
 76          KM   Route C3
 77          RD   11323    .023    .030           TRAP      40      20
             *

 78          KK   B8
 79          KM   Runoff from Basin 8
 80          BA   1.012
 81          LS       0    84.0
 82          UD    0.67
             *

 83          KK   B9
 84          KM   Runoff from Basin 9
 85          BA   0.242
 86          LS       0    85.5
 87          UD    0.26
             *

 88          KK   B10
 89          KM   Runoff from Basin 10
 90          BA   0.129
 91          LS       0    86.7
 92          UD    0.18
             *

 93          KK   C4
 94          KM   Combine B9, B10
 95          HC       2
             *

 96          KK   RC4
 97          KM   Route C4
 98          RD    3380    .037    .030           TRAP      40      20
             *
```

```
 99          KK   B11
100          KM   Runoff from Basin 11
101          BA   0.279
102          LS       0    84.8
103          UD    0.39
             *

104          KK   C5
105          KM   Combine RC3, B8, RC4, B11
106          HC       4
             *

107          KK   B12
108          KM   Runoff from Basin 12
109          BA   0.127
110          LS       0    81.2
111          UD    0.40
             *
1                                          HEC-1 INPUT                                          PAGE  4

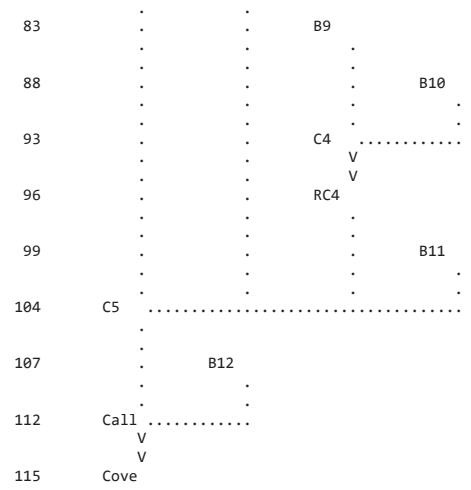
          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


112          KK   Call
113          KM   Combine C5, B12
114          HC       2
             *

115          KK   Cove Reservoir
116          KM   Routing through Res'v
117          RS       1    ELEV  5545.5
118          SV       0      19      95     240     453     738    1105    1563    2217    2773
119          SV    3542    4423    5419    6149    7347    8000
120          SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
121          SE    5530    5536    5542    5548    5552    5558
122          SL  5545.5   4.909     0.6     0.5
123          SS  5549.2      30    2.67     1.5
124          ST  5552.0    1892     2.9     1.5
             *
125          ZZ
1
               SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    18       B1
                 V
                 V
    27       RB1
                 .
                 .
    30           .       B2
                 .           .
                 .           .
    35           .           .       B3
                 .           .           .
                 .           .           .
    40       C1   ........................
                 V
                 V
    43       RC1
                 .
                 .
    46           .       B4
                 .           .
                 .           .
    51           .           .       B5
                 .           .           .
                 .           .           .
    56       C2   ........................
                 V
                 V
    59       RC2
                 .
                 .
    62           .       B6
                 .           .
                 .           .
    67           .           .       B7
                 .           .           .
                 .           .           .
    72       C3   ........................
                 V
                 V
    75       RC3
                 .
                 .
    78           .       B8
                 .           .
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
 *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
 *              JUN   1998               *
 *            VERSION 4.1                *
 *                                       *
 *  RUN DATE   06AUG20  TIME  02:51:41   *
 *                                       *
 *****************************************
```

```
*************************************
*                                   *
*    U.S. ARMY CORPS OF ENGINEERS     *
*    HYDROLOGIC ENGINEERING CENTER    *
*          609 SECOND STREET          *
*       DAVIS, CALIFORNIA 95616       *
*           (916) 756-1104            *
*                                   *
*************************************
```

HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

5-YR, 24-HR, AMC II

```
  16 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           0  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN          72  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ          50  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      3    0  ENDING DATE
                     NDTIME        1048  ENDING TIME
                     ICENT           19  CENTURY MARK

                   COMPUTATION INTERVAL    1.20 HOURS
                        TOTAL TIME BASE   58.80 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                       NPLAN           1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                    1.00
```

*** ***

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 112 KK    *     Call   *
           *            *
           **************
                        Combine C5, B12

 114 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

*****************************************************************************************************************************************

                                                HYDROGRAPH AT STATION    Call
                                                     SUM OF  2 HYDROGRAPHS
                                                    PLAN 1,   RATIO =  1.00

*****************************************************************************************************************************************
                                *                                *                                *
   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW
                                *                                *                                *
     1     0000    1        0.   *    1     1536   14        90.   *    2     0712   27        0.   *    2     2248   40        0.
     1     0112    2        0.   *    1     1648   15        81.   *    2     0824   28        0.   *    3     0000   41        0.
     1     0224    3        0.   *    1     1800   16        78.   *    2     0936   29        0.   *    3     0112   42        0.
     1     0336    4        0.   *    1     1912   17        72.   *    2     1048   30        0.   *    3     0224   43        0.
     1     0448    5        0.   *    1     2024   18        69.   *    2     1200   31        0.   *    3     0336   44        0.
     1     0600    6        0.   *    1     2136   19        68.   *    2     1312   32        0.   *    3     0448   45        0.
     1     0712    7        0.   *    1     2248   20        69.   *    2     1424   33        0.   *    3     0600   46        0.
     1     0824    8       17.   *    2     0000   21        64.   *    2     1536   34        0.   *    3     0712   47        0.
     1     0936    9      110.   *    2     0112   22        36.   *    2     1648   35        0.   *    3     0824   48        0.
     1     1048   10      175.   *    2     0224   23        15.   *    2     1800   36        0.   *    3     0936   49        0.
     1     1200   11      141.   *    2     0336   24         6.   *    2     1912   37        0.   *    3     1048   50        0.
     1     1312   12      113.   *    2     0448   25         3.   *    2     2024   38        0.   *
     1     1424   13       99.   *    2     0600   26         1.   *    2     2136   39        0.   *
                                *                                *                                *
*****************************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR     58.80-HR
+   (CFS)       (HR)
                        (CFS)
+     175.     10.80                  125.          65.          27.          27.
                          (INCHES)     .246         .512         .512         .512
                           (AC-FT)      62.         130.         130.         130.

                         CUMULATIVE AREA =    4.74 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 115 KK    *     Cove   *     Reservoir
           *            *
           **************
                        Routing through Res'v

              HYDROGRAPH ROUTING DATA

 117 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC     5545.50  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

 118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                  3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

 120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                               5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

 122 SL          LOW-LEVEL OUTLET
                       ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                       CAREA        4.91  CROSS-SECTIONAL AREA
                        COQL         .60  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

 123 SS          SPILLWAY
                        CREL     5549.20  SPILLWAY CREST ELEVATION
                       SPWID       30.00  SPILLWAY WIDTH
                        COQW        2.67  WEIR COEFFICIENT
                        EXPW        1.50  EXPONENT OF HEAD

 124 ST          TOP OF DAM
```

TOPEL	5552.00	ELEVATION AT TOP OF DAM
DAMWID	1892.00	DAM WIDTH
COQD	2.90	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1	0000	1	0.	5844.8	5545.5	1	2024	18	20.	5931.0	5546.2	2	1648	35	19.	5925.4	5546.2			
1	0112	2	0.	5844.8	5545.5	1	2136	19	20.	5935.8	5546.2	2	1800	36	19.	5923.5	5546.1			
1	0224	3	0.	5844.8	5545.5	1	2248	20	21.	5940.6	5546.3	2	1912	37	19.	5921.6	5546.1			
1	0336	4	0.	5844.8	5545.5	2	0000	21	21.	5945.1	5546.3	2	2024	38	19.	5919.8	5546.1			
1	0448	5	0.	5844.8	5545.5	2	0112	22	22.	5947.9	5546.3	2	2136	39	18.	5918.0	5546.1			
1	0600	6	0.	5844.8	5545.5	2	0224	23	22.	5948.3	5546.4	2	2248	40	18.	5916.2	5546.1			
1	0712	7	0.	5844.8	5545.5	2	0336	24	22.	5947.1	5546.3	3	0000	41	18.	5914.4	5546.1			
1	0824	8	2.	5845.6	5545.5	2	0448	25	21.	5945.4	5546.3	3	0112	42	18.	5912.6	5546.1			
1	0936	9	6.	5851.5	5545.6	2	0600	26	21.	5943.4	5546.3	3	0224	43	17.	5910.9	5546.0			
1	1048	10	10.	5864.9	5545.7	2	0712	27	21.	5941.4	5546.3	3	0336	44	17.	5909.2	5546.0			
1	1200	11	13.	5879.5	5545.8	2	0824	28	21.	5939.4	5546.3	3	0448	45	17.	5907.4	5546.0			
1	1312	12	15.	5890.8	5545.9	2	0936	29	21.	5937.3	5546.3	3	0600	46	17.	5905.8	5546.0			
1	1424	13	16.	5899.8	5546.0	2	1048	30	20.	5935.3	5546.2	3	0712	47	16.	5904.1	5546.0			
1	1536	14	17.	5907.5	5546.0	2	1200	31	20.	5933.2	5546.2	3	0824	48	16.	5902.5	5546.0			
1	1648	15	18.	5914.3	5546.1	2	1312	32	20.	5931.3	5546.2	3	0936	49	16.	5900.9	5546.0			
1	1800	16	19.	5920.4	5546.1	2	1424	33	20.	5929.3	5546.2	3	1048	50	16.	5899.3	5545.9			
1	1912	17	19.	5926.0	5546.2	2	1536	34	19.	5927.4	5546.2									

PEAK OUTFLOW IS 22. AT TIME 26.40 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	58.80-HR
+ (CFS)	(HR)				
		(CFS)			
+ 22.	26.40	22.	20.	15.	15.
		(INCHES) .042	.161	.297	.297
		(AC-FT) 11.	41.	75.	75.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (AC-FT)	(HR)				
5948.	26.40	5947.	5937.	5908.	5908.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (FEET)	(HR)				
5546.35	26.40	5546.33	5546.25	5546.02	5546.02

CUMULATIVE AREA = 4.74 SQ MI

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1
					1.00
HYDROGRAPH AT					
+	B1	.50	1	FLOW	11.
				TIME	10.80
ROUTED TO					
+	RB1	.50	1	FLOW	10.
				TIME	12.00
HYDROGRAPH AT					
+	B2	.44	1	FLOW	10.
				TIME	10.80
HYDROGRAPH AT					
+	B3	.28	1	FLOW	5.
				TIME	10.80
3 COMBINED AT					
+	C1	1.22	1	FLOW	23.
				TIME	10.80
ROUTED TO					
+	RC1	1.22	1	FLOW	21.
				TIME	12.00
HYDROGRAPH AT					
+	B4	.45	1	FLOW	11.
				TIME	10.80
HYDROGRAPH AT					
+	B5	.81	1	FLOW	21.
				TIME	10.80
3 COMBINED AT					
+	C2	2.48	1	FLOW	50.
				TIME	10.80
ROUTED TO					
+	RC2	2.48	1	FLOW	48.
				TIME	10.80
HYDROGRAPH AT					
+	B6	.15	1	FLOW	11.
				TIME	10.80
HYDROGRAPH AT					
+	B7	.33	1	FLOW	11.
				TIME	10.80
3 COMBINED AT					
+	C3	2.95	1	FLOW	69.
				TIME	10.80
ROUTED TO					
+	RC3	2.95	1	FLOW	63.
				TIME	12.00
HYDROGRAPH AT					
+	B8	1.01	1	FLOW	70.
				TIME	10.80
HYDROGRAPH AT					
+	B9	.24	1	FLOW	19.
				TIME	10.80
HYDROGRAPH AT					
+	B10	.13	1	FLOW	11.
				TIME	10.80
2 COMBINED AT					
+	C4	.37	1	FLOW	30.
				TIME	10.80
ROUTED TO					
+	RC4	.37	1	FLOW	29.
				TIME	10.80
HYDROGRAPH AT					
+	B11	.28	1	FLOW	21.
				TIME	10.80
4 COMBINED AT					
+	C5	4.61	1	FLOW	168.
				TIME	10.80

```
 HYDROGRAPH AT
+                  B12          .13     1   FLOW           7.
                                            TIME        10.80

  2 COMBINED AT
+                  Call        4.74     1   FLOW         175.
                                            TIME        10.80

 ROUTED TO
+                  Cove        4.74     1   FLOW          22.
                                            TIME        26.40

                                        ** PEAK STAGES IN FEET **
                                        1   STAGE     5546.35
                                            TIME        26.40
1
                                            SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                                (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                    INTERPOLATED TO
                                                                                 COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

           FOR PLAN = 1  RATIO=  .00
              RB1    MANE         7.20     11.31    676.80       .32     72.00      9.54    720.00         .32


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .8557E+01 EXCESS= .0000E+00 OUTFLOW= .8560E+01 BASIN STORAGE= .3508E-02 PERCENT ERROR=   -.1


           FOR PLAN = 1  RATIO=  .00
              RC1    MANE         7.20     23.21    676.80       .30     72.00     21.22    720.00         .31


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1977E+02 EXCESS= .0000E+00 OUTFLOW= .1977E+02 BASIN STORAGE= .3640E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC2    MANE         7.20     50.33    655.20       .33     72.00     47.70    648.00         .33


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .4326E+02 EXCESS= .0000E+00 OUTFLOW= .4326E+02 BASIN STORAGE= .2914E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC3    MANE        10.80     69.04    691.20       .36     72.00     63.27    720.00         .36


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5668E+02 EXCESS= .0000E+00 OUTFLOW= .5670E+02 BASIN STORAGE= .9084E-02 PERCENT ERROR=   -.1


           FOR PLAN = 1  RATIO=  .00
              RC4    MANE        14.08     29.35    633.76       .85     72.00     29.23    648.00         .86


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1687E+02 EXCESS= .0000E+00 OUTFLOW= .1688E+02 BASIN STORAGE= .2335E-02 PERCENT ERROR=    .0


1                               SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                              (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


      PLAN  1 .............                    INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                  ELEVATION        5545.50           5549.20          5552.00
                                  STORAGE             5845.             6508.            7347.
                                  OUTFLOW                0.               45.              435.


                        RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                          OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                         PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                        1.00      5546.35         .00       5948.        22.       .00        26.40         .00


 *** NORMAL END OF HEC-1 ***
```

Storm Event 3. 10-year, 24-hour

```
1****************************************                                  ************************************
 *                                      *                                  *                                  *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                  *    U.S. ARMY CORPS OF ENGINEERS  *
 *              JUN   1998              *                                  *    HYDROLOGIC ENGINEERING CENTER *
 *            VERSION 4.1               *                                  *         609 SECOND STREET        *
 *                                      *                                  *       DAVIS, CALIFORNIA 95616    *
 *  RUN DATE   06AUG20  TIME  02:52:08  *                                  *           (916) 756-1104         *
 *                                      *                                  *                                  *
 ****************************************                                  ************************************

                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X       X     X         XX
                                                X     X  X       X               X
                                                XXXXXXX  XXXX    X        XXXXX  X
                                                X     X  X       X               X
                                                X     X  X       X     X         X
                                                X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   10-YR, 24-HR, AMC II
           13           ID
                        *Diagram
           14           JR    PREC     1.0
           15           IT      72       0       0      50
           16           IO       0
           17           IN      72
                        *

           18           KK   B1
           19           KM   Runoff from Basin 1
           20           BA   0.503
           21           PB    2.34
           22           PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
           23           PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
           24           PC   1.000
           25           LS       0    72.8
           26           UD    0.51
                        *

           27           KK   RB1
           28           KM   Route B1
           29           RD    4928    .045    .050           TRAP      20      20
                        *

           30           KK   B2
           31           KM   Runoff from Basin 2
           32           BA   0.436
           33           LS       0    72.5
           34           UD    0.52
                        *

           35           KK   B3
           36           KM   Runoff from Basin 3
           37           BA   0.279
           38           LS       0    71.0
           39           UD    0.39
                        *
1                                                HEC-1 INPUT                                                PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
          40          KK   C1
          41          KM   Combine RB1, B2, B3
          42          HC       3
                      *

          43          KK   RC1
          44          KM   Route RC1
          45          RD    7255    .060    .030           TRAP      20      20
                      *

          46          KK   B4
          47          KM   Runoff from Basin 4
          48          BA   0.453
          49          LS       0    73.3
          50          UD    0.48
                      *

          51          KK   B5
          52          KM   Runoff from Basin 5
          53          BA   0.805
          54          LS       0    74.1
          55          UD    0.63
                      *

          56          KK   C2
          57          KM   Combine RC1, B4, B5
          58          HC       3
                      *

          59          KK   RC2
          60          KM   Route C2
          61          RD    2380    .039    .030           TRAP      40       2
                      *

          62          KK   B6
          63          KM   Runoff from Basin 6
          64          BA   0.150
          65          LS       0    84.3
          66          UD    0.19
                      *

          67          KK   B7
          68          KM   Runoff from Basin 7
          69          BA   0.327
          70          LS       0    75.7
          71          UD    0.46
                      *

          72          KK   C3
          73          KM   Combine RC2, B6, B7
          74          HC       3
                      *
1                                        HEC-1 INPUT                                          PAGE  3

        LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


          75          KK   RC3
          76          KM   Route C3
          77          RD   11323    .023    .030           TRAP      40      20
                      *

          78          KK   B8
          79          KM   Runoff from Basin 8
          80          BA   1.012
          81          LS       0    84.0
          82          UD    0.67
                      *

          83          KK   B9
          84          KM   Runoff from Basin 9
          85          BA   0.242
          86          LS       0    85.5
          87          UD    0.26
                      *

          88          KK   B10
          89          KM   Runoff from Basin 10
          90          BA   0.129
          91          LS       0    86.7
          92          UD    0.18
                      *

          93          KK   C4
          94          KM   Combine B9, B10
          95          HC       2
                      *

          96          KK   RC4
          97          KM   Route C4
          98          RD    3380    .037    .030           TRAP      40      20
                      *
```

```
 99          KK   B11
100          KM   Runoff from Basin 11
101          BA   0.279
102          LS       0    84.8
103          UD    0.39
             *

104          KK   C5
105          KM   Combine RC3, B8, RC4, B11
106          HC       4
             *

107          KK   B12
108          KM   Runoff from Basin 12
109          BA   0.127
110          LS       0    81.2
111          UD    0.40
             *
1                                          HEC-1 INPUT                                          PAGE  4

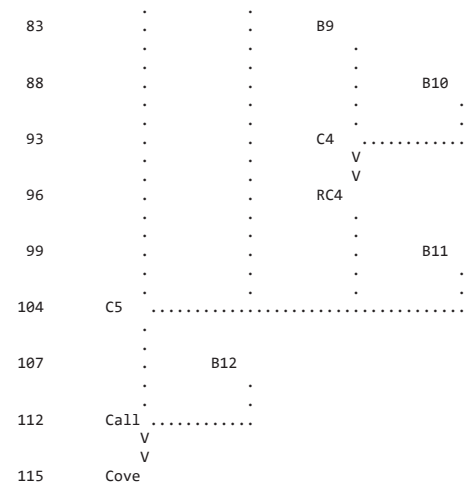
          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


112          KK   Call
113          KM   Combine C5, B12
114          HC       2
             *

115          KK   Cove Reservoir
116          KM   Routing through Res'v
117          RS       1    ELEV  5545.5
118          SV       0      19      95     240     453     738    1105    1563    2217    2773
119          SV    3542    4423    5419    6149    7347    8000
120          SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
121          SE    5530    5536    5542    5548    5552    5558
122          SL  5545.5   4.909     0.6     0.5
123          SS  5549.2      30    2.67     1.5
124          ST  5552.0    1892     2.9     1.5
             *
125          ZZ
1
               SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

    NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     18      B1
                 V
                 V
     27      RB1
                 .
                 .
     30          .       B2
                 .           .
                 .           .
     35          .           .       B3
                 .           .           .
                 .           .           .
     40      C1   ........................
                 V
                 V
     43      RC1
                 .
                 .
     46          .       B4
                 .           .
                 .           .
     51          .           .       B5
                 .           .           .
                 .           .           .
     56      C2   ........................
                 V
                 V
     59      RC2
                 .
                 .
     62          .       B6
                 .           .
                 .           .
     67          .           .       B7
                 .           .           .
                 .           .           .
     72      C3   ........................
                 V
                 V
     75      RC3
                 .
                 .
     78          .       B8
                 .           .
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************                    *****************************************
 *                                       *                    *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *    U.S. ARMY CORPS OF ENGINEERS       *
 *              JUN   1998               *                    *    HYDROLOGIC ENGINEERING CENTER      *
 *            VERSION 4.1                *                    *          609 SECOND STREET            *
 *                                       *                    *       DAVIS, CALIFORNIA 95616         *
 *  RUN DATE   06AUG20  TIME  02:52:08   *                    *           (916) 756-1104              *
 *                                       *                    *                                       *
 *****************************************                    *****************************************
```

HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

10-YR, 24-HR, AMC II

```
  16 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           0  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN          72  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ          50  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      3    0  ENDING DATE
                     NDTIME        1048  ENDING TIME
                     ICENT           19  CENTURY MARK

                   COMPUTATION INTERVAL    1.20 HOURS
                        TOTAL TIME BASE   58.80 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                       NPLAN           1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                    1.00


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
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*** ***

```
           **************
           *            *
 112 KK    *     Call   *
           *            *
           **************
                        Combine C5, B12

 114 HC          HYDROGRAPH COMBINATION
                      ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***
```

****

HYDROGRAPH AT STATION Call
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = 1.00

****

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		1536	14	120.	2		0712	27	0.	2		2248	40	0.
1		0112	2	0.	1		1648	15	107.	2		0824	28	0.	3		0000	41	0.
1		0224	3	0.	1		1800	16	102.	2		0936	29	0.	3		0112	42	0.
1		0336	4	0.	1		1912	17	94.	2		1048	30	0.	3		0224	43	0.
1		0448	5	0.	1		2024	18	89.	2		1200	31	0.	3		0336	44	0.
1		0600	6	0.	1		2136	19	89.	2		1312	32	0.	3		0448	45	0.
1		0712	7	1.	1		2248	20	89.	2		1424	33	0.	3		0600	46	0.
1		0824	8	32.	2		0000	21	82.	2		1536	34	0.	3		0712	47	0.
1		0936	9	165.	2		0112	22	46.	2		1648	35	0.	3		0824	48	0.
1		1048	10	261.	2		0224	23	18.	2		1800	36	0.	3		0936	49	0.
1		1200	11	201.	2		0336	24	7.	2		1912	37	0.	3		1048	50	0.
1		1312	12	155.	2		0448	25	2.	2		2024	38	0.					
1		1424	13	133.	2		0600	26	1.	2		2136	39	0.					

****

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	58.80-HR
(CFS)	(HR)				
		(CFS)			
261.	10.80	179.	90.	37.	37.
		(INCHES) .350	.704	.705	.705
		(AC-FT) 89.	178.	178.	178.

CUMULATIVE AREA = 4.74 SQ MI

*** ***

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           **************
           *            *
 115 KK    *     Cove   *     Reservoir
           *            *
           **************
                        Routing through Res'v

              HYDROGRAPH ROUTING DATA

 117 RS          STORAGE ROUTING
                      NSTPS           1  NUMBER OF SUBREACHES
                       ITYP        ELEV  TYPE OF INITIAL CONDITION
                     RSVRIC     5545.50  INITIAL CONDITION
                          X         .00 WORKING R AND D COEFFICIENT

 118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                 3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

 120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                               5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

 122 SL          LOW-LEVEL OUTLET
                      ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                      CAREA        4.91  CROSS-SECTIONAL AREA
                       COQL         .60  COEFFICIENT
                       EXPL         .50  EXPONENT OF HEAD

 123 SS          SPILLWAY
                       CREL     5549.20  SPILLWAY CREST ELEVATION
                      SPWID       30.00  SPILLWAY WIDTH
                       COQW        2.67  WEIR COEFFICIENT
                       EXPW        1.50  EXPONENT OF HEAD

 124 ST          TOP OF DAM
```

TOPEL	5552.00	ELEVATION AT TOP OF DAM
DAMWID	1892.00	DAM WIDTH
COQD	2.90	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1	0000		1	0.	5844.8	5545.5	1		2024	18	24.	5968.3	5546.5	2		1648	35	23.	5964.1	5546.5
1	0112		2	0.	5844.8	5545.5	1		2136	19	24.	5974.8	5546.6	2		1800	36	23.	5961.7	5546.5
1	0224		3	0.	5844.8	5545.5	1		2248	20	25.	5981.1	5546.6	2		1912	37	23.	5959.5	5546.4
1	0336		4	0.	5844.8	5545.5	2		0000	21	26.	5987.1	5546.7	2		2024	38	23.	5957.2	5546.4
1	0448		5	0.	5844.8	5545.5	2		0112	22	26.	5990.9	5546.7	2		2136	39	22.	5955.0	5546.4
1	0600		6	0.	5844.8	5545.5	2		0224	23	26.	5991.5	5546.7	2		2248	40	22.	5952.8	5546.4
1	0712		7	1.	5844.9	5545.5	2		0336	24	26.	5990.2	5546.7	3		0000	41	22.	5950.6	5546.4
1	0824		8	3.	5846.4	5545.5	2		0448	25	26.	5988.1	5546.7	3		0112	42	22.	5948.4	5546.4
1	0936		9	7.	5855.7	5545.6	2		0600	26	25.	5985.7	5546.7	3		0224	43	22.	5946.2	5546.3
1	1048		10	12.	5876.0	5545.8	2		0712	27	25.	5983.3	5546.6	3		0336	44	21.	5944.1	5546.3
1	1200		11	16.	5897.5	5545.9	2		0824	28	25.	5980.8	5546.6	3		0448	45	21.	5942.0	5546.3
1	1312		12	18.	5913.6	5546.1	2		0936	29	25.	5978.4	5546.6	3		0600	46	21.	5939.9	5546.3
1	1424		13	19.	5926.0	5546.2	2		1048	30	25.	5975.9	5546.6	3		0712	47	21.	5937.9	5546.3
1	1536		14	21.	5936.6	5546.3	2		1200	31	24.	5973.5	5546.6	3		0824	48	20.	5935.8	5546.2
1	1648		15	22.	5945.8	5546.3	2		1312	32	24.	5971.1	5546.5	3		0936	49	20.	5933.8	5546.2
1	1800		16	22.	5954.1	5546.4	2		1424	33	24.	5968.8	5546.5	3		1048	50	20.	5931.8	5546.2
1	1912		17	23.	5961.6	5546.5	2		1536	34	24.	5966.4	5546.5							

PEAK OUTFLOW IS 26. AT TIME 26.40 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	58.80-HR
+ (CFS)	(HR)				
		(CFS)			
+ 26.	26.40	26.	25.	19.	19.
		(INCHES) .050	.193	.362	.362
		(AC-FT) 13.	49.	91.	91.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (AC-FT)	(HR)				
5992.	26.40	5989.	5977.	5938.	5938.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (FEET)	(HR)				
5546.71	26.40	5546.69	5546.59	5546.27	5546.27

CUMULATIVE AREA = 4.74 SQ MI

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1
					1.00
HYDROGRAPH AT					
+	B1	.50	1	FLOW	19.
				TIME	10.80
ROUTED TO					
+	RB1	.50	1	FLOW	16.
				TIME	10.80
HYDROGRAPH AT					
+	B2	.44	1	FLOW	16.
				TIME	10.80
HYDROGRAPH AT					
+	B3	.28	1	FLOW	9.
				TIME	10.80
3 COMBINED AT					
+	C1	1.22	1	FLOW	41.
				TIME	10.80
ROUTED TO					
+	RC1	1.22	1	FLOW	35.
				TIME	10.80
HYDROGRAPH AT					
+	B4	.45	1	FLOW	18.
				TIME	10.80
HYDROGRAPH AT					
+	B5	.81	1	FLOW	34.
				TIME	10.80
3 COMBINED AT					
+	C2	2.48	1	FLOW	88.
				TIME	10.80
ROUTED TO					
+	RC2	2.48	1	FLOW	84.
				TIME	10.80
HYDROGRAPH AT					
+	B6	.15	1	FLOW	14.
				TIME	10.80
HYDROGRAPH AT					
+	B7	.33	1	FLOW	16.
				TIME	10.80
3 COMBINED AT					
+	C3	2.95	1	FLOW	115.
				TIME	10.80
ROUTED TO					
+	RC3	2.95	1	FLOW	99.
				TIME	12.00
HYDROGRAPH AT					
+	B8	1.01	1	FLOW	94.
				TIME	10.80
HYDROGRAPH AT					
+	B9	.24	1	FLOW	25.
				TIME	10.80
HYDROGRAPH AT					
+	B10	.13	1	FLOW	14.
				TIME	9.60
2 COMBINED AT					
+	C4	.37	1	FLOW	39.
				TIME	10.80
ROUTED TO					
+	RC4	.37	1	FLOW	39.
				TIME	10.80
HYDROGRAPH AT					
+	B11	.28	1	FLOW	27.
				TIME	10.80
4 COMBINED AT					
+	C5	4.61	1	FLOW	251.
				TIME	10.80

```
 HYDROGRAPH AT
+                  B12          .13     1   FLOW          10.
                                            TIME        10.80

  2 COMBINED AT
+                  Call        4.74     1   FLOW         261.
                                            TIME        10.80

 ROUTED TO
+                  Cove        4.74     1   FLOW          26.
                                            TIME        26.40

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     5546.71
                                            TIME        26.40
1
                                            SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                                (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                    INTERPOLATED TO
                                                                                 COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

          FOR PLAN = 1  RATIO=  .00
             RB1    MANE         7.20     18.90    676.80       .48     72.00     16.14    648.00         .48


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1277E+02 EXCESS= .0000E+00 OUTFLOW= .1278E+02 BASIN STORAGE= .3345E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
             RC1    MANE         7.20     40.76    669.60       .46     72.00     35.00    648.00         .46


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2976E+02 EXCESS= .0000E+00 OUTFLOW= .2977E+02 BASIN STORAGE= .3635E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC2    MANE         6.10     86.70    652.57       .49     72.00     84.43    648.00         .49


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .6439E+02 EXCESS= .0000E+00 OUTFLOW= .6439E+02 BASIN STORAGE= .3086E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC3    MANE        14.40    113.78    691.20       .53     72.00     99.11    720.00         .52


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .8293E+02 EXCESS= .0000E+00 OUTFLOW= .8298E+02 BASIN STORAGE= .8804E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
             RC4    MANE        13.06     39.45    600.61      1.11     72.00     38.67    648.00        1.11


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2195E+02 EXCESS= .0000E+00 OUTFLOW= .2195E+02 BASIN STORAGE= .2242E-02 PERCENT ERROR=    .0


1                              SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                             (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


      PLAN  1 .............                    INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                 ELEVATION         5545.50           5549.20          5552.00
                                 STORAGE             5845.             6508.            7347.
                                 OUTFLOW                0.               45.              435.


                       RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                         OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                        PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                       1.00      5546.71         .00       5992.        26.       .00        26.40         .00


 *** NORMAL END OF HEC-1 ***
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Storm Event 4. 25-year, 24-hour

```
1*************************************                                  *************************************
 *                                   *                                  *                                   *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                              *    U.S. ARMY CORPS OF ENGINEERS     *
 *              JUN   1998           *                                  *    HYDROLOGIC ENGINEERING CENTER    *
 *            VERSION 4.1            *                                  *         609 SECOND STREET           *
 *                                   *                                  *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   06AUG20  TIME  02:52:36   *                              *           (916) 756-1104            *
 *                                   *                                  *                                   *
 *************************************                                  *************************************

                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X        X     X         XX
                                                X     X  X        X               X
                                                XXXXXXX  XXXX     X        XXXXX  X
                                                X     X  X        X               X
                                                X     X  X        X     X         X
                                                X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                              HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   25-YR, 24-HR, AMC II
           13           ID
                        *Diagram
           14           JR    PREC     1.0
           15           IT      72       0       0      50
           16           IO       0
           17           IN      72
                        *

           18           KK   B1
           19           KM   Runoff from Basin 1
           20           BA   0.503
           21           PB    2.79
           22           PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
           23           PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
           24           PC   1.000
           25           LS       0    72.8
           26           UD    0.51
                        *

           27           KK   RB1
           28           KM   Route B1
           29           RD    4928    .045    .050           TRAP      20      20
                        *

           30           KK   B2
           31           KM   Runoff from Basin 2
           32           BA   0.436
           33           LS       0    72.5
           34           UD    0.52
                        *

           35           KK   B3
           36           KM   Runoff from Basin 3
           37           BA   0.279
           38           LS       0    71.0
           39           UD    0.39
                        *
1                                              HEC-1 INPUT                                                PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
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```
  40          KK   C1
  41          KM   Combine RB1, B2, B3
  42          HC       3
              *

  43          KK   RC1
  44          KM   Route RC1
  45          RD    7255    .060    .030           TRAP      20      20
              *

  46          KK   B4
  47          KM   Runoff from Basin 4
  48          BA   0.453
  49          LS       0    73.3
  50          UD    0.48
              *

  51          KK   B5
  52          KM   Runoff from Basin 5
  53          BA   0.805
  54          LS       0    74.1
  55          UD    0.63
              *

  56          KK   C2
  57          KM   Combine RC1, B4, B5
  58          HC       3
              *

  59          KK   RC2
  60          KM   Route C2
  61          RD    2380    .039    .030           TRAP      40       2
              *

  62          KK   B6
  63          KM   Runoff from Basin 6
  64          BA   0.150
  65          LS       0    84.3
  66          UD    0.19
              *

  67          KK   B7
  68          KM   Runoff from Basin 7
  69          BA   0.327
  70          LS       0    75.7
  71          UD    0.46
              *

  72          KK   C3
  73          KM   Combine RC2, B6, B7
  74          HC       3
              *
1                                        HEC-1 INPUT                                          PAGE  3

 LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


  75          KK   RC3
  76          KM   Route C3
  77          RD   11323    .023    .030           TRAP      40      20
              *

  78          KK   B8
  79          KM   Runoff from Basin 8
  80          BA   1.012
  81          LS       0    84.0
  82          UD    0.67
              *

  83          KK   B9
  84          KM   Runoff from Basin 9
  85          BA   0.242
  86          LS       0    85.5
  87          UD    0.26
              *

  88          KK   B10
  89          KM   Runoff from Basin 10
  90          BA   0.129
  91          LS       0    86.7
  92          UD    0.18
              *

  93          KK   C4
  94          KM   Combine B9, B10
  95          HC       2
              *

  96          KK   RC4
  97          KM   Route C4
  98          RD    3380    .037    .030           TRAP      40      20
              *
```

```
 99          KK   B11
100          KM   Runoff from Basin 11
101          BA   0.279
102          LS       0    84.8
103          UD    0.39
             *

104          KK   C5
105          KM   Combine RC3, B8, RC4, B11
106          HC       4
             *

107          KK   B12
108          KM   Runoff from Basin 12
109          BA   0.127
110          LS       0    81.2
111          UD    0.40
             *
1                                          HEC-1 INPUT                                          PAGE  4

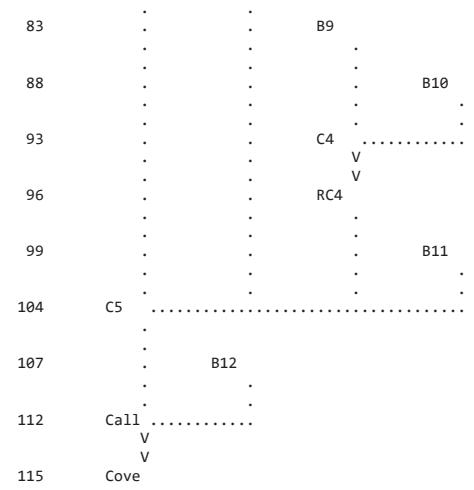
          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


112          KK   Call
113          KM   Combine C5, B12
114          HC       2
             *

115          KK   Cove Reservoir
116          KM   Routing through Res'v
117          RS       1    ELEV  5545.5
118          SV       0      19      95     240     453     738    1105    1563    2217    2773
119          SV    3542    4423    5419    6149    7347    8000
120          SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
121          SE    5530    5536    5542    5548    5552    5558
122          SL  5545.5   4.909     0.6     0.5
123          SS  5549.2      30    2.67     1.5
124          ST  5552.0    1892     2.9     1.5
             *
125          ZZ
1
               SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

    NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     18       B1
                  V
                  V
     27       RB1
                  .
                  .
     30           .       B2
                  .           .
                  .           .
     35           .           .       B3
                  .           .           .
                  .           .           .
     40       C1   ........................
                  V
                  V
     43       RC1
                  .
                  .
     46           .       B4
                  .           .
                  .           .
     51           .           .       B5
                  .           .           .
                  .           .           .
     56       C2   ........................
                  V
                  V
     59       RC2
                  .
                  .
     62           .       B6
                  .           .
                  .           .
     67           .           .       B7
                  .           .           .
                  .           .           .
     72       C3   ........................
                  V
                  V
     75       RC3
                  .
                  .
     78           .       B8
                  .           .
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
 *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
 *              JUN   1998               *
 *            VERSION 4.1                *
 *                                       *
 *  RUN DATE   06AUG20  TIME  02:52:36   *
 *                                       *
 *****************************************
```

```
*************************************
*                                   *
*    U.S. ARMY CORPS OF ENGINEERS     *
*    HYDROLOGIC ENGINEERING CENTER    *
*          609 SECOND STREET          *
*       DAVIS, CALIFORNIA 95616       *
*           (916) 756-1104            *
*                                   *
*************************************
```

HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

25-YR, 24-HR, AMC II

```
  16 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           0  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN          72  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ          50  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      3    0  ENDING DATE
                     NDTIME        1048  ENDING TIME
                     ICENT           19  CENTURY MARK

                   COMPUTATION INTERVAL    1.20 HOURS
                        TOTAL TIME BASE   58.80 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                       NPLAN           1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                    1.00
```

*** ***

*** ***

```
           **************
           *            *
 112 KK    *     Call   *
           *            *
           **************
                        Combine C5, B12

 114 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***
```

****

HYDROGRAPH AT STATION Call
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = 1.00

****

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		1536	14	162.	2		0712	27	0.	2		2248	40	0.
1		0112	2	0.	1		1648	15	144.	2		0824	28	0.	3		0000	41	0.
1		0224	3	0.	1		1800	16	137.	2		0936	29	0.	3		0112	42	0.
1		0336	4	0.	1		1912	17	125.	2		1048	30	0.	3		0224	43	0.
1		0448	5	0.	1		2024	18	119.	2		1200	31	0.	3		0336	44	0.
1		0600	6	0.	1		2136	19	117.	2		1312	32	0.	3		0448	45	0.
1		0712	7	6.	1		2248	20	118.	2		1424	33	0.	3		0600	46	0.
1		0824	8	59.	2		0000	21	108.	2		1536	34	0.	3		0712	47	0.
1		0936	9	288.	2		0112	22	59.	2		1648	35	0.	3		0824	48	0.
1		1048	10	396.	2		0224	23	23.	2		1800	36	0.	3		0936	49	0.
1		1200	11	290.	2		0336	24	9.	2		1912	37	0.	3		1048	50	0.
1		1312	12	216.	2		0448	25	3.	2		2024	38	0.					
1		1424	13	183.	2		0600	26	1.	2		2136	39	0.					

****

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	58.80-HR
(CFS)	(HR)				
		(CFS)			
396.	10.80	262.	128.	52.	52.
		(INCHES) .514	1.005	1.005	1.005
		(AC-FT) 130.	254.	254.	254.

CUMULATIVE AREA = 4.74 SQ MI

*** ***

```
           **************
           *            *
 115 KK    *     Cove   *     Reservoir
           *            *
           **************
                        Routing through Res'v

              HYDROGRAPH ROUTING DATA

 117 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC     5545.50  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

 118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                 3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

 120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                               5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

 122 SL          LOW-LEVEL OUTLET
                       ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                       CAREA        4.91  CROSS-SECTIONAL AREA
                        COQL         .60  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

 123 SS          SPILLWAY
                        CREL     5549.20  SPILLWAY CREST ELEVATION
                       SPWID       30.00  SPILLWAY WIDTH
                        COQW        2.67  WEIR COEFFICIENT
                        EXPW        1.50  EXPONENT OF HEAD

 124 ST          TOP OF DAM
```

TOPEL	5552.00	ELEVATION AT TOP OF DAM
DAMWID	1892.00	DAM WIDTH
COQD	2.90	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1	0000		1	0.	5844.8	5545.5	1	2024		18	29.	6028.3	5547.0	2	1648		35	29.	6026.4	5547.0
1	0112		2	0.	5844.8	5545.5	1	2136		19	30.	6037.1	5547.1	2	1800		36	29.	6023.5	5547.0
1	0224		3	0.	5844.8	5545.5	1	2248		20	30.	6045.7	5547.2	2	1912		37	28.	6020.7	5546.9
1	0336		4	0.	5844.8	5545.5	2	0000		21	31.	6053.9	5547.2	2	2024		38	28.	6017.9	5546.9
1	0448		5	0.	5844.8	5545.5	2	0112		22	31.	6059.1	5547.3	2	2136		39	28.	6015.1	5546.9
1	0600		6	0.	5844.8	5545.5	2	0224		23	31.	6060.1	5547.3	2	2248		40	28.	6012.4	5546.9
1	0712		7	1.	5845.1	5545.5	2	0336		24	31.	6058.5	5547.3	3	0000		41	27.	6009.6	5546.9
1	0824		8	4.	5848.0	5545.5	2	0448		25	31.	6056.0	5547.2	3	0112		42	27.	6006.9	5546.8
1	0936		9	10.	5864.6	5545.7	2	0600		26	31.	6053.1	5547.2	3	0224		43	27.	6004.2	5546.8
1	1048		10	16.	5897.3	5545.9	2	0712		27	31.	6050.0	5547.2	3	0336		44	27.	6001.6	5546.8
1	1200		11	20.	5929.6	5546.2	2	0824		28	30.	6047.0	5547.2	3	0448		45	27.	5998.9	5546.8
1	1312		12	22.	5952.7	5546.4	2	0936		29	30.	6044.0	5547.1	3	0600		46	26.	5996.3	5546.7
1	1424		13	24.	5970.2	5546.5	2	1048		30	30.	6041.0	5547.1	3	0712		47	26.	5993.6	5546.7
1	1536		14	25.	5984.9	5546.7	2	1200		31	30.	6038.0	5547.1	3	0824		48	26.	5991.1	5546.7
1	1648		15	26.	5997.5	5546.8	2	1312		32	30.	6035.1	5547.1	3	0936		49	26.	5988.5	5546.7
1	1800		16	27.	6008.8	5546.8	2	1424		33	29.	6032.1	5547.0	3	1048		50	25.	5986.0	5546.7
1	1912		17	28.	6019.0	5546.9	2	1536		34	29.	6029.2	5547.0							

PEAK OUTFLOW IS 31. AT TIME 26.40 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	58.80-HR
+ (CFS)	(HR)				
		(CFS)			
+ 31.	26.40	31.	30.	23.	23.
		(INCHES) .061	.236	.447	.447
		(AC-FT) 15.	60.	113.	113.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (AC-FT)	(HR)				
6060.	26.40	6057.	6042.	5986.	5986.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (FEET)	(HR)				
5547.27	26.40	5547.25	5547.12	5546.66	5546.66

CUMULATIVE AREA = 4.74 SQ MI

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1
					1.00
HYDROGRAPH AT					
+	B1	.50	1	FLOW	31.
				TIME	10.80
ROUTED TO					
+	RB1	.50	1	FLOW	29.
				TIME	10.80
HYDROGRAPH AT					
+	B2	.44	1	FLOW	27.
				TIME	10.80
HYDROGRAPH AT					
+	B3	.28	1	FLOW	15.
				TIME	10.80
3 COMBINED AT					
+	C1	1.22	1	FLOW	70.
				TIME	10.80
ROUTED TO					
+	RC1	1.22	1	FLOW	64.
				TIME	10.80
HYDROGRAPH AT					
+	B4	.45	1	FLOW	29.
				TIME	10.80
HYDROGRAPH AT					
+	B5	.81	1	FLOW	55.
				TIME	10.80
3 COMBINED AT					
+	C2	2.48	1	FLOW	148.
				TIME	10.80
ROUTED TO					
+	RC2	2.48	1	FLOW	145.
				TIME	10.80
HYDROGRAPH AT					
+	B6	.15	1	FLOW	20.
				TIME	9.60
HYDROGRAPH AT					
+	B7	.33	1	FLOW	25.
				TIME	10.80
3 COMBINED AT					
+	C3	2.95	1	FLOW	190.
				TIME	10.80
ROUTED TO					
+	RC3	2.95	1	FLOW	166.
				TIME	10.80
HYDROGRAPH AT					
+	B8	1.01	1	FLOW	128.
				TIME	10.80
HYDROGRAPH AT					
+	B9	.24	1	FLOW	34.
				TIME	9.60
HYDROGRAPH AT					
+	B10	.13	1	FLOW	20.
				TIME	9.60
2 COMBINED AT					
+	C4	.37	1	FLOW	54.
				TIME	9.60
ROUTED TO					
+	RC4	.37	1	FLOW	52.
				TIME	10.80
HYDROGRAPH AT					
+	B11	.28	1	FLOW	38.
				TIME	9.60
4 COMBINED AT					
+	C5	4.61	1	FLOW	383.
				TIME	10.80

```
 HYDROGRAPH AT
+                  B12          .13     1   FLOW          14.
                                            TIME        10.80

  2 COMBINED AT
+                  Call        4.74     1   FLOW         396.
                                            TIME        10.80

 ROUTED TO
+                  Cove        4.74     1   FLOW          31.
                                            TIME        26.40

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     5547.27
                                            TIME        26.40
1
                                            SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                                (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                    INTERPOLATED TO
                                                                                 COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

          FOR PLAN = 1  RATIO=  .00
             RB1    MANE        10.80     30.91    669.60       .72     72.00     28.63    648.00         .73


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1937E+02 EXCESS= .0000E+00 OUTFLOW= .1938E+02 BASIN STORAGE= .4507E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
             RC1    MANE        10.80     69.48    669.60       .70     72.00     64.10    648.00         .71


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .4557E+02 EXCESS= .0000E+00 OUTFLOW= .4558E+02 BASIN STORAGE= .4033E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC2    MANE         5.04    146.95    655.56       .74     72.00    145.12    648.00         .74


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .9743E+02 EXCESS= .0000E+00 OUTFLOW= .9744E+02 BASIN STORAGE= .3141E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC3    MANE        14.40    187.14    676.80       .79     72.00    165.61    648.00         .78


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1237E+03 EXCESS= .0000E+00 OUTFLOW= .1237E+03 BASIN STORAGE= .1170E-01 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
             RC4    MANE        11.89     54.51    594.33      1.48     72.00     52.02    648.00        1.48


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2925E+02 EXCESS= .0000E+00 OUTFLOW= .2926E+02 BASIN STORAGE= .2520E-02 PERCENT ERROR=    .0


1                                SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                               (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


      PLAN  1 .............                    INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                  ELEVATION        5545.50           5549.20          5552.00
                                  STORAGE             5845.             6508.            7347.
                                  OUTFLOW                0.               45.              435.


                        RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                          OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                         PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                        1.00      5547.27         .00       6060.        31.       .00        26.40         .00


 *** NORMAL END OF HEC-1 ***
```

Storm Event 5. 50-year, 24-hour

```
1*************************************                                  *************************************
 *                                   *                                  *                                   *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                              *    U.S. ARMY CORPS OF ENGINEERS     *
 *              JUN   1998           *                                  *    HYDROLOGIC ENGINEERING CENTER    *
 *            VERSION 4.1            *                                  *         609 SECOND STREET           *
 *                                   *                                  *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   06AUG20  TIME  02:53:04   *                              *           (916) 756-1104            *
 *                                   *                                  *                                   *
 *************************************                                  *************************************

                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X        X     X         XX
                                                X     X  X        X               X
                                                XXXXXXX  XXXX     X        XXXXX  X
                                                X     X  X        X               X
                                                X     X  X        X     X         X
                                                X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                              HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   50-YR, 24-HR, AMC II
           13           ID
                        *Diagram
           14           JR    PREC     1.0
           15           IT      72       0       0      50
           16           IO       0
           17           IN      72
                        *

           18           KK   B1
           19           KM   Runoff from Basin 1
           20           BA   0.503
           21           PB    3.14
           22           PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
           23           PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
           24           PC   1.000
           25           LS       0    72.8
           26           UD    0.51
                        *

           27           KK   RB1
           28           KM   Route B1
           29           RD    4928    .045    .050           TRAP      20      20
                        *

           30           KK   B2
           31           KM   Runoff from Basin 2
           32           BA   0.436
           33           LS       0    72.5
           34           UD    0.52
                        *

           35           KK   B3
           36           KM   Runoff from Basin 3
           37           BA   0.279
           38           LS       0    71.0
           39           UD    0.39
                        *
1                                              HEC-1 INPUT                                                PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
            40          KK   C1
            41          KM   Combine RB1, B2, B3
            42          HC       3
                        *

            43          KK   RC1
            44          KM   Route RC1
            45          RD    7255    .060    .030           TRAP      20      20
                        *

            46          KK   B4
            47          KM   Runoff from Basin 4
            48          BA   0.453
            49          LS       0    73.3
            50          UD    0.48
                        *

            51          KK   B5
            52          KM   Runoff from Basin 5
            53          BA   0.805
            54          LS       0    74.1
            55          UD    0.63
                        *

            56          KK   C2
            57          KM   Combine RC1, B4, B5
            58          HC       3
                        *

            59          KK   RC2
            60          KM   Route C2
            61          RD    2380    .039    .030           TRAP      40       2
                        *

            62          KK   B6
            63          KM   Runoff from Basin 6
            64          BA   0.150
            65          LS       0    84.3
            66          UD    0.19
                        *

            67          KK   B7
            68          KM   Runoff from Basin 7
            69          BA   0.327
            70          LS       0    75.7
            71          UD    0.46
                        *

            72          KK   C3
            73          KM   Combine RC2, B6, B7
            74          HC       3
                        *
1                                          HEC-1 INPUT                                          PAGE  3

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            75          KK   RC3
            76          KM   Route C3
            77          RD   11323    .023    .030           TRAP      40      20
                        *

            78          KK   B8
            79          KM   Runoff from Basin 8
            80          BA   1.012
            81          LS       0    84.0
            82          UD    0.67
                        *

            83          KK   B9
            84          KM   Runoff from Basin 9
            85          BA   0.242
            86          LS       0    85.5
            87          UD    0.26
                        *

            88          KK   B10
            89          KM   Runoff from Basin 10
            90          BA   0.129
            91          LS       0    86.7
            92          UD    0.18
                        *

            93          KK   C4
            94          KM   Combine B9, B10
            95          HC       2
                        *

            96          KK   RC4
            97          KM   Route C4
            98          RD    3380    .037    .030           TRAP      40      20
                        *
```

```
 99          KK   B11
100          KM   Runoff from Basin 11
101          BA   0.279
102          LS       0    84.8
103          UD    0.39
             *

104          KK   C5
105          KM   Combine RC3, B8, RC4, B11
106          HC       4
             *

107          KK   B12
108          KM   Runoff from Basin 12
109          BA   0.127
110          LS       0    81.2
111          UD    0.40
             *
1                                          HEC-1 INPUT                                          PAGE  4

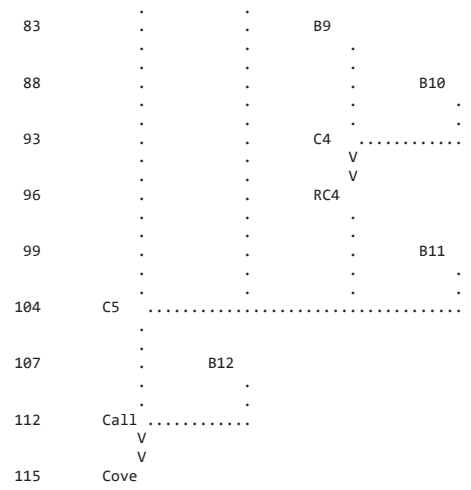
          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


112          KK   Call
113          KM   Combine C5, B12
114          HC       2
             *

115          KK   Cove Reservoir
116          KM   Routing through Res'v
117          RS       1    ELEV  5545.5
118          SV       0      19      95     240     453     738    1105    1563    2217    2773
119          SV    3542    4423    5419    6149    7347    8000
120          SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
121          SE    5530    5536    5542    5548    5552    5558
122          SL  5545.5   4.909     0.6     0.5
123          SS  5549.2      30    2.67     1.5
124          ST  5552.0    1892     2.9     1.5
             *
125          ZZ
1
               SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    18       B1
                 V
                 V
    27       RB1
                 .
                 .
    30           .       B2
                 .           .
                 .           .
    35           .           .       B3
                 .           .           .
                 .           .           .
    40       C1   ........................
                 V
                 V
    43       RC1
                 .
                 .
    46           .       B4
                 .           .
                 .           .
    51           .           .       B5
                 .           .           .
                 .           .           .
    56       C2   ........................
                 V
                 V
    59       RC2
                 .
                 .
    62           .       B6
                 .           .
                 .           .
    67           .           .       B7
                 .           .           .
                 .           .           .
    72       C3   ........................
                 V
                 V
    75       RC3
                 .
                 .
    78           .       B8
                 .           .
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************                    *****************************************
 *                                       *                    *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *    U.S. ARMY CORPS OF ENGINEERS       *
 *              JUN   1998               *                    *    HYDROLOGIC ENGINEERING CENTER      *
 *            VERSION 4.1                *                    *          609 SECOND STREET            *
 *                                       *                    *       DAVIS, CALIFORNIA 95616         *
 *  RUN DATE   06AUG20  TIME  02:53:04   *                    *           (916) 756-1104              *
 *                                       *                    *                                       *
 *****************************************                    *****************************************
```

HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

50-YR, 24-HR, AMC II

```
  16 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           0  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN          72  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ          50  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      3    0  ENDING DATE
                     NDTIME        1048  ENDING TIME
                     ICENT           19  CENTURY MARK

                  COMPUTATION INTERVAL    1.20 HOURS
                       TOTAL TIME BASE   58.80 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                       NPLAN           1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                    1.00


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
```

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 112 KK    *     Call   *
           *            *
           **************
                        Combine C5, B12

 114 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

*****************************************************************************************************************************************

                                                HYDROGRAPH AT STATION    Call
                                                     SUM OF  2 HYDROGRAPHS
                                                    PLAN 1,   RATIO =  1.00

*****************************************************************************************************************************************
                                *                                *                                *                                *
   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW
                                *                                *                                *
    1     0000    1        0.   *    1     1536   14       196.   *    2     0712   27        0.   *    2     2248   40        0.
    1     0112    2        0.   *    1     1648   15       174.   *    2     0824   28        0.   *    3     0000   41        0.
    1     0224    3        0.   *    1     1800   16       165.   *    2     0936   29        0.   *    3     0112   42        0.
    1     0336    4        0.   *    1     1912   17       150.   *    2     1048   30        0.   *    3     0224   43        0.
    1     0448    5        0.   *    1     2024   18       142.   *    2     1200   31        0.   *    3     0336   44        0.
    1     0600    6        1.   *    1     2136   19       140.   *    2     1312   32        0.   *    3     0448   45        0.
    1     0712    7       12.   *    1     2248   20       141.   *    2     1424   33        0.   *    3     0600   46        0.
    1     0824    8       85.   *    2     0000   21       129.   *    2     1536   34        0.   *    3     0712   47        0.
    1     0936    9      398.   *    2     0112   22        69.   *    2     1648   35        0.   *    3     0824   48        0.
    1     1048   10      506.   *    2     0224   23        28.   *    2     1800   36        0.   *    3     0936   49        0.
    1     1200   11      362.   *    2     0336   24         9.   *    2     1912   37        0.   *    3     1048   50        0.
    1     1312   12      268.   *    2     0448   25         3.   *    2     2024   38        0.   *
    1     1424   13      223.   *    2     0600   26         1.   *    2     2136   39        0.   *
                                *                                *                                *
*****************************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR     58.80-HR
+   (CFS)       (HR)
                      (CFS)
+     506.     10.80                338.         160.          65.          65.
                    (INCHES)      .662        1.254        1.255        1.255
                     (AC-FT)      167.         317.         317.         317.

                     CUMULATIVE AREA =    4.74 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 115 KK    *     Cove   *     Reservoir
           *            *
           **************
                        Routing through Res'v

              HYDROGRAPH ROUTING DATA

 117 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC     5545.50  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

 118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                  3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

 120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                               5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

 122 SL          LOW-LEVEL OUTLET
                       ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                       CAREA        4.91  CROSS-SECTIONAL AREA
                        COQL         .60  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

 123 SS          SPILLWAY
                        CREL     5549.20  SPILLWAY CREST ELEVATION
                       SPWID       30.00  SPILLWAY WIDTH
                        COQW        2.67  WEIR COEFFICIENT
                        EXPW        1.50  EXPONENT OF HEAD

 124 ST          TOP OF DAM
```

TOPEL	5552.00	ELEVATION AT TOP OF DAM
DAMWID	1892.00	DAM WIDTH
COQD	2.90	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1	0000		1	0.	5844.8	5545.5	1	2024		18	33.	6079.1	5547.4	2	1648		35	33.	6079.8	5547.4
1	0112		2	0.	5844.8	5545.5	1	2136		19	34.	6089.8	5547.5	2	1800		36	33.	6076.5	5547.4
1	0224		3	0.	5844.8	5545.5	1	2248		20	34.	6100.3	5547.6	2	1912		37	32.	6073.3	5547.4
1	0336		4	0.	5844.8	5545.5	2	0000		21	35.	6110.3	5547.7	2	2024		38	32.	6070.1	5547.4
1	0448		5	0.	5844.8	5545.5	2	0112		22	35.	6116.6	5547.7	2	2136		39	32.	6067.0	5547.3
1	0600		6	0.	5844.8	5545.5	2	0224		23	35.	6117.8	5547.7	2	2248		40	32.	6063.8	5547.3
1	0712		7	2.	5845.4	5545.5	2	0336		24	35.	6116.1	5547.7	3	0000		41	31.	6060.7	5547.3
1	0824		8	5.	5849.9	5545.5	2	0448		25	35.	6113.2	5547.7	3	0112		42	31.	6057.6	5547.2
1	0936		9	11.	5873.1	5545.7	2	0600		26	35.	6109.9	5547.7	3	0224		43	31.	6054.5	5547.2
1	1048		10	18.	5916.5	5546.1	2	0712		27	35.	6106.5	5547.7	3	0336		44	31.	6051.4	5547.2
1	1200		11	23.	5957.5	5546.4	2	0824		28	34.	6103.1	5547.6	3	0448		45	31.	6048.4	5547.2
1	1312		12	25.	5986.4	5546.7	2	0936		29	34.	6099.8	5547.6	3	0600		46	30.	6045.3	5547.1
1	1424		13	27.	6008.1	5546.8	2	1048		30	34.	6096.4	5547.6	3	0712		47	30.	6042.4	5547.1
1	1536		14	29.	6026.1	5547.0	2	1200		31	34.	6093.0	5547.5	3	0824		48	30.	6039.4	5547.1
1	1648		15	30.	6041.5	5547.1	2	1312		32	34.	6089.7	5547.5	3	0936		49	30.	6036.4	5547.1
1	1800		16	31.	6055.3	5547.2	2	1424		33	33.	6086.3	5547.5	3	1048		50	29.	6033.5	5547.1
1	1912		17	32.	6067.8	5547.3	2	1536		34	33.	6083.1	5547.5							

PEAK OUTFLOW IS 35. AT TIME 26.40 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	58.80-HR
+ (CFS)	(HR)				
		(CFS)			
+ 35.	26.40	35.	34.	27.	27.
		(INCHES) .069	.267	.509	.509
		(AC-FT) 17.	67.	129.	129.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (AC-FT)	(HR)				
6118.	26.40	6115.	6097.	6028.	6028.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (FEET)	(HR)				
5547.74	26.40	5547.72	5547.57	5547.00	5547.00

CUMULATIVE AREA = 4.74 SQ MI

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1
					1.00
HYDROGRAPH AT					
+	B1	.50	1	FLOW	42.
				TIME	10.80
ROUTED TO					
+	RB1	.50	1	FLOW	39.
				TIME	10.80
HYDROGRAPH AT					
+	B2	.44	1	FLOW	36.
				TIME	10.80
HYDROGRAPH AT					
+	B3	.28	1	FLOW	20.
				TIME	10.80
3 COMBINED AT					
+	C1	1.22	1	FLOW	95.
				TIME	10.80
ROUTED TO					
+	RC1	1.22	1	FLOW	89.
				TIME	10.80
HYDROGRAPH AT					
+	B4	.45	1	FLOW	39.
				TIME	10.80
HYDROGRAPH AT					
+	B5	.81	1	FLOW	73.
				TIME	10.80
3 COMBINED AT					
+	C2	2.48	1	FLOW	201.
				TIME	10.80
ROUTED TO					
+	RC2	2.48	1	FLOW	198.
				TIME	10.80
HYDROGRAPH AT					
+	B6	.15	1	FLOW	24.
				TIME	9.60
HYDROGRAPH AT					
+	B7	.33	1	FLOW	33.
				TIME	10.80
3 COMBINED AT					
+	C3	2.95	1	FLOW	254.
				TIME	10.80
ROUTED TO					
+	RC3	2.95	1	FLOW	226.
				TIME	10.80
HYDROGRAPH AT					
+	B8	1.01	1	FLOW	156.
				TIME	10.80
HYDROGRAPH AT					
+	B9	.24	1	FLOW	43.
				TIME	9.60
HYDROGRAPH AT					
+	B10	.13	1	FLOW	24.
				TIME	9.60
2 COMBINED AT					
+	C4	.37	1	FLOW	67.
				TIME	9.60
ROUTED TO					
+	RC4	.37	1	FLOW	63.
				TIME	10.80
HYDROGRAPH AT					
+	B11	.28	1	FLOW	47.
				TIME	9.60
4 COMBINED AT					
+	C5	4.61	1	FLOW	489.
				TIME	10.80

```
 HYDROGRAPH AT
+                  B12          .13     1   FLOW          17.
                                            TIME        10.80

  2 COMBINED AT
+                  Call        4.74     1   FLOW         506.
                                            TIME        10.80

 ROUTED TO
+                  Cove        4.74     1   FLOW          35.
                                            TIME        26.40

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     5547.74
                                            TIME        26.40
1
                                            SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                                (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                    INTERPOLATED TO
                                                                                 COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

           FOR PLAN = 1  RATIO=  .00
              RB1    MANE        10.80     41.28    669.60       .93     72.00     39.32    648.00         .94


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2506E+02 EXCESS= .0000E+00 OUTFLOW= .2507E+02 BASIN STORAGE= .3252E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC1    MANE        10.80     93.85    669.60       .91     72.00     89.39    648.00         .92


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5909E+02 EXCESS= .0000E+00 OUTFLOW= .5910E+02 BASIN STORAGE= .3497E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC2    MANE         4.52    199.61    651.21       .95     72.00    197.63    648.00         .95


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1257E+03 EXCESS= .0000E+00 OUTFLOW= .1257E+03 BASIN STORAGE= .3088E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC3    MANE        18.00    247.22    666.00      1.01     72.00    225.83    648.00        1.01


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1584E+03 EXCESS= .0000E+00 OUTFLOW= .1585E+03 BASIN STORAGE= .1185E-01 PERCENT ERROR=   -.1


           FOR PLAN = 1  RATIO=  .00
              RC4    MANE        11.21     66.99    594.15      1.78     72.00     62.77    648.00        1.78


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3515E+02 EXCESS= .0000E+00 OUTFLOW= .3516E+02 BASIN STORAGE= .2436E-02 PERCENT ERROR=    .0


1                               SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                              (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


       PLAN  1 .............                    INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                 ELEVATION         5545.50           5549.20          5552.00
                                 STORAGE             5845.             6508.            7347.
                                 OUTFLOW                0.               45.              435.


                        RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                          OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                         PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                        1.00      5547.74         .00       6118.        35.        .00        26.40         .00


 *** NORMAL END OF HEC-1 ***
```

Storm Event 6. 100-year, 24-hour

```
1*************************************                                  *************************************
 *                                   *                                  *                                   *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                              *    U.S. ARMY CORPS OF ENGINEERS     *
 *              JUN   1998           *                                  *    HYDROLOGIC ENGINEERING CENTER    *
 *            VERSION 4.1            *                                  *         609 SECOND STREET           *
 *                                   *                                  *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   06AUG20  TIME  02:53:31   *                              *           (916) 756-1104            *
 *                                   *                                  *                                   *
 *************************************                                  *************************************

                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X        X     X         XX
                                                X     X  X        X               X
                                                XXXXXXX  XXXX     X        XXXXX  X
                                                X     X  X        X               X
                                                X     X  X        X     X         X
                                                X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                              HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   100-YR, 24-HR, AMC II
           13           ID
                        *Diagram
           14           JR    PREC     1.0
           15           IT      72       0       0      50
           16           IO       0
           17           IN      72
                        *

           18           KK   B1
           19           KM   Runoff from Basin 1
           20           BA   0.503
           21           PB    3.51
           22           PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
           23           PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
           24           PC   1.000
           25           LS       0    72.8
           26           UD    0.51
                        *

           27           KK   RB1
           28           KM   Route B1
           29           RD    4928    .045    .050           TRAP      20      20
                        *

           30           KK   B2
           31           KM   Runoff from Basin 2
           32           BA   0.436
           33           LS       0    72.5
           34           UD    0.52
                        *

           35           KK   B3
           36           KM   Runoff from Basin 3
           37           BA   0.279
           38           LS       0    71.0
           39           UD    0.39
                        *
1                                              HEC-1 INPUT                                                PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
 40          KK   C1
 41          KM   Combine RB1, B2, B3
 42          HC       3
             *

 43          KK   RC1
 44          KM   Route RC1
 45          RD    7255    .060    .030           TRAP      20      20
             *

 46          KK   B4
 47          KM   Runoff from Basin 4
 48          BA   0.453
 49          LS       0    73.3
 50          UD    0.48
             *

 51          KK   B5
 52          KM   Runoff from Basin 5
 53          BA   0.805
 54          LS       0    74.1
 55          UD    0.63
             *

 56          KK   C2
 57          KM   Combine RC1, B4, B5
 58          HC       3
             *

 59          KK   RC2
 60          KM   Route C2
 61          RD    2380    .039    .030           TRAP      40       2
             *

 62          KK   B6
 63          KM   Runoff from Basin 6
 64          BA   0.150
 65          LS       0    84.3
 66          UD    0.19
             *

 67          KK   B7
 68          KM   Runoff from Basin 7
 69          BA   0.327
 70          LS       0    75.7
 71          UD    0.46
             *

 72          KK   C3
 73          KM   Combine RC2, B6, B7
 74          HC       3
             *
1                                        HEC-1 INPUT                                          PAGE  3

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 75          KK   RC3
 76          KM   Route C3
 77          RD   11323    .023    .030           TRAP      40      20
             *

 78          KK   B8
 79          KM   Runoff from Basin 8
 80          BA   1.012
 81          LS       0    84.0
 82          UD    0.67
             *

 83          KK   B9
 84          KM   Runoff from Basin 9
 85          BA   0.242
 86          LS       0    85.5
 87          UD    0.26
             *

 88          KK   B10
 89          KM   Runoff from Basin 10
 90          BA   0.129
 91          LS       0    86.7
 92          UD    0.18
             *

 93          KK   C4
 94          KM   Combine B9, B10
 95          HC       2
             *

 96          KK   RC4
 97          KM   Route C4
 98          RD    3380    .037    .030           TRAP      40      20
             *
```

```
 99          KK   B11
100          KM   Runoff from Basin 11
101          BA   0.279
102          LS       0    84.8
103          UD    0.39
             *

104          KK   C5
105          KM   Combine RC3, B8, RC4, B11
106          HC       4
             *

107          KK   B12
108          KM   Runoff from Basin 12
109          BA   0.127
110          LS       0    81.2
111          UD    0.40
             *
1                                          HEC-1 INPUT                                          PAGE  4

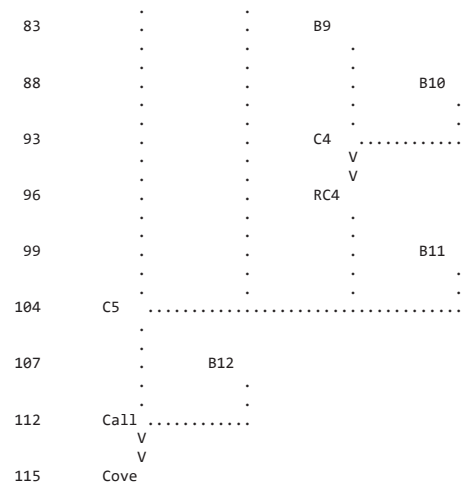
          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


112          KK   Call
113          KM   Combine C5, B12
114          HC       2
             *

115          KK   Cove Reservoir
116          KM   Routing through Res'v
117          RS       1    ELEV  5545.5
118          SV       0      19      95     240     453     738    1105    1563    2217    2773
119          SV    3542    4423    5419    6149    7347    8000
120          SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
121          SE    5530    5536    5542    5548    5552    5558
122          SL  5545.5   4.909     0.6     0.5
123          SS  5549.2      30    2.67     1.5
124          ST  5552.0    1892     2.9     1.5
             *
125          ZZ
1
               SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    18       B1
                 V
                 V
    27       RB1
                 .
                 .
    30           .       B2
                 .           .
                 .           .
    35           .           .       B3
                 .           .           .
                 .           .           .
    40       C1   ........................
                 V
                 V
    43       RC1
                 .
                 .
    46           .       B4
                 .           .
                 .           .
    51           .           .       B5
                 .           .           .
                 .           .           .
    56       C2   ........................
                 V
                 V
    59       RC2
                 .
                 .
    62           .       B6
                 .           .
                 .           .
    67           .           .       B7
                 .           .           .
                 .           .           .
    72       C3   ........................
                 V
                 V
    75       RC3
                 .
                 .
    78           .       B8
                 .           .
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************                    *****************************************
 *                                       *                    *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *    U.S. ARMY CORPS OF ENGINEERS       *
 *              JUN   1998               *                    *    HYDROLOGIC ENGINEERING CENTER      *
 *            VERSION 4.1                *                    *          609 SECOND STREET            *
 *                                       *                    *       DAVIS, CALIFORNIA 95616         *
 *  RUN DATE   06AUG20  TIME  02:53:31   *                    *           (916) 756-1104              *
 *                                       *                    *                                       *
 *****************************************                    *****************************************
```

HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

100-YR, 24-HR, AMC II

```
  16 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           0  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN          72  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ          50  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      3    0  ENDING DATE
                     NDTIME        1048  ENDING TIME
                     ICENT           19  CENTURY MARK

                  COMPUTATION INTERVAL    1.20 HOURS
                       TOTAL TIME BASE   58.80 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                       NPLAN           1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                    1.00


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
```

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 112 KK    *     Call   *
           *            *
           **************
                        Combine C5, B12

 114 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

*****************************************************************************************************************************************

                                                HYDROGRAPH AT STATION    Call
                                                     SUM OF  2 HYDROGRAPHS
                                                    PLAN 1,   RATIO =  1.00

*****************************************************************************************************************************************
                                *                                *                                *                                *
   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW
                                *                                *                                *
    1     0000    1        0.   *    1     1536   14       233.   *    2     0712   27        0.   *    2     2248   40        0.
    1     0112    2        0.   *    1     1648   15       206.   *    2     0824   28        0.   *    3     0000   41        0.
    1     0224    3        0.   *    1     1800   16       194.   *    2     0936   29        0.   *    3     0112   42        0.
    1     0336    4        0.   *    1     1912   17       177.   *    2     1048   30        0.   *    3     0224   43        0.
    1     0448    5        0.   *    1     2024   18       167.   *    2     1200   31        0.   *    3     0336   44        0.
    1     0600    6        3.   *    1     2136   19       165.   *    2     1312   32        0.   *    3     0448   45        0.
    1     0712    7       20.   *    1     2248   20       165.   *    2     1424   33        0.   *    3     0600   46        0.
    1     0824    8      116.   *    2     0000   21       150.   *    2     1536   34        0.   *    3     0712   47        0.
    1     0936    9      519.   *    2     0112   22        79.   *    2     1648   35        0.   *    3     0824   48        0.
    1     1048   10      632.   *    2     0224   23        32.   *    2     1800   36        0.   *    3     0936   49        0.
    1     1200   11      442.   *    2     0336   24        11.   *    2     1912   37        0.   *    3     1048   50        0.
    1     1312   12      321.   *    2     0448   25         3.   *    2     2024   38        0.   *
    1     1424   13      265.   *    2     0600   26         1.   *    2     2136   39        0.   *
                                *                                *                                *
*****************************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR     58.80-HR
+   (CFS)       (HR)
                        (CFS)
+     632.     10.80                  421.         195.          80.          80.
                       (INCHES)      .826        1.529        1.530        1.530
                        (AC-FT)      209.         387.         387.         387.

                        CUMULATIVE AREA =    4.74 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 115 KK    *     Cove   *     Reservoir
           *            *
           **************
                        Routing through Res'v

              HYDROGRAPH ROUTING DATA

 117 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC     5545.50  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

 118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                  3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

 120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                               5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

 122 SL          LOW-LEVEL OUTLET
                       ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                       CAREA        4.91  CROSS-SECTIONAL AREA
                        COQL         .60  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

 123 SS          SPILLWAY
                        CREL     5549.20  SPILLWAY CREST ELEVATION
                       SPWID       30.00  SPILLWAY WIDTH
                        COQW        2.67  WEIR COEFFICIENT
                        EXPW        1.50  EXPONENT OF HEAD

 124 ST          TOP OF DAM
```

TOPEL	5552.00	ELEVATION AT TOP OF DAM
DAMWID	1892.00	DAM WIDTH
COQD	2.90	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	5844.8	5545.5	1		2024	18	36.	6135.3	5547.9	2		1648	35	37.	6140.0	5547.9
1		0112	2	0.	5844.8	5545.5	1		2136	19	37.	6148.0	5548.0	2		1800	36	37.	6136.3	5547.9
1		0224	3	0.	5844.8	5545.5	1		2248	20	38.	6160.7	5548.0	2		1912	37	36.	6132.7	5547.9
1		0336	4	0.	5844.8	5545.5	2		0000	21	38.	6172.5	5548.1	2		2024	38	36.	6129.2	5547.8
1		0448	5	0.	5844.8	5545.5	2		0112	22	38.	6180.1	5548.1	2		2136	39	36.	6125.6	5547.8
1		0600	6	1.	5845.0	5545.5	2		0224	23	38.	6181.9	5548.1	2		2248	40	36.	6122.0	5547.8
1		0712	7	2.	5846.0	5545.5	2		0336	24	38.	6180.1	5548.1	3		0000	41	35.	6118.5	5547.7
1		0824	8	6.	5852.3	5545.6	2		0448	25	38.	6177.1	5548.1	3		0112	42	35.	6115.0	5547.7
1		0936	9	13.	5882.9	5545.8	2		0600	26	38.	6173.4	5548.1	3		0224	43	35.	6111.5	5547.7
1		1048	10	21.	5938.3	5546.3	2		0712	27	38.	6169.8	5548.1	3		0336	44	35.	6108.1	5547.7
1		1200	11	26.	5989.3	5546.7	2		0824	28	38.	6166.0	5548.1	3		0448	45	35.	6104.6	5547.6
1		1312	12	29.	6024.4	5547.0	2		0936	29	38.	6162.2	5548.0	3		0600	46	34.	6101.2	5547.6
1		1424	13	31.	6050.6	5547.2	2		1048	30	38.	6158.4	5548.0	3		0712	47	34.	6097.9	5547.6
1		1536	14	32.	6072.1	5547.4	2		1200	31	37.	6154.7	5548.0	3		0824	48	34.	6094.5	5547.6
1		1648	15	34.	6090.6	5547.5	2		1312	32	37.	6151.0	5548.0	3		0936	49	34.	6091.1	5547.5
1		1800	16	35.	6107.0	5547.7	2		1424	33	37.	6147.3	5548.0	3		1048	50	33.	6087.8	5547.5
1		1912	17	36.	6121.9	5547.8	2		1536	34	37.	6143.7	5548.0							

PEAK OUTFLOW IS 38. AT TIME 26.40 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	58.80-HR
+ (CFS)	(HR)				
		(CFS)			
+ 38.	26.40	38.	37.	30.	30.
		(INCHES) .075	.294	.568	.568
		(AC-FT) 19.	74.	144.	144.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (AC-FT)	(HR)				
6182.	26.40	6178.	6158.	6075.	6075.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (FEET)	(HR)				
5548.11	26.40	5548.10	5548.02	5547.36	5547.36

CUMULATIVE AREA = 4.74 SQ MI

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1
					1.00
HYDROGRAPH AT					
+	B1	.50	1	FLOW	54.
				TIME	10.80
ROUTED TO					
+	RB1	.50	1	FLOW	51.
				TIME	10.80
HYDROGRAPH AT					
+	B2	.44	1	FLOW	46.
				TIME	10.80
HYDROGRAPH AT					
+	B3	.28	1	FLOW	27.
				TIME	10.80
3 COMBINED AT					
+	C1	1.22	1	FLOW	124.
				TIME	10.80
ROUTED TO					
+	RC1	1.22	1	FLOW	118.
				TIME	10.80
HYDROGRAPH AT					
+	B4	.45	1	FLOW	50.
				TIME	10.80
HYDROGRAPH AT					
+	B5	.81	1	FLOW	92.
				TIME	10.80
3 COMBINED AT					
+	C2	2.48	1	FLOW	260.
				TIME	10.80
ROUTED TO					
+	RC2	2.48	1	FLOW	257.
				TIME	10.80
HYDROGRAPH AT					
+	B6	.15	1	FLOW	30.
				TIME	9.60
HYDROGRAPH AT					
+	B7	.33	1	FLOW	41.
				TIME	10.80
3 COMBINED AT					
+	C3	2.95	1	FLOW	326.
				TIME	10.80
ROUTED TO					
+	RC3	2.95	1	FLOW	298.
				TIME	10.80
HYDROGRAPH AT					
+	B8	1.01	1	FLOW	190.
				TIME	9.60
HYDROGRAPH AT					
+	B9	.24	1	FLOW	51.
				TIME	9.60
HYDROGRAPH AT					
+	B10	.13	1	FLOW	29.
				TIME	9.60
2 COMBINED AT					
+	C4	.37	1	FLOW	81.
				TIME	9.60
ROUTED TO					
+	RC4	.37	1	FLOW	74.
				TIME	10.80
HYDROGRAPH AT					
+	B11	.28	1	FLOW	57.
				TIME	9.60
4 COMBINED AT					
+	C5	4.61	1	FLOW	611.
				TIME	10.80

```
 HYDROGRAPH AT
+                  B12          .13     1   FLOW          21.
                                            TIME         9.60

  2 COMBINED AT
+                  Call        4.74     1   FLOW         632.
                                            TIME        10.80

 ROUTED TO
+                  Cove        4.74     1   FLOW          38.
                                            TIME        26.40

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     5548.11
                                            TIME        26.40
1
                                            SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                                (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                    INTERPOLATED TO
                                                                                 COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

          FOR PLAN = 1  RATIO=  .00
             RB1    MANE        10.80     52.87    669.60      1.17     72.00     51.47    648.00        1.18


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3151E+02 EXCESS= .0000E+00 OUTFLOW= .3152E+02 BASIN STORAGE= .3618E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC1    MANE        10.80    122.15    658.80      1.15     72.00    118.32    648.00        1.15


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .7446E+02 EXCESS= .0000E+00 OUTFLOW= .7448E+02 BASIN STORAGE= .3965E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC2    MANE         4.12    258.94    650.80      1.19     72.00    257.20    648.00        1.20


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1578E+03 EXCESS= .0000E+00 OUTFLOW= .1578E+03 BASIN STORAGE= .3030E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC3    MANE        18.00    321.28    666.00      1.25     72.00    298.28    648.00        1.26


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1975E+03 EXCESS= .0000E+00 OUTFLOW= .1976E+03 BASIN STORAGE= .8525E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
             RC4    MANE        10.64     80.58    595.79      2.10     72.00     74.24    648.00        2.11


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .4157E+02 EXCESS= .0000E+00 OUTFLOW= .4158E+02 BASIN STORAGE= .3047E-02 PERCENT ERROR=    .0


1                              SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                             (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


      PLAN  1 .............                    INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                ELEVATION         5545.50           5549.20          5552.00
                                STORAGE             5845.             6508.            7347.
                                OUTFLOW                0.               45.              435.


                       RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                         OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                        PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                       1.00      5548.11         .00       6182.        38.       .00        26.40         .00


 *** NORMAL END OF HEC-1 ***
```

Storm Event 7. 500-year, 24-hour

```
1*************************************                                  *************************************
 *                                   *                                  *                                   *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                              *    U.S. ARMY CORPS OF ENGINEERS     *
 *              JUN   1998           *                                  *    HYDROLOGIC ENGINEERING CENTER    *
 *            VERSION 4.1            *                                  *         609 SECOND STREET           *
 *                                   *                                  *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   06AUG20  TIME  02:53:56   *                              *           (916) 756-1104            *
 *                                   *                                  *                                   *
 *************************************                                  *************************************

                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X        X     X         XX
                                                X     X  X        X               X
                                                XXXXXXX  XXXX     X        XXXXX  X
                                                X     X  X        X               X
                                                X     X  X        X     X         X
                                                X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                              HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   500-YR, 24-HR, AMC II
           13           ID
                        *Diagram
           14           JR    PREC     1.0
           15           IT      72       0       0      50
           16           IO       0
           17           IN      72
                        *

           18           KK   B1
           19           KM   Runoff from Basin 1
           20           BA   0.503
           21           PB    4.69
           22           PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
           23           PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
           24           PC   1.000
           25           LS       0    72.8
           26           UD    0.51
                        *

           27           KK   RB1
           28           KM   Route B1
           29           RD    4928    .045    .050           TRAP      20      20
                        *

           30           KK   B2
           31           KM   Runoff from Basin 2
           32           BA   0.436
           33           LS       0    72.5
           34           UD    0.52
                        *

           35           KK   B3
           36           KM   Runoff from Basin 3
           37           BA   0.279
           38           LS       0    71.0
           39           UD    0.39
                        *
1                                              HEC-1 INPUT                                                PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
 40          KK   C1
 41          KM   Combine RB1, B2, B3
 42          HC       3
             *

 43          KK   RC1
 44          KM   Route RC1
 45          RD    7255    .060    .030           TRAP      20      20
             *

 46          KK   B4
 47          KM   Runoff from Basin 4
 48          BA   0.453
 49          LS       0    73.3
 50          UD    0.48
             *

 51          KK   B5
 52          KM   Runoff from Basin 5
 53          BA   0.805
 54          LS       0    74.1
 55          UD    0.63
             *

 56          KK   C2
 57          KM   Combine RC1, B4, B5
 58          HC       3
             *

 59          KK   RC2
 60          KM   Route C2
 61          RD    2380    .039    .030           TRAP      40       2
             *

 62          KK   B6
 63          KM   Runoff from Basin 6
 64          BA   0.150
 65          LS       0    84.3
 66          UD    0.19
             *

 67          KK   B7
 68          KM   Runoff from Basin 7
 69          BA   0.327
 70          LS       0    75.7
 71          UD    0.46
             *

 72          KK   C3
 73          KM   Combine RC2, B6, B7
 74          HC       3
             *
1                                        HEC-1 INPUT                                          PAGE  3

          LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 75          KK   RC3
 76          KM   Route C3
 77          RD   11323    .023    .030           TRAP      40      20
             *

 78          KK   B8
 79          KM   Runoff from Basin 8
 80          BA   1.012
 81          LS       0    84.0
 82          UD    0.67
             *

 83          KK   B9
 84          KM   Runoff from Basin 9
 85          BA   0.242
 86          LS       0    85.5
 87          UD    0.26
             *

 88          KK   B10
 89          KM   Runoff from Basin 10
 90          BA   0.129
 91          LS       0    86.7
 92          UD    0.18
             *

 93          KK   C4
 94          KM   Combine B9, B10
 95          HC       2
             *

 96          KK   RC4
 97          KM   Route C4
 98          RD    3380    .037    .030           TRAP      40      20
             *
```

```
 99          KK   B11
100          KM   Runoff from Basin 11
101          BA   0.279
102          LS       0    84.8
103          UD    0.39
             *

104          KK   C5
105          KM   Combine RC3, B8, RC4, B11
106          HC       4
             *

107          KK   B12
108          KM   Runoff from Basin 12
109          BA   0.127
110          LS       0    81.2
111          UD    0.40
             *
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


112          KK   Call
113          KM   Combine C5, B12
114          HC       2
             *

115          KK   Cove Reservoir
116          KM   Routing through Res'v
117          RS       1    ELEV  5545.5
118          SV       0      19      95     240     453     738    1105    1563    2217    2773
119          SV    3542    4423    5419    6149    7347    8000
120          SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
121          SE    5530    5536    5542    5548    5552    5558
122          SL  5545.5   4.909     0.6     0.5
123          SS  5549.2      30    2.67     1.5
124          ST  5552.0    1892     2.9     1.5
             *
125          ZZ
```

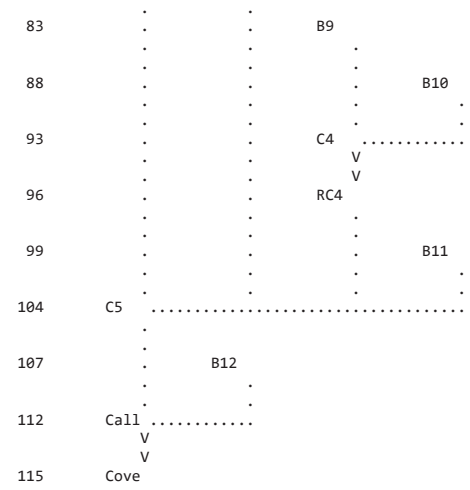
1

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

    NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     18      B1
                 V
                 V
     27      RB1
                 .
                 .
     30          .       B2
                 .           .
                 .           .
     35          .           .       B3
                 .           .           .
                 .           .           .
     40      C1   ........................
                 V
                 V
     43      RC1
                 .
                 .
     46          .       B4
                 .           .
                 .           .
     51          .           .       B5
                 .           .           .
                 .           .           .
     56      C2   ........................
                 V
                 V
     59      RC2
                 .
                 .
     62          .       B6
                 .           .
                 .           .
     67          .           .       B7
                 .           .           .
                 .           .           .
     72      C3   ........................
                 V
                 V
     75      RC3
                 .
                 .
     78          .       B8
                 .           .
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************                    *****************************************
 *                                       *                    *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *    U.S. ARMY CORPS OF ENGINEERS       *
 *              JUN   1998               *                    *    HYDROLOGIC ENGINEERING CENTER      *
 *            VERSION 4.1                *                    *          609 SECOND STREET            *
 *                                       *                    *       DAVIS, CALIFORNIA 95616         *
 *  RUN DATE   06AUG20  TIME  02:53:56   *                    *          (916) 756-1104               *
 *                                       *                    *                                       *
 *****************************************                    *****************************************
```

HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

500-YR, 24-HR, AMC II

```
  16 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           0  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN          72  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ          50  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      3    0  ENDING DATE
                     NDTIME        1048  ENDING TIME
                     ICENT           19  CENTURY MARK

                   COMPUTATION INTERVAL    1.20 HOURS
                        TOTAL TIME BASE   58.80 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                       NPLAN           1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                    1.00


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
```

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 112 KK    *     Call   *
           *            *
           **************
                        Combine C5, B12

 114 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

*****************************************************************************************************************************************************

                                                 HYDROGRAPH AT STATION    Call
                                                      SUM OF  2 HYDROGRAPHS
                                                     PLAN 1,   RATIO =  1.00

*****************************************************************************************************************************************************
                                *                                *                                *                                *
   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW
                                *                                *                                *
    1     0000    1        0.   *    1     1536   14       352.   *    2     0712   27        0.   *    2     2248   40        0.
    1     0112    2        0.   *    1     1648   15       309.   *    2     0824   28        0.   *    3     0000   41        0.
    1     0224    3        0.   *    1     1800   16       291.   *    2     0936   29        0.   *    3     0112   42        0.
    1     0336    4        0.   *    1     1912   17       263.   *    2     1048   30        0.   *    3     0224   43        0.
    1     0448    5        2.   *    1     2024   18       247.   *    2     1200   31        0.   *    3     0336   44        0.
    1     0600    6       17.   *    1     2136   19       244.   *    2     1312   32        0.   *    3     0448   45        0.
    1     0712    7       55.   *    1     2248   20       244.   *    2     1424   33        0.   *    3     0600   46        0.
    1     0824    8      257.   *    2     0000   21       221.   *    2     1536   34        0.   *    3     0712   47        0.
    1     0936    9      937.   *    2     0112   22       114.   *    2     1648   35        0.   *    3     0824   48        0.
    1     1048   10     1064.   *    2     0224   23        43.   *    2     1800   36        0.   *    3     0936   49        0.
    1     1200   11      711.   *    2     0336   24        13.   *    2     1912   37        0.   *    3     1048   50        0.
    1     1312   12      497.   *    2     0448   25         3.   *    2     2024   38        0.   *
    1     1424   13      404.   *    2     0600   26         1.   *    2     2136   39        0.   *
                                *                                *                                *
*****************************************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR     58.80-HR
+   (CFS)       (HR)
                        (CFS)
+    1064.     10.80                  708.         314.         128.         128.
                         (INCHES)     1.388        2.465        2.466        2.466
                          (AC-FT)      351.         623.         624.         624.

                        CUMULATIVE AREA =    4.74 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 115 KK    *     Cove   *     Reservoir
           *            *
           **************
                        Routing through Res'v

              HYDROGRAPH ROUTING DATA

 117 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC     5545.50  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

 118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                  3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

 120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                               5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

 122 SL          LOW-LEVEL OUTLET
                       ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                       CAREA        4.91  CROSS-SECTIONAL AREA
                        COQL         .60  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

 123 SS          SPILLWAY
                        CREL     5549.20  SPILLWAY CREST ELEVATION
                       SPWID       30.00  SPILLWAY WIDTH
                        COQW        2.67  WEIR COEFFICIENT
                        EXPW        1.50  EXPONENT OF HEAD

 124 ST          TOP OF DAM
```

TOPEL	5552.00	ELEVATION AT TOP OF DAM
DAMWID	1892.00	DAM WIDTH
COQD	2.90	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1	0000		1	0.	5844.8	5545.5	1	2024		18	42.	6333.4	5548.6	2	1648		35	42.	6361.0	5548.7
1	0112		2	0.	5844.8	5545.5	1	2136		19	42.	6353.6	5548.7	2	1800		36	42.	6356.8	5548.7
1	0224		3	0.	5844.8	5545.5	1	2248		20	43.	6373.6	5548.8	2	1912		37	42.	6352.6	5548.7
1	0336		4	0.	5844.8	5545.5	2	0000		21	43.	6392.5	5548.8	2	2024		38	42.	6348.3	5548.7
1	0448		5	1.	5845.0	5545.5	2	0112		22	43.	6404.8	5548.9	2	2136		39	42.	6344.2	5548.7
1	0600		6	2.	5845.8	5545.5	2	0224		23	43.	6408.3	5548.9	2	2248		40	42.	6340.1	5548.6
1	0712		7	4.	5849.1	5545.5	2	0336		24	43.	6406.8	5548.9	3	0000		41	42.	6336.0	5548.6
1	0824		8	9.	5863.8	5545.7	2	0448		25	43.	6403.3	5548.8	3	0112		42	42.	6331.9	5548.6
1	0936		9	19.	5921.6	5546.1	2	0600		26	43.	6399.2	5548.8	3	0224		43	42.	6327.9	5548.6
1	1048		10	28.	6018.5	5546.9	2	0712		27	43.	6395.0	5548.8	3	0336		44	41.	6323.8	5548.6
1	1200		11	34.	6103.4	5547.6	2	0824		28	43.	6390.7	5548.8	3	0448		45	41.	6319.7	5548.6
1	1312		12	38.	6159.7	5548.0	2	0936		29	43.	6386.5	5548.8	3	0600		46	41.	6315.6	5548.6
1	1424		13	39.	6200.6	5548.2	2	1048		30	43.	6382.3	5548.8	3	0712		47	41.	6311.5	5548.5
1	1536		14	39.	6234.3	5548.3	2	1200		31	43.	6378.0	5548.8	3	0824		48	41.	6307.4	5548.5
1	1648		15	40.	6263.1	5548.4	2	1312		32	43.	6373.8	5548.8	3	0936		49	41.	6303.3	5548.5
1	1800		16	41.	6288.8	5548.5	2	1424		33	42.	6369.5	5548.7	3	1048		50	41.	6299.2	5548.5
1	1912		17	41.	6312.2	5548.5	2	1536		34	42.	6365.3	5548.7							

PEAK OUTFLOW IS 43. AT TIME 26.40 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	58.80-HR
+ (CFS)	(HR)				
		(CFS)			
+ 43.	26.40	43.	43.	35.	35.
		(INCHES) .085	.335	.670	.670
		(AC-FT) 21.	85.	169.	169.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (AC-FT)	(HR)				
6408.	26.40	6404.	6380.	6245.	6245.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (FEET)	(HR)				
5548.87	26.40	5548.85	5548.77	5548.06	5548.06

CUMULATIVE AREA = 4.74 SQ MI

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1
					1.00
HYDROGRAPH AT					
+	B1	.50	1	FLOW	95.
				TIME	10.80
ROUTED TO					
+	RB1	.50	1	FLOW	96.
				TIME	10.80
HYDROGRAPH AT					
+	B2	.44	1	FLOW	82.
				TIME	10.80
HYDROGRAPH AT					
+	B3	.28	1	FLOW	49.
				TIME	10.80
3 COMBINED AT					
+	C1	1.22	1	FLOW	227.
				TIME	10.80
ROUTED TO					
+	RC1	1.22	1	FLOW	221.
				TIME	10.80
HYDROGRAPH AT					
+	B4	.45	1	FLOW	88.
				TIME	10.80
HYDROGRAPH AT					
+	B5	.81	1	FLOW	161.
				TIME	10.80
3 COMBINED AT					
+	C2	2.48	1	FLOW	469.
				TIME	10.80
ROUTED TO					
+	RC2	2.48	1	FLOW	467.
				TIME	10.80
HYDROGRAPH AT					
+	B6	.15	1	FLOW	48.
				TIME	9.60
HYDROGRAPH AT					
+	B7	.33	1	FLOW	70.
				TIME	9.60
3 COMBINED AT					
+	C3	2.95	1	FLOW	579.
				TIME	10.80
ROUTED TO					
+	RC3	2.95	1	FLOW	555.
				TIME	10.80
HYDROGRAPH AT					
+	B8	1.01	1	FLOW	307.
				TIME	9.60
HYDROGRAPH AT					
+	B9	.24	1	FLOW	81.
				TIME	9.60
HYDROGRAPH AT					
+	B10	.13	1	FLOW	45.
				TIME	9.60
2 COMBINED AT					
+	C4	.37	1	FLOW	126.
				TIME	9.60
ROUTED TO					
+	RC4	.37	1	FLOW	117.
				TIME	9.60
HYDROGRAPH AT					
+	B11	.28	1	FLOW	91.
				TIME	9.60
4 COMBINED AT					
+	C5	4.61	1	FLOW	1031.
				TIME	10.80

```
 HYDROGRAPH AT
+                  B12          .13     1   FLOW          36.
                                            TIME         9.60

  2 COMBINED AT
+                  Call        4.74     1   FLOW        1064.
                                            TIME        10.80

 ROUTED TO
+                  Cove        4.74     1   FLOW          43.
                                            TIME        26.40

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     5548.87
                                            TIME        26.40
1
                                            SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                                (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                    INTERPOLATED TO
                                                                                 COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

          FOR PLAN = 1  RATIO=  .00
             RB1    MANE        14.40     95.90    648.00      2.02     72.00     95.90    648.00        2.04


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5431E+02 EXCESS= .0000E+00 OUTFLOW= .5432E+02 BASIN STORAGE= .4285E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC1    MANE        13.43    223.85    658.04      1.99     72.00    220.85    648.00        2.00


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1292E+03 EXCESS= .0000E+00 OUTFLOW= .1293E+03 BASIN STORAGE= .3778E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC2    MANE         3.33    467.63    649.64      2.05     72.00    466.77    648.00        2.06


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2710E+03 EXCESS= .0000E+00 OUTFLOW= .2710E+03 BASIN STORAGE= .3014E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC3    MANE        21.60    572.39    669.60      2.13     72.00    554.87    648.00        2.13


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3352E+03 EXCESS= .0000E+00 OUTFLOW= .3354E+03 BASIN STORAGE= .1060E-01 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC4    MANE         9.39    125.40    591.38      3.17     72.00    117.08    576.00        3.18


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .6274E+02 EXCESS= .0000E+00 OUTFLOW= .6274E+02 BASIN STORAGE= .2980E-02 PERCENT ERROR=    .0


1                               SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                              (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


       PLAN  1 .............                    INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                 ELEVATION         5545.50           5549.20          5552.00
                                 STORAGE             5845.             6508.            7347.
                                 OUTFLOW                0.               45.              435.


                        RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                          OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                         PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                        1.00      5548.87         .00       6408.        43.        .00        26.40         .00


 *** NORMAL END OF HEC-1 ***
```

Storm Event 8. 100-year, 6-hour AMC III

```
1*************************************                                  *************************************
 *                                   *                                  *                                   *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                              *    U.S. ARMY CORPS OF ENGINEERS     *
 *              JUN   1998           *                                  *    HYDROLOGIC ENGINEERING CENTER    *
 *           VERSION 4.1             *                                  *         609 SECOND STREET           *
 *                                   *                                  *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   06AUG20  TIME  02:54:27   *                              *           (916) 756-1104            *
 *                                   *                                  *                                   *
 *************************************                                  *************************************

                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X        X     X         XX
                                                X     X  X        X               X
                                                XXXXXXX  XXXX     X        XXXXX  X
                                                X     X  X        X               X
                                                X     X  X        X     X         X
                                                X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                              HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   100-YR, 6-HR, AMC III
           13           ID
                        *Diagram
           14           JR    PREC     1.0
           15           IT      18       0       0      50
           16           IO       0
           17           IN      18
                        *

           18           KK   B1
           19           KM   Runoff from Basin 1
           20           BA   0.503
           21           PB    2.75
           22           PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
           23           PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
           24           PC   1.000
           25           LS       0    86.0
           26           UD    0.34
                        *

           27           KK   RB1
           28           KM   Route B1
           29           RD    4928    .045    .050           TRAP      20      20
                        *

           30           KK   B2
           31           KM   Runoff from Basin 2
           32           BA   0.436
           33           LS       0    85.8
           34           UD    0.34
                        *

           35           KK   B3
           36           KM   Runoff from Basin 3
           37           BA   0.279
           38           LS       0    84.9
           39           UD    0.25
                        *
1                                              HEC-1 INPUT                                                PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
 40          KK   C1
 41          KM   Combine RB1, B2, B3
 42          HC       3
             *

 43          KK   RC1
 44          KM   Route RC1
 45          RD    7255    .060    .030           TRAP      20      20
             *

 46          KK   B4
 47          KM   Runoff from Basin 4
 48          BA   0.453
 49          LS       0    86.3
 50          UD    0.32
             *

 51          KK   B5
 52          KM   Runoff from Basin 5
 53          BA   0.805
 54          LS       0    86.8
 55          UD    0.42
             *

 56          KK   C2
 57          KM   Combine RC1, B4, B5
 58          HC       3
             *

 59          KK   RC2
 60          KM   Route C2
 61          RD    2380    .039    .030           TRAP      40       2
             *

 62          KK   B6
 63          KM   Runoff from Basin 6
 64          BA   0.150
 65          LS       0    92.5
 66          UD    0.14
             *

 67          KK   B7
 68          KM   Runoff from Basin 7
 69          BA   0.327
 70          LS       0    87.8
 71          UD    0.31
             *

 72          KK   C3
 73          KM   Combine RC2, B6, B7
 74          HC       3
             *
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 75          KK   RC3
 76          KM   Route C3
 77          RD   11323    .023    .030           TRAP      40      20
             *

 78          KK   B8
 79          KM   Runoff from Basin 8
 80          BA   1.012
 81          LS       0    92.4
 82          UD    0.48
             *

 83          KK   B9
 84          KM   Runoff from Basin 9
 85          BA   0.242
 86          LS       0    93.1
 87          UD    0.19
             *

 88          KK   B10
 89          KM   Runoff from Basin 10
 90          BA   0.129
 91          LS       0    93.7
 92          UD    0.14
             *

 93          KK   C4
 94          KM   Combine B9, B10
 95          HC       2
             *

 96          KK   RC4
 97          KM   Route C4
 98          RD    3380    .037    .030           TRAP      40      20
             *
```

```
 99          KK   B11
100          KM   Runoff from Basin 11
101          BA   0.279
102          LS       0    92.8
103          UD    0.28
             *

104          KK   C5
105          KM   Combine RC3, B8, RC4, B11
106          HC       4
             *

107          KK   B12
108          KM   Runoff from Basin 12
109          BA   0.127
110          LS       0    90.9
111          UD    0.28
             *
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


112          KK   Call
113          KM   Combine C5, B12
114          HC       2
             *

115          KK   Cove Reservoir
116          KM   Routing through Res'v
117          RS       1    ELEV  5545.5
118          SV       0      19      95     240     453     738    1105    1563    2217    2773
119          SV    3542    4423    5419    6149    7347    8000
120          SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
121          SE    5530    5536    5542    5548    5552    5558
122          SL  5545.5   4.909     0.6     0.5
123          SS  5549.2      30    2.67     1.5
124          ST  5552.0    1892     2.9     1.5
             *
125          ZZ
```

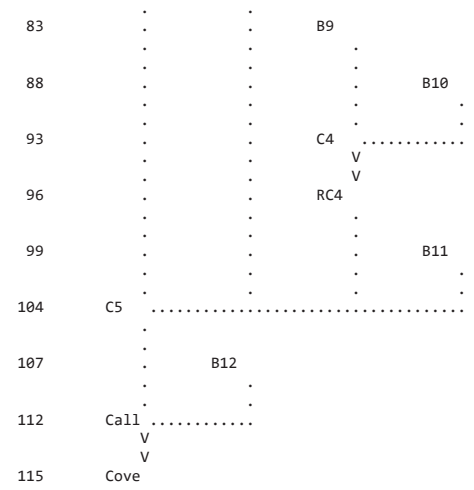
1

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

    NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     18      B1
                 V
                 V
     27      RB1
                 .
                 .
     30          .       B2
                 .           .
                 .           .
     35          .           .       B3
                 .           .           .
                 .           .           .
     40      C1   ........................
                 V
                 V
     43      RC1
                 .
                 .
     46          .       B4
                 .           .
                 .           .
     51          .           .       B5
                 .           .           .
                 .           .           .
     56      C2   ........................
                 V
                 V
     59      RC2
                 .
                 .
     62          .       B6
                 .           .
                 .           .
     67          .           .       B7
                 .           .           .
                 .           .           .
     72      C3   ........................
                 V
                 V
     75      RC3
                 .
                 .
     78          .       B8
                 .           .
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************                    *****************************************
 *                                       *                    *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *    U.S. ARMY CORPS OF ENGINEERS       *
 *              JUN   1998               *                    *    HYDROLOGIC ENGINEERING CENTER      *
 *            VERSION 4.1                *                    *          609 SECOND STREET            *
 *                                       *                    *       DAVIS, CALIFORNIA 95616         *
 *  RUN DATE   06AUG20  TIME  02:54:27   *                    *           (916) 756-1104              *
 *                                       *                    *                                       *
 *****************************************                    *****************************************
```

HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

100-YR, 6-HR, AMC III

```
  16 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           0  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN          18  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ          50  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      1    0  ENDING DATE
                     NDTIME        1442  ENDING TIME
                     ICENT           19  CENTURY MARK

                  COMPUTATION INTERVAL     .30 HOURS
                       TOTAL TIME BASE   14.70 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                       NPLAN           1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                    1.00
```

*** *** *** *

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 112 KK    *     Call   *
           *            *
           **************
                        Combine C5, B12

 114 HC          HYDROGRAPH COMBINATION
                      ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

*****************************************************************************************************************************************

                                                HYDROGRAPH AT STATION    Call
                                                     SUM OF  2 HYDROGRAPHS
                                                   PLAN 1,   RATIO =  1.00

*****************************************************************************************************************************************
                                *                                       *                                       *
   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW
                                *                                       *                                       *
    1     0000    1        0.   *    1     0354   14     1248.   *    1     0748   27       53.   *    1     1142   40        0.
    1     0018    2        0.   *    1     0412   15     1032.   *    1     0806   28       30.   *    1     1200   41        0.
    1     0036    3        0.   *    1     0430   16      892.   *    1     0824   29       15.   *    1     1218   42        0.
    1     0054    4        1.   *    1     0448   17      796.   *    1     0842   30        8.   *    1     1236   43        0.
    1     0112    5       10.   *    1     0506   18      719.   *    1     0900   31        4.   *    1     1254   44        0.
    1     0130    6       39.   *    1     0524   19      668.   *    1     0918   32        2.   *    1     1312   45        0.
    1     0148    7      106.   *    1     0542   20      638.   *    1     0936   33        1.   *    1     1330   46        0.
    1     0206    8      321.   *    1     0600   21      611.   *    1     0954   34        0.   *    1     1348   47        0.
    1     0224    9      883.   *    1     0618   22      529.   *    1     1012   35        0.   *    1     1406   48        0.
    1     0242   10     1826.   *    1     0636   23      386.   *    1     1030   36        0.   *    1     1424   49        0.
    1     0300   11     2280.   *    1     0654   24      254.   *    1     1048   37        0.   *    1     1442   50        0.
    1     0318   12     1978.   *    1     0712   25      156.   *    1     1106   38        0.   *
    1     0336   13     1550.   *    1     0730   26       95.   *    1     1124   39        0.   *
                                *                                       *                                       *
*****************************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR      14.70-HR
+   (CFS)       (HR)
                        (CFS)
+    2280.      3.00                  847.         350.         350.          350.
                          (INCHES)    1.661        1.679        1.679         1.679
                           (AC-FT)     420.         425.         425.          425.

                         CUMULATIVE AREA =    4.74 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 115 KK    *     Cove   *     Reservoir
           *            *
           **************
                        Routing through Res'v

              HYDROGRAPH ROUTING DATA

 117 RS          STORAGE ROUTING
                      NSTPS           1  NUMBER OF SUBREACHES
                       ITYP        ELEV  TYPE OF INITIAL CONDITION
                     RSVRIC     5545.50  INITIAL CONDITION
                          X         .00 WORKING R AND D COEFFICIENT

 118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                  3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

 120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                               5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

 122 SL          LOW-LEVEL OUTLET
                      ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                      CAREA        4.91  CROSS-SECTIONAL AREA
                       COQL         .60  COEFFICIENT
                       EXPL         .50  EXPONENT OF HEAD

 123 SS          SPILLWAY
                       CREL     5549.20  SPILLWAY CREST ELEVATION
                      SPWID       30.00  SPILLWAY WIDTH
                       COQW        2.67  WEIR COEFFICIENT
                       EXPW        1.50  EXPONENT OF HEAD

 124 ST          TOP OF DAM
```

TOPEL	5552.00	ELEVATION AT TOP OF DAM
DAMWID	1892.00	DAM WIDTH
COQD	2.90	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	5844.8	5545.5	1		0506	18	38.	6168.2	5548.1	1		1012	35	40.	6245.8	5548.3
1		0018	2	0.	5844.8	5545.5	1		0524	19	38.	6184.4	5548.1	1		1030	36	40.	6244.8	5548.3
1		0036	3	0.	5844.8	5545.5	1		0542	20	39.	6199.6	5548.2	1		1048	37	40.	6243.8	5548.3
1		0054	4	0.	5844.8	5545.5	1		0600	21	39.	6214.1	5548.2	1		1106	38	40.	6242.7	5548.3
1		0112	5	1.	5845.0	5545.5	1		0618	22	39.	6227.2	5548.3	1		1124	39	40.	6241.7	5548.3
1		0130	6	2.	5845.5	5545.5	1		0636	23	39.	6237.6	5548.3	1		1142	40	40.	6240.7	5548.3
1		0148	7	3.	5847.3	5545.5	1		0654	24	40.	6244.6	5548.3	1		1200	41	40.	6239.7	5548.3
1		0206	8	6.	5852.4	5545.6	1		0712	25	40.	6248.7	5548.3	1		1218	42	40.	6238.6	5548.3
1		0224	9	10.	5867.2	5545.7	1		0730	26	40.	6250.9	5548.3	1		1236	43	39.	6237.6	5548.3
1		0242	10	16.	5900.4	5546.0	1		0748	27	40.	6251.8	5548.3	1		1254	44	39.	6236.6	5548.3
1		0300	11	22.	5950.9	5546.4	1		0806	28	40.	6251.8	5548.3	1		1312	45	39.	6235.6	5548.3
1		0318	12	27.	6003.0	5546.8	1		0824	29	40.	6251.4	5548.3	1		1330	46	39.	6234.6	5548.3
1		0336	13	30.	6046.0	5547.2	1		0842	30	40.	6250.6	5548.3	1		1348	47	39.	6233.5	5548.3
1		0354	14	33.	6080.0	5547.4	1		0900	31	40.	6249.8	5548.3	1		1406	48	39.	6232.5	5548.3
1		0412	15	35.	6107.4	5547.7	1		0918	32	40.	6248.9	5548.3	1		1424	49	39.	6231.5	5548.3
1		0430	16	36.	6130.3	5547.8	1		0936	33	40.	6247.9	5548.3	1		1442	50	39.	6230.5	5548.3
1		0448	17	37.	6150.3	5548.0	1		0954	34	40.	6246.8	5548.3							

PEAK OUTFLOW IS 40. AT TIME 7.80 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	14.70-HR
+ (CFS)	(HR)				
		(CFS)			
+ 40.	7.80	40.	31.	31.	31.
		(INCHES) .078	.151	.151	.151
		(AC-FT) 20.	38.	38.	38.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	14.70-HR
+ (AC-FT)	(HR)				
6252.	7.80	6246.	6138.	6138.	6138.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	14.70-HR
+ (FEET)	(HR)				
5548.34	7.80	5548.32	5547.63	5547.63	5547.63

CUMULATIVE AREA = 4.74 SQ MI

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1
					1.00
HYDROGRAPH AT					
+	B1	.50	1	FLOW	252.
				TIME	2.70
ROUTED TO					
+	RB1	.50	1	FLOW	245.
				TIME	3.00
HYDROGRAPH AT					
+	B2	.44	1	FLOW	216.
				TIME	2.70
HYDROGRAPH AT					
+	B3	.28	1	FLOW	142.
				TIME	2.70
3 COMBINED AT					
+	C1	1.22	1	FLOW	542.
				TIME	2.70
ROUTED TO					
+	RC1	1.22	1	FLOW	538.
				TIME	3.00
HYDROGRAPH AT					
+	B4	.45	1	FLOW	237.
				TIME	2.70
HYDROGRAPH AT					
+	B5	.81	1	FLOW	376.
				TIME	2.70
3 COMBINED AT					
+	C2	2.48	1	FLOW	1100.
				TIME	3.00
ROUTED TO					
+	RC2	2.48	1	FLOW	1090.
				TIME	3.00
HYDROGRAPH AT					
+	B6	.15	1	FLOW	128.
				TIME	2.40
HYDROGRAPH AT					
+	B7	.33	1	FLOW	188.
				TIME	2.70
3 COMBINED AT					
+	C3	2.95	1	FLOW	1294.
				TIME	3.00
ROUTED TO					
+	RC3	2.95	1	FLOW	1250.
				TIME	3.30
HYDROGRAPH AT					
+	B8	1.01	1	FLOW	620.
				TIME	3.00
HYDROGRAPH AT					
+	B9	.24	1	FLOW	196.
				TIME	2.40
HYDROGRAPH AT					
+	B10	.13	1	FLOW	118.
				TIME	2.40
2 COMBINED AT					
+	C4	.37	1	FLOW	314.
				TIME	2.40
ROUTED TO					
+	RC4	.37	1	FLOW	290.
				TIME	2.70
HYDROGRAPH AT					
+	B11	.28	1	FLOW	212.
				TIME	2.70
4 COMBINED AT					
+	C5	4.61	1	FLOW	2218.
				TIME	3.00

```
 HYDROGRAPH AT
+                  B12          .13     1   FLOW          88.
                                            TIME         2.70

  2 COMBINED AT
+                  Call        4.74     1   FLOW        2280.
                                            TIME         3.00

 ROUTED TO
+                  Cove        4.74     1   FLOW          40.
                                            TIME         7.80

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     5548.34
                                            TIME         7.80
1
                                            SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                                (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                    INTERPOLATED TO
                                                                                  COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

           FOR PLAN = 1  RATIO=  .00
              RB1    MANE         4.50    251.41    175.50      1.45     18.00    245.28    180.00        1.45


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3891E+02 EXCESS= .0000E+00 OUTFLOW= .3894E+02 BASIN STORAGE= .4659E-02 PERCENT ERROR=   -.1


           FOR PLAN = 1  RATIO=  .00
              RC1    MANE         4.50    551.33    175.50      1.43     18.00    538.17    180.00        1.42


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .9271E+02 EXCESS= .0000E+00 OUTFLOW= .9275E+02 BASIN STORAGE= .3503E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC2    MANE         2.45   1093.25    181.44      1.46     18.00   1089.58    180.00        1.46


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1924E+03 EXCESS= .0000E+00 OUTFLOW= .1925E+03 BASIN STORAGE= .2883E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC3    MANE         7.20   1313.52    187.20      1.50     18.00   1250.30    198.00        1.50


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2363E+03 EXCESS= .0000E+00 OUTFLOW= .2366E+03 BASIN STORAGE= .1038E-01 PERCENT ERROR=   -.1


           FOR PLAN = 1  RATIO=  .00
              RC4    MANE         5.40    310.06    156.60      2.04     18.00    289.52    162.00        2.04


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .4045E+02 EXCESS= .0000E+00 OUTFLOW= .4046E+02 BASIN STORAGE= .2901E-02 PERCENT ERROR=    .0


1                               SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                              (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


      PLAN  1 .............                    INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                 ELEVATION        5545.50           5549.20          5552.00
                                 STORAGE             5845.             6508.            7347.
                                 OUTFLOW                0.               45.              435.


                       RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                         OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                        PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                       1.00      5548.34         .00       6252.        40.        .00         7.80         .00


 *** NORMAL END OF HEC-1 ***
```

Storm Event 9. 100-year, 24-hour AMC III

```
1****************************************                                  ****************************************
 *                                      *                                  *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                  *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                  *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1               *                                  *         609 SECOND STREET            *
 *                                      *                                  *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   06AUG20  TIME  02:55:10  *                                  *           (916) 756-1104             *
 *                                      *                                  *                                      *
 ****************************************                                  ****************************************

                                                X     X  XXXXXXX   XXXXX           X
                                                X     X  X        X     X         XX
                                                X     X  X        X                X
                                                XXXXXXX  XXXX     X        XXXXX   X
                                                X     X  X        X                X
                                                X     X  X        X     X          X
                                                X     X  XXXXXXX   XXXXX          XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   100-YR, 24-HR, AMC III
           13           ID
                        *Diagram
           14           JR    PREC     1.0
           15           IT      72       0       0      50
           16           IO       0
           17           IN      72
                        *

           18           KK   B1
           19           KM   Runoff from Basin 1
           20           BA   0.503
           21           PB    3.51
           22           PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
           23           PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
           24           PC   1.000
           25           LS       0    86.0
           26           UD    0.34
                        *

           27           KK   RB1
           28           KM   Route B1
           29           RD    4928    .045    .050           TRAP      20      20
                        *

           30           KK   B2
           31           KM   Runoff from Basin 2
           32           BA   0.436
           33           LS       0    85.8
           34           UD    0.34
                        *

           35           KK   B3
           36           KM   Runoff from Basin 3
           37           BA   0.279
           38           LS       0    84.9
           39           UD    0.25
                        *
1                                                HEC-1 INPUT                                                PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
 40          KK   C1
 41          KM   Combine RB1, B2, B3
 42          HC       3
             *

 43          KK   RC1
 44          KM   Route RC1
 45          RD    7255    .060    .030           TRAP      20      20
             *

 46          KK   B4
 47          KM   Runoff from Basin 4
 48          BA   0.453
 49          LS       0    86.3
 50          UD    0.32
             *

 51          KK   B5
 52          KM   Runoff from Basin 5
 53          BA   0.805
 54          LS       0    86.8
 55          UD    0.42
             *

 56          KK   C2
 57          KM   Combine RC1, B4, B5
 58          HC       3
             *

 59          KK   RC2
 60          KM   Route C2
 61          RD    2380    .039    .030           TRAP      40       2
             *

 62          KK   B6
 63          KM   Runoff from Basin 6
 64          BA   0.150
 65          LS       0    92.5
 66          UD    0.14
             *

 67          KK   B7
 68          KM   Runoff from Basin 7
 69          BA   0.327
 70          LS       0    87.8
 71          UD    0.31
             *

 72          KK   C3
 73          KM   Combine RC2, B6, B7
 74          HC       3
             *
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 75          KK   RC3
 76          KM   Route C3
 77          RD   11323    .023    .030           TRAP      40      20
             *

 78          KK   B8
 79          KM   Runoff from Basin 8
 80          BA   1.012
 81          LS       0    92.4
 82          UD    0.48
             *

 83          KK   B9
 84          KM   Runoff from Basin 9
 85          BA   0.242
 86          LS       0    93.1
 87          UD    0.19
             *

 88          KK   B10
 89          KM   Runoff from Basin 10
 90          BA   0.129
 91          LS       0    93.7
 92          UD    0.14
             *

 93          KK   C4
 94          KM   Combine B9, B10
 95          HC       2
             *

 96          KK   RC4
 97          KM   Route C4
 98          RD    3380    .037    .030           TRAP      40      20
             *
```

```
 99          KK   B11
100          KM   Runoff from Basin 11
101          BA   0.279
102          LS       0    92.8
103          UD    0.28
             *

104          KK   C5
105          KM   Combine RC3, B8, RC4, B11
106          HC       4
             *

107          KK   B12
108          KM   Runoff from Basin 12
109          BA   0.127
110          LS       0    90.9
111          UD    0.28
             *
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


112          KK   Call
113          KM   Combine C5, B12
114          HC       2
             *

115          KK   Cove Reservoir
116          KM   Routing through Res'v
117          RS       1    ELEV  5545.5
118          SV       0      19      95     240     453     738    1105    1563    2217    2773
119          SV    3542    4423    5419    6149    7347    8000
120          SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
121          SE    5530    5536    5542    5548    5552    5558
122          SL  5545.5   4.909     0.6     0.5
123          SS  5549.2      30    2.67     1.5
124          ST  5552.0    1892     2.9     1.5
             *
125          ZZ
```

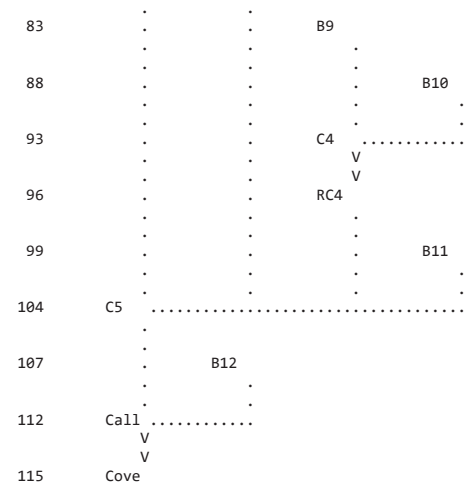
1

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

    NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     18      B1
                 V
                 V
     27      RB1
                 .
                 .
     30          .       B2
                 .           .
                 .           .
     35          .           .       B3
                 .           .           .
                 .           .           .
     40      C1   ........................
                 V
                 V
     43      RC1
                 .
                 .
     46          .       B4
                 .           .
                 .           .
     51          .           .       B5
                 .           .           .
                 .           .           .
     56      C2   ........................
                 V
                 V
     59      RC2
                 .
                 .
     62          .       B6
                 .           .
                 .           .
     67          .           .       B7
                 .           .           .
                 .           .           .
     72      C3   ........................
                 V
                 V
     75      RC3
                 .
                 .
     78          .       B8
                 .           .
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              JUN   1998               *
*            VERSION 4.1                *
*                                       *
*  RUN DATE   06AUG20  TIME  02:55:10   *
*                                       *
*****************************************
```

```
*************************************
*                                   *
*    U.S. ARMY CORPS OF ENGINEERS     *
*    HYDROLOGIC ENGINEERING CENTER    *
*          609 SECOND STREET          *
*       DAVIS, CALIFORNIA 95616       *
*           (916) 756-1104            *
*                                   *
*************************************
```

HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

100-YR, 24-HR, AMC III

```
  16 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           0  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN          72  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ          50  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      3    0  ENDING DATE
                     NDTIME        1048  ENDING TIME
                     ICENT           19  CENTURY MARK

                   COMPUTATION INTERVAL    1.20 HOURS
                        TOTAL TIME BASE   58.80 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                       NPLAN           1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                    1.00
```

*** ***

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 112 KK    *     Call   *
           *            *
           **************
                        Combine C5, B12

 114 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

*****************************************************************************************************************************************

                                                HYDROGRAPH AT STATION    Call
                                                     SUM OF  2 HYDROGRAPHS
                                                    PLAN 1,   RATIO =  1.00

*****************************************************************************************************************************************
                                *                                *                                *                                *
   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW
                                *                                *                                *
    1     0000    1        0.   *    1     1536   14       305.   *    2     0712   27        0.   *    2     2248   40        0.
    1     0112    2        0.   *    1     1648   15       266.   *    2     0824   28        0.   *    3     0000   41        0.
    1     0224    3        0.   *    1     1800   16       248.   *    2     0936   29        0.   *    3     0112   42        0.
    1     0336    4        6.   *    1     1912   17       223.   *    2     1048   30        0.   *    3     0224   43        0.
    1     0448    5       18.   *    1     2024   18       209.   *    2     1200   31        0.   *    3     0336   44        0.
    1     0600    6       44.   *    1     2136   19       205.   *    2     1312   32        0.   *    3     0448   45        0.
    1     0712    7      101.   *    1     2248   20       204.   *    2     1424   33        0.   *    3     0600   46        0.
    1     0824    8      371.   *    2     0000   21       185.   *    2     1536   34        0.   *    3     0712   47        0.
    1     0936    9     1026.   *    2     0112   22        96.   *    2     1648   35        0.   *    3     0824   48        0.
    1     1048   10     1031.   *    2     0224   23        37.   *    2     1800   36        0.   *    3     0936   49        0.
    1     1200   11      662.   *    2     0336   24        12.   *    2     1912   37        0.   *    3     1048   50        0.
    1     1312   12      453.   *    2     0448   25         3.   *    2     2024   38        0.   *
    1     1424   13      356.   *    2     0600   26         1.   *    2     2136   39        0.   *
                                *                                *                                *
*****************************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR     58.80-HR
+   (CFS)       (HR)
                        (CFS)
+    1031.     10.80                  707.         302.         124.         124.
                          (INCHES)    1.386        2.372        2.377        2.377
                           (AC-FT)     351.         600.         601.         601.

                         CUMULATIVE AREA =    4.74 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 115 KK    *     Cove   *     Reservoir
           *            *
           **************
                        Routing through Res'v

              HYDROGRAPH ROUTING DATA

 117 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC     5545.50  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

 118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                  3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

 120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                               5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

 122 SL          LOW-LEVEL OUTLET
                       ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                       CAREA        4.91  CROSS-SECTIONAL AREA
                        COQL         .60  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

 123 SS          SPILLWAY
                        CREL     5549.20  SPILLWAY CREST ELEVATION
                       SPWID       30.00  SPILLWAY WIDTH
                        COQW        2.67  WEIR COEFFICIENT
                        EXPW        1.50  EXPONENT OF HEAD

 124 ST          TOP OF DAM
```

TOPEL	5552.00	ELEVATION AT TOP OF DAM
DAMWID	1892.00	DAM WIDTH
COQD	2.90	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1	0000		1	0.	5844.8	5545.5	1		2024	18	42.	6325.1	5548.6	2		1648	35	42.	6337.5	5548.6
1	0112		2	0.	5844.8	5545.5	1		2136	19	42.	6341.5	5548.6	2		1800	36	42.	6333.4	5548.6
1	0224		3	0.	5844.8	5545.5	1		2248	20	42.	6357.5	5548.7	2		1912	37	42.	6329.3	5548.6
1	0336		4	1.	5845.1	5545.5	2		0000	21	43.	6372.6	5548.7	2		2024	38	42.	6325.2	5548.6
1	0448		5	2.	5846.1	5545.5	2		0112	22	43.	6382.3	5548.8	2		2136	39	41.	6321.1	5548.6
1	0600		6	4.	5848.8	5545.5	2		0224	23	43.	6384.6	5548.8	2		2248	40	41.	6317.0	5548.6
1	0712		7	7.	5855.4	5545.6	2		0336	24	43.	6382.8	5548.8	3		0000	41	41.	6312.9	5548.5
1	0824		8	12.	5877.9	5545.8	2		0448	25	43.	6379.3	5548.8	3		0112	42	41.	6308.8	5548.5
1	0936		9	21.	5945.5	5546.3	2		0600	26	43.	6375.2	5548.8	3		0224	43	41.	6304.7	5548.5
1	1048		10	30.	6044.9	5547.1	2		0712	27	43.	6371.0	5548.7	3		0336	44	41.	6300.7	5548.5
1	1200		11	36.	6125.6	5547.8	2		0824	28	42.	6366.8	5548.7	3		0448	45	41.	6296.6	5548.5
1	1312		12	38.	6177.2	5548.1	2		0936	29	42.	6362.5	5548.7	3		0600	46	41.	6292.5	5548.5
1	1424		13	39.	6213.5	5548.2	2		1048	30	42.	6358.3	5548.7	3		0712	47	41.	6288.4	5548.5
1	1536		14	40.	6242.4	5548.3	2		1200	31	42.	6354.0	5548.7	3		0824	48	41.	6284.3	5548.5
1	1648		15	40.	6266.9	5548.4	2		1312	32	42.	6349.8	5548.7	3		0936	49	40.	6280.3	5548.4
1	1800		16	41.	6288.4	5548.5	2		1424	33	42.	6345.7	5548.7	3		1048	50	40.	6276.4	5548.4
1	1912		17	41.	6307.7	5548.5	2		1536	34	42.	6341.6	5548.6							

PEAK OUTFLOW IS 43. AT TIME 26.40 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	58.80-HR
+ (CFS)	(HR)				
		(CFS)			
+ 43.	26.40	43.	42.	35.	35.
		(INCHES) .084	.331	.671	.671
		(AC-FT) 21.	84.	170.	170.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (AC-FT)	(HR)				
6385.	26.40	6381.	6358.	6233.	6233.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	58.80-HR
+ (FEET)	(HR)				
5548.79	26.40	5548.77	5548.70	5548.03	5548.03

CUMULATIVE AREA = 4.74 SQ MI

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1
					1.00
HYDROGRAPH AT					
+	B1	.50	1	FLOW	110.
				TIME	9.60
ROUTED TO					
+	RB1	.50	1	FLOW	102.
				TIME	10.80
HYDROGRAPH AT					
+	B2	.44	1	FLOW	94.
				TIME	9.60
HYDROGRAPH AT					
+	B3	.28	1	FLOW	57.
				TIME	9.60
3 COMBINED AT					
+	C1	1.22	1	FLOW	245.
				TIME	9.60
ROUTED TO					
+	RC1	1.22	1	FLOW	241.
				TIME	10.80
HYDROGRAPH AT					
+	B4	.45	1	FLOW	100.
				TIME	9.60
HYDROGRAPH AT					
+	B5	.81	1	FLOW	183.
				TIME	9.60
3 COMBINED AT					
+	C2	2.48	1	FLOW	502.
				TIME	9.60
ROUTED TO					
+	RC2	2.48	1	FLOW	496.
				TIME	10.80
HYDROGRAPH AT					
+	B6	.15	1	FLOW	44.
				TIME	9.60
HYDROGRAPH AT					
+	B7	.33	1	FLOW	78.
				TIME	9.60
3 COMBINED AT					
+	C3	2.95	1	FLOW	612.
				TIME	9.60
ROUTED TO					
+	RC3	2.95	1	FLOW	589.
				TIME	10.80
HYDROGRAPH AT					
+	B8	1.01	1	FLOW	298.
				TIME	9.60
HYDROGRAPH AT					
+	B9	.24	1	FLOW	73.
				TIME	9.60
HYDROGRAPH AT					
+	B10	.13	1	FLOW	40.
				TIME	9.60
2 COMBINED AT					
+	C4	.37	1	FLOW	113.
				TIME	9.60
ROUTED TO					
+	RC4	.37	1	FLOW	106.
				TIME	9.60
HYDROGRAPH AT					
+	B11	.28	1	FLOW	83.
				TIME	9.60
4 COMBINED AT					
+	C5	4.61	1	FLOW	1001.
				TIME	10.80

```
 HYDROGRAPH AT
+                  B12          .13     1   FLOW          35.
                                            TIME         9.60

  2 COMBINED AT
+                  Call        4.74     1   FLOW        1031.
                                            TIME        10.80

 ROUTED TO
+                  Cove        4.74     1   FLOW          43.
                                            TIME        26.40

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     5548.79
                                            TIME        26.40
1
                                            SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                                (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                    INTERPOLATED TO
                                                                                 COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

          FOR PLAN = 1  RATIO=  .00
             RB1    MANE        17.89    109.66    608.15      2.11     72.00    102.14    648.00        2.12


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5653E+02 EXCESS= .0000E+00 OUTFLOW= .5654E+02 BASIN STORAGE= .5474E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC1    MANE        13.16    246.58    605.26      2.08     72.00    240.71    648.00        2.09


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1354E+03 EXCESS= .0000E+00 OUTFLOW= .1354E+03 BASIN STORAGE= .3020E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC2    MANE         3.25    503.11    582.29      2.13     72.00    496.18    648.00        2.13


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2808E+03 EXCESS= .0000E+00 OUTFLOW= .2808E+03 BASIN STORAGE= .2726E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC3    MANE        23.97    630.14    623.12      2.17     72.00    588.94    648.00        2.18


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3423E+03 EXCESS= .0000E+00 OUTFLOW= .3424E+03 BASIN STORAGE= .1070E-01 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC4    MANE         9.67    112.23    590.06      2.78     72.00    105.70    576.00        2.78


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5492E+02 EXCESS= .0000E+00 OUTFLOW= .5492E+02 BASIN STORAGE= .2119E-02 PERCENT ERROR=    .0


1                                SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                               (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


      PLAN  1 ..............                    INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                  ELEVATION        5545.50           5549.20          5552.00
                                  STORAGE             5845.             6508.            7347.
                                  OUTFLOW                0.               45.              435.


                        RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                          OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                         PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                        1.00      5548.79         .00       6385.        43.       .00        26.40         .00


 *** NORMAL END OF HEC-1 ***
```

Storm Event 10. Local SEP Hydrograph

```
1*************************************                                  *************************************
 *                                   *                                  *                                   *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                              *    U.S. ARMY CORPS OF ENGINEERS     *
 *              JUN   1998           *                                  *    HYDROLOGIC ENGINEERING CENTER    *
 *            VERSION 4.1            *                                  *         609 SECOND STREET           *
 *                                   *                                  *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   06AUG20  TIME  02:56:10   *                              *           (916) 756-1104            *
 *                                   *                                  *                                   *
 *************************************                                  *************************************

                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X        X     X         XX
                                                X     X  X        X               X
                                                XXXXXXX  XXXX     X        XXXXX  X
                                                X     X  X        X               X
                                                X     X  X        X     X         X
                                                X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                              HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   Local SEP
           13           ID
                        *Diagram
           14           JR    PREC     1.0
           15           IT      18       0       0      50
           16           IO       0
           17           IN      18
                        *

           18           KK   B1
           19           KM   Runoff from Basin 1
           20           BA   0.503
           21           PB    7.67
           22           PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
           23           PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
           24           PC   1.000
           25           LS       0    72.8
           26           UD    0.51
                        *

           27           KK   RB1
           28           KM   Route B1
           29           RD    4928    .045    .050           TRAP      20      20
                        *

           30           KK   B2
           31           KM   Runoff from Basin 2
           32           BA   0.436
           33           LS       0    72.5
           34           UD    0.52
                        *

           35           KK   B3
           36           KM   Runoff from Basin 3
           37           BA   0.279
           38           LS       0    71.0
           39           UD    0.39
                        *
1                                              HEC-1 INPUT                                                PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
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```
 40          KK   C1
 41          KM   Combine RB1, B2, B3
 42          HC       3
             *

 43          KK   RC1
 44          KM   Route RC1
 45          RD    7255    .060    .030           TRAP      20      20
             *

 46          KK   B4
 47          KM   Runoff from Basin 4
 48          BA   0.453
 49          LS       0    73.3
 50          UD    0.48
             *

 51          KK   B5
 52          KM   Runoff from Basin 5
 53          BA   0.805
 54          LS       0    74.1
 55          UD    0.63
             *

 56          KK   C2
 57          KM   Combine RC1, B4, B5
 58          HC       3
             *

 59          KK   RC2
 60          KM   Route C2
 61          RD    2380    .039    .030           TRAP      40       2
             *

 62          KK   B6
 63          KM   Runoff from Basin 6
 64          BA   0.150
 65          LS       0    84.3
 66          UD    0.19
             *

 67          KK   B7
 68          KM   Runoff from Basin 7
 69          BA   0.327
 70          LS       0    75.7
 71          UD    0.46
             *

 72          KK   C3
 73          KM   Combine RC2, B6, B7
 74          HC       3
             *
1                                        HEC-1 INPUT                                          PAGE  3

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 75          KK   RC3
 76          KM   Route C3
 77          RD   11323    .023    .030           TRAP      40      20
             *

 78          KK   B8
 79          KM   Runoff from Basin 8
 80          BA   1.012
 81          LS       0    84.0
 82          UD    0.67
             *

 83          KK   B9
 84          KM   Runoff from Basin 9
 85          BA   0.242
 86          LS       0    85.5
 87          UD    0.26
             *

 88          KK   B10
 89          KM   Runoff from Basin 10
 90          BA   0.129
 91          LS       0    86.7
 92          UD    0.18
             *

 93          KK   C4
 94          KM   Combine B9, B10
 95          HC       2
             *

 96          KK   RC4
 97          KM   Route C4
 98          RD    3380    .037    .030           TRAP      40      20
             *
```

```
 99          KK   B11
100          KM   Runoff from Basin 11
101          BA   0.279
102          LS       0    84.8
103          UD    0.39
             *

104          KK   C5
105          KM   Combine RC3, B8, RC4, B11
106          HC       4
             *

107          KK   B12
108          KM   Runoff from Basin 12
109          BA   0.127
110          LS       0    81.2
111          UD    0.40
             *
1                                          HEC-1 INPUT                                          PAGE  4

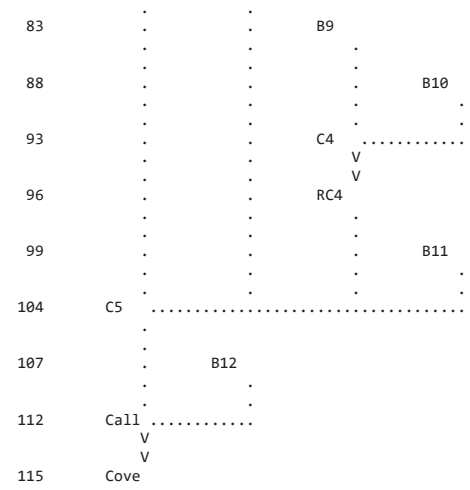
          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


112          KK   Call
113          KM   Combine C5, B12
114          HC       2
             *

115          KK   Cove Reservoir
116          KM   Routing through Res'v
117          RS       1    ELEV  5545.5
118          SV       0      19      95     240     453     738    1105    1563    2217    2773
119          SV    3542    4423    5419    6149    7347    8000
120          SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
121          SE    5530    5536    5542    5548    5552    5558
122          SL  5545.5   4.909     0.6     0.5
123          SS  5549.2      30    2.67     1.5
124          ST  5552.0    1892     2.9     1.5
             *
125          ZZ
1
               SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    18       B1
                 V
                 V
    27       RB1
                 .
                 .
    30           .       B2
                 .           .
                 .           .
    35           .           .       B3
                 .           .           .
                 .           .           .
    40       C1   ........................
                 V
                 V
    43       RC1
                 .
                 .
    46           .       B4
                 .           .
                 .           .
    51           .           .       B5
                 .           .           .
                 .           .           .
    56       C2   ........................
                 V
                 V
    59       RC2
                 .
                 .
    62           .       B6
                 .           .
                 .           .
    67           .           .       B7
                 .           .           .
                 .           .           .
    72       C3   ........................
                 V
                 V
    75       RC3
                 .
                 .
    78           .       B8
                 .           .
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************                    *****************************************
 *                                       *                    *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *    U.S. ARMY CORPS OF ENGINEERS       *
 *              JUN   1998               *                    *    HYDROLOGIC ENGINEERING CENTER      *
 *            VERSION 4.1                *                    *          609 SECOND STREET            *
 *                                       *                    *       DAVIS, CALIFORNIA 95616         *
 *  RUN DATE   06AUG20  TIME  02:56:10   *                    *          (916) 756-1104               *
 *                                       *                    *                                       *
 *****************************************                    *****************************************
```

HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

Local SEP

```
  16 IO          OUTPUT CONTROL VARIABLES
                       IPRNT           0  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                        NMIN          18  MINUTES IN COMPUTATION INTERVAL
                       IDATE      1    0  STARTING DATE
                       ITIME        0000  STARTING TIME
                          NQ          50  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE      1    0  ENDING DATE
                      NDTIME        1442  ENDING TIME
                       ICENT          19  CENTURY MARK

                   COMPUTATION INTERVAL     .30 HOURS
                        TOTAL TIME BASE   14.70 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                       NPLAN           1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                    1.00
```

*** *** *** *

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 112 KK    *     Call   *
           *            *
           **************
                        Combine C5, B12

 114 HC          HYDROGRAPH COMBINATION
                      ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

**********************************************************************************************************************************

                                              HYDROGRAPH AT STATION    Call
                                                   SUM OF  2 HYDROGRAPHS
                                                  PLAN 1,   RATIO =  1.00

**********************************************************************************************************************************
                                *                                *                                *
   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW
                                *                                *                                *
    1     0000    1        0.   *    1     0354   14     4063.   *    1     0748   27      201.   *    1     1142   40        0.
    1     0018    2        0.   *    1     0412   15     3364.   *    1     0806   28      113.   *    1     1200   41        0.
    1     0036    3        0.   *    1     0430   16     2855.   *    1     0824   29       62.   *    1     1218   42        0.
    1     0054    4        8.   *    1     0448   17     2500.   *    1     0842   30       34.   *    1     1236   43        0.
    1     0112    5       43.   *    1     0506   18     2228.   *    1     0900   31       18.   *    1     1254   44        0.
    1     0130    6      129.   *    1     0524   19     2039.   *    1     0918   32        9.   *    1     1312   45        0.
    1     0148    7      306.   *    1     0542   20     1913.   *    1     0936   33        5.   *    1     1330   46        0.
    1     0206    8      824.   *    1     0600   21     1819.   *    1     0954   34        2.   *    1     1348   47        0.
    1     0224    9     2325.   *    1     0618   22     1614.   *    1     1012   35        1.   *    1     1406   48        0.
    1     0242   10     4867.   *    1     0636   23     1240.   *    1     1030   36        0.   *    1     1424   49        0.
    1     0300   11     6395.   *    1     0654   24      851.   *    1     1048   37        0.   *    1     1442   50        0.
    1     0318   12     6123.   *    1     0712   25      540.   *    1     1106   38        0.   *
    1     0336   13     5053.   *    1     0730   26      332.   *    1     1124   39        0.   *
                                *                                *                                *
**********************************************************************************************************************************

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR     14.70-HR
+   (CFS)       (HR)
                      (CFS)
+    6395.      3.00                2560.       1059.       1059.       1059.
                     (INCHES)      5.019       5.085       5.085       5.085
                      (AC-FT)      1269.       1286.       1286.       1286.

                      CUMULATIVE AREA =    4.74 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 115 KK    *     Cove   *     Reservoir
           *            *
           **************
                        Routing through Res'v

              HYDROGRAPH ROUTING DATA

 117 RS          STORAGE ROUTING
                      NSTPS           1  NUMBER OF SUBREACHES
                       ITYP        ELEV  TYPE OF INITIAL CONDITION
                     RSVRIC     5545.50  INITIAL CONDITION
                          X         .00 WORKING R AND D COEFFICIENT

 118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                 3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

 120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                               5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

 122 SL          LOW-LEVEL OUTLET
                      ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                      CAREA        4.91  CROSS-SECTIONAL AREA
                       COQL         .60  COEFFICIENT
                       EXPL         .50  EXPONENT OF HEAD

 123 SS          SPILLWAY
                       CREL     5549.20  SPILLWAY CREST ELEVATION
                      SPWID       30.00  SPILLWAY WIDTH
                       COQW        2.67  WEIR COEFFICIENT
                       EXPW        1.50  EXPONENT OF HEAD

 124 ST          TOP OF DAM
```

TOPEL	5552.00	ELEVATION AT TOP OF DAM
DAMWID	1892.00	DAM WIDTH
COQD	2.90	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	5844.8	5545.5	1		0506	18	137.	6821.4	5550.2	1		1012	35	233.	7019.3	5550.9
1		0018	2	0.	5844.8	5545.5	1		0524	19	159.	6870.7	5550.4	1		1030	36	230.	7013.6	5550.9
1		0036	3	0.	5844.8	5545.5	1		0542	20	180.	6915.4	5550.6	1		1048	37	227.	7007.9	5550.9
1		0054	4	1.	5845.0	5545.5	1		0600	21	201.	6957.0	5550.7	1		1106	38	224.	7002.3	5550.8
1		0112	5	2.	5845.5	5545.5	1		0618	22	220.	6994.3	5550.8	1		1124	39	221.	6996.8	5550.8
1		0130	6	4.	5847.6	5545.5	1		0636	23	236.	7024.0	5550.9	1		1142	40	218.	6991.3	5550.8
1		0148	7	6.	5852.9	5545.6	1		0654	24	247.	7043.8	5551.0	1		1200	41	216.	6985.9	5550.8
1		0206	8	10.	5866.8	5545.7	1		0712	25	253.	7054.8	5551.0	1		1218	42	213.	6980.7	5550.8
1		0224	9	17.	5905.5	5546.0	1		0730	26	255.	7059.3	5551.0	1		1236	43	210.	6975.4	5550.8
1		0242	10	26.	5994.1	5546.7	1		0748	27	256.	7059.6	5551.0	1		1254	44	207.	6970.3	5550.7
1		0300	11	36.	6133.0	5547.9	1		0806	28	254.	7057.2	5551.0	1		1312	45	205.	6965.2	5550.7
1		0318	12	41.	6287.2	5548.5	1		0824	29	252.	7053.1	5551.0	1		1330	46	202.	6960.0	5550.7
1		0336	13	44.	6424.7	5548.9	1		0842	30	249.	7048.1	5551.0	1		1348	47	200.	6955.1	5550.7
1		0354	14	48.	6536.5	5549.3	1		0900	31	246.	7042.5	5551.0	1		1406	48	197.	6950.1	5550.7
1		0412	15	68.	6627.1	5549.6	1		0918	32	243.	7036.8	5551.0	1		1424	49	195.	6945.3	5550.7
1		0430	16	91.	6702.2	5549.8	1		0936	33	240.	7031.0	5550.9	1		1442	50	192.	6940.5	5550.6
1		0448	17	114.	6766.0	5550.1	1		0954	34	237.	7025.1	5550.9							

PEAK OUTFLOW IS 256. AT TIME 7.80 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	14.70-HR
+ (CFS)	(HR)				
	(CFS)				
+ 256.	7.80	238.	156.	156.	156.
	(INCHES)	.466	.752	.752	.752
	(AC-FT)	118.	190.	190.	190.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	14.70-HR
+ (AC-FT)	(HR)				
7060.	7.80	7027.	6705.	6705.	6705.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	14.70-HR
+ (FEET)	(HR)				
5551.04	7.80	5550.93	5549.59	5549.59	5549.59

CUMULATIVE AREA = 4.74 SQ MI

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1
					1.00
HYDROGRAPH AT					
+	B1	.50	1	FLOW	689.
				TIME	3.00
ROUTED TO					
+	RB1	.50	1	FLOW	657.
				TIME	3.00
HYDROGRAPH AT					
+	B2	.44	1	FLOW	589.
				TIME	3.00
HYDROGRAPH AT					
+	B3	.28	1	FLOW	393.
				TIME	2.70
3 COMBINED AT					
+	C1	1.22	1	FLOW	1608.
				TIME	3.00
ROUTED TO					
+	RC1	1.22	1	FLOW	1507.
				TIME	3.00
HYDROGRAPH AT					
+	B4	.45	1	FLOW	636.
				TIME	3.00
HYDROGRAPH AT					
+	B5	.81	1	FLOW	1050.
				TIME	3.00
3 COMBINED AT					
+	C2	2.48	1	FLOW	3194.
				TIME	3.00
ROUTED TO					
+	RC2	2.48	1	FLOW	3137.
				TIME	3.00
HYDROGRAPH AT					
+	B6	.15	1	FLOW	351.
				TIME	2.40
HYDROGRAPH AT					
+	B7	.33	1	FLOW	490.
				TIME	3.00
3 COMBINED AT					
+	C3	2.95	1	FLOW	3813.
				TIME	3.00
ROUTED TO					
+	RC3	2.95	1	FLOW	3723.
				TIME	3.30
HYDROGRAPH AT					
+	B8	1.01	1	FLOW	1656.
				TIME	3.00
HYDROGRAPH AT					
+	B9	.24	1	FLOW	547.
				TIME	2.70
HYDROGRAPH AT					
+	B10	.13	1	FLOW	326.
				TIME	2.40
2 COMBINED AT					
+	C4	.37	1	FLOW	835.
				TIME	2.70
ROUTED TO					
+	RC4	.37	1	FLOW	819.
				TIME	2.70
HYDROGRAPH AT					
+	B11	.28	1	FLOW	575.
				TIME	2.70
4 COMBINED AT					
+	C5	4.61	1	FLOW	6184.
				TIME	3.00

```
 HYDROGRAPH AT
+                  B12          .13     1   FLOW         238.
                                            TIME         2.70

  2 COMBINED AT
+                  Call        4.74     1   FLOW        6395.
                                            TIME         3.00

 ROUTED TO
+                  Cove        4.74     1   FLOW         256.
                                            TIME         7.80

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     5551.04
                                            TIME         7.80
1
                                            SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                                (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                    INTERPOLATED TO
                                                                                 COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

           FOR PLAN = 1  RATIO=  .00
              RB1    MANE         5.40    673.41    189.00      4.50     18.00    657.41    180.00        4.48


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1206E+03 EXCESS= .0000E+00 OUTFLOW= .1207E+03 BASIN STORAGE= .3686E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC1    MANE         5.40   1594.30    189.00      4.43     18.00   1507.33    180.00        4.43


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2880E+03 EXCESS= .0000E+00 OUTFLOW= .2881E+03 BASIN STORAGE= .3547E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC2    MANE         1.67   3186.21    182.05      4.52     18.00   3137.38    180.00        4.53


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5970E+03 EXCESS= .0000E+00 OUTFLOW= .5970E+03 BASIN STORAGE= .3099E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC3    MANE         7.20   3778.09    194.40      4.63     18.00   3723.23    198.00        4.64


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .7287E+03 EXCESS= .0000E+00 OUTFLOW= .7291E+03 BASIN STORAGE= .1048E-01 PERCENT ERROR=   -.1


           FOR PLAN = 1  RATIO=  .00
              RC4    MANE         5.53    841.55    154.72      6.01     18.00    818.78    162.00        6.02


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1188E+03 EXCESS= .0000E+00 OUTFLOW= .1189E+03 BASIN STORAGE= .2808E-02 PERCENT ERROR=    .0


1                                SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                                (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


      PLAN  1 .............                    INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                 ELEVATION        5545.50           5549.20          5552.00
                                 STORAGE             5845.             6508.            7347.
                                 OUTFLOW                0.               45.              435.


                       RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                         OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                        PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                       1.00      5551.04         .00       7060.       256.       .00         7.80         .00


 *** NORMAL END OF HEC-1 ***
```

Storm Event 11. General SEP Hydrograph

```
1*************************************                                  *************************************
 *                                   *                                  *                                   *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                              *    U.S. ARMY CORPS OF ENGINEERS     *
 *              JUN   1998           *                                  *    HYDROLOGIC ENGINEERING CENTER    *
 *            VERSION 4.1            *                                  *         609 SECOND STREET           *
 *                                   *                                  *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   06AUG20  TIME  02:56:37   *                              *           (916) 756-1104            *
 *                                   *                                  *                                   *
 *************************************                                  *************************************

                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X       X     X         XX
                                                X     X  X       X               X
                                                XXXXXXX  XXXX    X        XXXXX  X
                                                X     X  X       X               X
                                                X     X  X       X     X         X
                                                X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                              HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   SEP General
           13           ID
                        *Diagram
           14           JR    PREC     1.0
           15           IT     216       0       0      50
           16           IO       0
           17           IN     216
                        *

           18           KK   B1
           19           KM   Runoff from Basin 1
           20           BA   0.503
           21           PB   12.50
           22           PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
           23           PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
           24           PC   1.000
           25           LS       0    72.8
           26           UD    0.51
                        *

           27           KK   RB1
           28           KM   Route B1
           29           RD    4928    .045    .050           TRAP      20      20
                        *

           30           KK   B2
           31           KM   Runoff from Basin 2
           32           BA   0.436
           33           LS       0    72.5
           34           UD    0.52
                        *

           35           KK   B3
           36           KM   Runoff from Basin 3
           37           BA   0.279
           38           LS       0    71.0
           39           UD    0.39
                        *
1                                              HEC-1 INPUT                                                PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
 40          KK   C1
 41          KM   Combine RB1, B2, B3
 42          HC       3
             *

 43          KK   RC1
 44          KM   Route RC1
 45          RD    7255    .060    .030           TRAP      20      20
             *

 46          KK   B4
 47          KM   Runoff from Basin 4
 48          BA   0.453
 49          LS       0    73.3
 50          UD    0.48
             *

 51          KK   B5
 52          KM   Runoff from Basin 5
 53          BA   0.805
 54          LS       0    74.1
 55          UD    0.63
             *

 56          KK   C2
 57          KM   Combine RC1, B4, B5
 58          HC       3
             *

 59          KK   RC2
 60          KM   Route C2
 61          RD    2380    .039    .030           TRAP      40       2
             *

 62          KK   B6
 63          KM   Runoff from Basin 6
 64          BA   0.150
 65          LS       0    84.3
 66          UD    0.19
             *

 67          KK   B7
 68          KM   Runoff from Basin 7
 69          BA   0.327
 70          LS       0    75.7
 71          UD    0.46
             *

 72          KK   C3
 73          KM   Combine RC2, B6, B7
 74          HC       3
             *
1                                        HEC-1 INPUT                                          PAGE  3

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 75          KK   RC3
 76          KM   Route C3
 77          RD   11323    .023    .030           TRAP      40      20
             *

 78          KK   B8
 79          KM   Runoff from Basin 8
 80          BA   1.012
 81          LS       0    84.0
 82          UD    0.67
             *

 83          KK   B9
 84          KM   Runoff from Basin 9
 85          BA   0.242
 86          LS       0    85.5
 87          UD    0.26
             *

 88          KK   B10
 89          KM   Runoff from Basin 10
 90          BA   0.129
 91          LS       0    86.7
 92          UD    0.18
             *

 93          KK   C4
 94          KM   Combine B9, B10
 95          HC       2
             *

 96          KK   RC4
 97          KM   Route C4
 98          RD    3380    .037    .030           TRAP      40      20
             *
```

```
 99          KK   B11
100          KM   Runoff from Basin 11
101          BA   0.279
102          LS       0    84.8
103          UD    0.39
             *

104          KK   C5
105          KM   Combine RC3, B8, RC4, B11
106          HC       4
             *

107          KK   B12
108          KM   Runoff from Basin 12
109          BA   0.127
110          LS       0    81.2
111          UD    0.40
             *
1                                          HEC-1 INPUT                                          PAGE  4

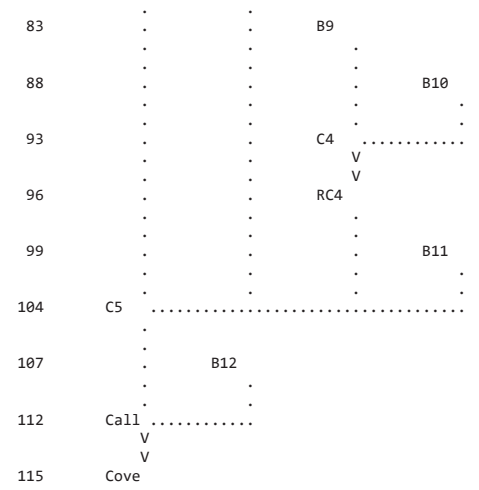
          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


112          KK   Call
113          KM   Combine C5, B12
114          HC       2
             *

115          KK   Cove Reservoir
116          KM   Routing through Res'v
117          RS       1    ELEV  5545.5
118          SV       0      19      95     240     453     738    1105    1563    2217    2773
119          SV    3542    4423    5419    6149    7347    8000
120          SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
121          SE    5530    5536    5542    5548    5552    5558
122          SL  5545.5   4.909     0.6     0.5
123          SS  5549.2      30    2.67     1.5
124          ST  5552.0    1892     2.9     1.5
             *
125          ZZ
1
               SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

    NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     18      B1
                 V
                 V
     27      RB1
                 .
                 .
     30          .       B2
                 .           .
                 .           .
     35          .           .       B3
                 .           .           .
                 .           .           .
     40      C1   ........................
                 V
                 V
     43      RC1
                 .
                 .
     46          .       B4
                 .           .
                 .           .
     51          .           .       B5
                 .           .           .
                 .           .           .
     56      C2   ........................
                 V
                 V
     59      RC2
                 .
                 .
     62          .       B6
                 .           .
                 .           .
     67          .           .       B7
                 .           .           .
                 .           .           .
     72      C3   ........................
                 V
                 V
     75      RC3
                 .
                 .
     78          .       B8
                 .           .
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************                    *****************************************
 *                                       *                    *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *    U.S. ARMY CORPS OF ENGINEERS       *
 *              JUN   1998               *                    *    HYDROLOGIC ENGINEERING CENTER      *
 *            VERSION 4.1                *                    *          609 SECOND STREET            *
 *                                       *                    *       DAVIS, CALIFORNIA 95616         *
 *  RUN DATE   06AUG20  TIME  02:56:37   *                    *           (916) 756-1104              *
 *                                       *                    *                                       *
 *****************************************                    *****************************************
```

HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

SEP General

```
  16 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           0  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN         216  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ          50  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      8    0  ENDING DATE
                     NDTIME        0824  ENDING TIME
                     ICENT           19  CENTURY MARK

                   COMPUTATION INTERVAL    3.60 HOURS
                        TOTAL TIME BASE  176.40 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                      NPLAN           1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                    1.00


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
```

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 112 KK    *     Call   *
           *            *
           **************
                        Combine C5, B12

 114 HC          HYDROGRAPH COMBINATION
                      ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

*****************************************************************************************************************************************

                                                HYDROGRAPH AT STATION    Call
                                                     SUM OF  2 HYDROGRAPHS
                                                    PLAN 1,   RATIO =  1.00

*****************************************************************************************************************************************
                                *                                *                                *
   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW   *   DA MON HRMN  ORD      FLOW
                                *                                *                                *
     1     0000    1        0.   *    2     2248   14       372.   *    4     2136   27        0.   *    6     2024   40        0.
     1     0336    2        0.   *    3     0224   15       323.   *    5     0112   28        0.   *    7     0000   41        0.
     1     0712    3        5.   *    3     0600   16       307.   *    5     0448   29        0.   *    7     0336   42        0.
     1     1048    4       25.   *    3     0936   17       271.   *    5     0824   30        0.   *    7     0712   43        0.
     1     1424    5       56.   *    3     1312   18       257.   *    5     1200   31        0.   *    7     1048   44        0.
     1     1800    6      120.   *    3     1648   19       254.   *    5     1536   32        0.   *    7     1424   45        0.
     1     2136    7      235.   *    3     2024   20       254.   *    5     1912   33        0.   *    7     1800   46        0.
     2     0112    8      688.   *    4     0000   21       221.   *    5     2248   34        0.   *    7     2136   47        0.
     2     0448    9     1587.   *    4     0336   22        81.   *    6     0224   35        0.   *    8     0112   48        0.
     2     0824   10     1393.   *    4     0712   23        21.   *    6     0600   36        0.   *    8     0448   49        0.
     2     1200   11      771.   *    4     1048   24         4.   *    6     0936   37        0.   *    8     0824   50        0.
     2     1536   12      523.   *    4     1424   25         1.   *    6     1312   38        0.   *
     2     1912   13      428.   *    4     1800   26         0.   *    6     1648   39        0.   *
                                *                                *                                *
*****************************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR        72-HR     176.40-HR
+   (CFS)       (HR)
                        (CFS)
+    1587.     28.80                 1490.         882.         409.          167.
                          (INCHES)    1.753        6.228        9.622         9.643
                           (AC-FT)     443.        1575.        2433.         2439.

                         CUMULATIVE AREA =    4.74 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 115 KK    *     Cove   *     Reservoir
           *            *
           **************
                        Routing through Res'v

              HYDROGRAPH ROUTING DATA

 117 RS          STORAGE ROUTING
                      NSTPS           1  NUMBER OF SUBREACHES
                       ITYP        ELEV  TYPE OF INITIAL CONDITION
                     RSVRIC     5545.50  INITIAL CONDITION
                          X         .00 WORKING R AND D COEFFICIENT

 118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                 3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

 120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                               5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

 122 SL          LOW-LEVEL OUTLET
                      ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                      CAREA        4.91  CROSS-SECTIONAL AREA
                       COQL         .60  COEFFICIENT
                       EXPL         .50  EXPONENT OF HEAD

 123 SS          SPILLWAY
                       CREL     5549.20  SPILLWAY CREST ELEVATION
                      SPWID       30.00  SPILLWAY WIDTH
                       COQW        2.67  WEIR COEFFICIENT
                       EXPW        1.50  EXPONENT OF HEAD

 124 ST          TOP OF DAM
```

TOPEL	5552.00	ELEVATION AT TOP OF DAM
DAMWID	1892.00	DAM WIDTH
COQD	2.90	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	5844.8	5545.5	3		1312	18	326.	7179.3	5551.4	6		0224	35	61.	6601.8	5549.5
1		0336	2	0.	5844.8	5545.5	3		1648	19	314.	7160.1	5551.4	6		0600	36	57.	6584.2	5549.5
1		0712	3	2.	5845.4	5545.5	3		2024	20	304.	7143.7	5551.3	6		0936	37	54.	6567.7	5549.4
1		1048	4	4.	5849.0	5545.5	4		0000	21	294.	7125.6	5551.3	6		1312	38	51.	6552.2	5549.3
1		1424	5	8.	5859.3	5545.6	4		0336	22	271.	7086.7	5551.1	6		1648	39	48.	6537.4	5549.3
1		1800	6	13.	5882.4	5545.8	4		0712	23	237.	7026.1	5550.9	6		2024	40	47.	6523.2	5549.2
1		2136	7	20.	5930.4	5546.2	4		1048	24	204.	6964.1	5550.7	7		0000	41	45.	6509.5	5549.2
2		0112	8	31.	6060.0	5547.3	4		1424	25	177.	6908.3	5550.5	7		0336	42	45.	6496.0	5549.2
2		0448	9	43.	6386.9	5548.8	4		1800	26	154.	6859.3	5550.4	7		0712	43	45.	6482.6	5549.1
2		0824	10	130.	6804.4	5550.2	4		2136	27	135.	6816.4	5550.2	7		1048	44	45.	6469.3	5549.1
2		1200	11	261.	7069.4	5551.1	5		0112	28	119.	6778.6	5550.1	7		1424	45	44.	6456.0	5549.0
2		1536	12	323.	7174.9	5551.4	5		0448	29	106.	6745.1	5550.0	7		1800	46	44.	6442.9	5549.0
2		1912	13	349.	7216.3	5551.6	5		0824	30	95.	6715.1	5549.9	7		2136	47	44.	6429.9	5548.9
2		2248	14	358.	7230.0	5551.6	5		1200	31	86.	6688.0	5549.8	8		0112	48	44.	6417.1	5548.9
3		0224	15	356.	7227.2	5551.6	5		1536	32	78.	6663.6	5549.7	8		0448	49	43.	6404.2	5548.9
3		0600	16	349.	7216.0	5551.6	5		1912	33	72.	6641.2	5549.6	8		0824	50	43.	6391.5	5548.8
3		0936	17	339.	7199.7	5551.5	5		2248	34	66.	6620.8	5549.6							

PEAK OUTFLOW IS 358. AT TIME 46.80 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	176.40-HR
+ (CFS)	(HR)				
		(CFS)			
+ 358.	46.80	357.	346.	254.	130.
		(INCHES)	.420	2.442	5.987	7.487
		(AC-FT)	106.	618.	1514.	1894.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	176.40-HR
+ (AC-FT)	(HR)				
7230.	46.80	7229.	7211.	7044.	6643.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	176.40-HR
+ (FEET)	(HR)				
5551.61	46.80	5551.60	5551.55	5550.99	5549.46

CUMULATIVE AREA = 4.74 SQ MI

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1
					1.00
HYDROGRAPH AT					
+	B1	.50	1	FLOW	162.
				TIME	28.80
ROUTED TO					
+	RB1	.50	1	FLOW	156.
				TIME	28.80
HYDROGRAPH AT					
+	B2	.44	1	FLOW	140.
				TIME	28.80
HYDROGRAPH AT					
+	B3	.28	1	FLOW	87.
				TIME	28.80
3 COMBINED AT					
+	C1	1.22	1	FLOW	382.
				TIME	28.80
ROUTED TO					
+	RC1	1.22	1	FLOW	371.
				TIME	28.80
HYDROGRAPH AT					
+	B4	.45	1	FLOW	147.
				TIME	28.80
HYDROGRAPH AT					
+	B5	.81	1	FLOW	266.
				TIME	28.80
3 COMBINED AT					
+	C2	2.48	1	FLOW	785.
				TIME	28.80
ROUTED TO					
+	RC2	2.48	1	FLOW	780.
				TIME	28.80
HYDROGRAPH AT					
+	B6	.15	1	FLOW	58.
				TIME	28.80
HYDROGRAPH AT					
+	B7	.33	1	FLOW	111.
				TIME	28.80
3 COMBINED AT					
+	C3	2.95	1	FLOW	949.
				TIME	28.80
ROUTED TO					
+	RC3	2.95	1	FLOW	900.
				TIME	28.80
HYDROGRAPH AT					
+	B8	1.01	1	FLOW	389.
				TIME	28.80
HYDROGRAPH AT					
+	B9	.24	1	FLOW	95.
				TIME	28.80
HYDROGRAPH AT					
+	B10	.13	1	FLOW	51.
				TIME	28.80
2 COMBINED AT					
+	C4	.37	1	FLOW	146.
				TIME	28.80
ROUTED TO					
+	RC4	.37	1	FLOW	143.
				TIME	28.80
HYDROGRAPH AT					
+	B11	.28	1	FLOW	108.
				TIME	28.80
4 COMBINED AT					
+	C5	4.61	1	FLOW	1540.
				TIME	28.80

```
 HYDROGRAPH AT
+                  B12          .13     1   FLOW          47.
                                            TIME        28.80

  2 COMBINED AT
+                  Call        4.74     1   FLOW        1587.
                                            TIME        28.80

 ROUTED TO
+                  Cove        4.74     1   FLOW         358.
                                            TIME        46.80

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     5551.61
                                            TIME        46.80
1
                                            SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                                (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                    INTERPOLATED TO
                                                                                  COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

           FOR PLAN = 1  RATIO=  .00
              RB1    MANE        16.14    161.33   1758.92      8.92    216.00    155.93   1728.00        8.94


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2392E+03 EXCESS= .0000E+00 OUTFLOW= .2392E+03 BASIN STORAGE= .3928E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC1    MANE        11.70    381.73   1743.12      8.85    216.00    371.42   1728.00        8.87


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5750E+03 EXCESS= .0000E+00 OUTFLOW= .5750E+03 BASIN STORAGE= .2955E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC2    MANE         2.77    784.17   1730.55      8.97    216.00    779.86   1728.00        8.97


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1184E+04 EXCESS= .0000E+00 OUTFLOW= .1184E+04 BASIN STORAGE= .2978E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC3    MANE        21.20    945.64   1759.24      9.09    216.00    900.19   1728.00        9.11


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1431E+04 EXCESS= .0000E+00 OUTFLOW= .1431E+04 BASIN STORAGE= .1049E-01 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RC4    MANE         9.01    145.33   1739.46     10.73    216.00    142.95   1728.00       10.74


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2123E+03 EXCESS= .0000E+00 OUTFLOW= .2123E+03 BASIN STORAGE= .2832E-02 PERCENT ERROR=    .0


1                              SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                             (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


      PLAN  1 .............                  INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                               ELEVATION        5545.50           5549.20          5552.00
                               STORAGE            5845.             6508.            7347.
                               OUTFLOW               0.               45.              435.


                     RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                       OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                      PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                     1.00      5551.61         .00       7230.       358.       .00        46.80         .00


 *** NORMAL END OF HEC-1 ***
```

Storm Event 12. Principal Spillway Hydrograph

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1****************************************                                    ****************************************
 *                                      *                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                    *    HYDROLOGIC ENGINEERING CENTER     *
 *           VERSION 4.1                *                                    *         609 SECOND STREET            *
 *                                      *                                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   06AUG20  TIME  03:15:56  *                                    *          (916) 756-1104              *
 *                                      *                                    *                                      *
 ****************************************                                    ****************************************

                                        X     X  XXXXXXX   XXXXX          X
                                        X     X  X       X     X        XX
                                        X     X  X       X              X
                                        XXXXXXX  XXXX    X       XXXXX  X
                                        X     X  X       X              X
                                        X     X  X       X     X        X
                                        X     X  XXXXXXX   XXXXX        XXX

  THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

  THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
  THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
  NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
  DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
  KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   PSH (NEH)
           13           ID
                        *Diagram
           14           JR    PREC     1.0
           15           IT      60       0       0     350
           16           IO       0
           17           IN      60
                        *
           18           QI       0      11      14      15      15      15      15      15      15      15
           19           QI      15      16      16      16      16      16      16      16      16      16
           20           QI      16      17      17      17      17      17      17      17      17      17
           21           QI      17      18      18      18      18      18      18      18      18      19
           22           QI      19      19      19      19      19      20      20      20      20      20
           23           QI      20      21      21      21      21      21      21      22      22      22
           24           QI      22      23      23      23      23      24      24      24      24      25
           25           QI      25      25      26      26      26      27      27      27      28      28
           26           QI      29      29      29      30      30      31      31      32      33      33
           27           QI      34      35      35      36      37      38      39      40      41      42
           28           QI      43      45      46      48      49      51      53      56      58      61
           29           QI      65      69      74      80      87      96     109     127     157     219
           30           QI     850     479     259     172     132     111      98      88      81      75
           31           QI      70      65      62      59      56      54      51      50      48      46
           32           QI      45      43      42      41      40      39      38      37      36      35
           33           QI      35      34      33      33      32      32      31      30      30      29
           34           QI      29      29      28      28      27      27      27      26      26      26
           35           QI      25      25      25      24      24      24      24      23      23      23
           36           QI      23      22      22      22      22      22      21      21      21      21
           37           QI      21      20      20      20      20      20      20      19      19      19
           38           QI      19      19      19      19      18      18      18      18      18      18
           39           QI      18      17      17      17      17      17      17      17      17      17
           40           QI      17      16      16      16      16      16      16      16      16      16
           41           QI      16      15      15      15      15      15      15      15      15      15
           42           QI      15       4       1
                        *

           43           KK   Cove Reservoir
           44           KM   Routing through Res'v
           45           RS       1    ELEV  5545.5
           46           SV       0      19      95     240     453     738    1105    1563    2217    2773
           47           SV    3542    4423    5419    6149    7347    8000
           48           SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
           49           SE    5530    5536    5542    5548    5552    5558
           50           SL  5545.5   4.909     0.6     0.5
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            51          SS  5549.2      30    2.67     1.5
1                                          HEC-1 INPUT                                          PAGE  2

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            52          ST  5552.0    1892     2.9     1.5
                        *
            53          ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

    NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

 *** HEC1 ERROR 4 *** NO HYDROGRAPHS AVAILABLE TO ROUTE
                 V
                 V
    43       Cove

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION

         1 ERRORS IN STREAM SYSTEM
1****************************************                                  ************************************
 *                                      *                                 *                                  *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                 *    U.S. ARMY CORPS OF ENGINEERS  *
 *               JUN   1998             *                                 *    HYDROLOGIC ENGINEERING CENTER *
 *            VERSION 4.1               *                                 *          609 SECOND STREET       *
 *                                      *                                 *       DAVIS, CALIFORNIA 95616    *
 *  RUN DATE   06AUG20  TIME  03:15:56  *                                 *           (916) 756-1104         *
 *                                      *                                 *                                  *
 ****************************************                                  ************************************



                          HYDROLOGY STUDY for COVE RESERVOIR
                          Located in KANE COUNTY, UTAH

                          AUG 2020

                          PREPARED BY ALPHA ENGINEERING
                          43 SOUTH 100 EAST, SUITE 100
                          ST. GEORGE, UTAH  84770
                          TEL: (435) 628-6500
                          FAX: (435) 628-6553

                          PSH (NEH)


   16 IO          OUTPUT CONTROL VARIABLES
                        IPRNT           0  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE

      IT          HYDROGRAPH TIME DATA
                         NMIN          60  MINUTES IN COMPUTATION INTERVAL
                        IDATE      1    0  STARTING DATE
                        ITIME        0000  STARTING TIME
                           NQ         350  NUMBER OF HYDROGRAPH ORDINATES
                       NDDATE     15    0  ENDING DATE
                       NDTIME       1300  ENDING TIME
                       ICENT          19  CENTURY MARK

                    COMPUTATION INTERVAL    1.00 HOURS
                         TOTAL TIME BASE  349.00 HOURS

            ENGLISH UNITS
                 DRAINAGE AREA         SQUARE MILES
                 PRECIPITATION DEPTH   INCHES
                 LENGTH, ELEVATION     FEET
                 FLOW                  CUBIC FEET PER SECOND
                 STORAGE VOLUME        ACRE-FEET
                 SURFACE AREA          ACRES
                 TEMPERATURE           DEGREES FAHRENHEIT

      JP          MULTI-PLAN OPTION
                        NPLAN           1  NUMBER OF PLANS

      JR          MULTI-RATIO OPTION
                      RATIOS OF PRECIPITATION
                     1.00

   17 IN          TIME DATA FOR INPUT TIME SERIES
                         JXMIN          60  TIME INTERVAL IN MINUTES
                        JXDATE      1    0  STARTING DATE
                        JXTIME           0  STARTING TIME

                SUBBASIN RUNOFF DATA

    0 BA          SUBBASIN CHARACTERISTICS
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TAREA .00 SUBBASIN AREA

***

HYDROGRAPH AT STATION Cove

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	4		1600	89	33.	8		0800	177	24.	12		0000	265	1.
1		0100	2	11.	4		1700	90	33.	8		0900	178	23.	12		0100	266	1.
1		0200	3	14.	4		1800	91	34.	8		1000	179	23.	12		0200	267	1.
1		0300	4	15.	4		1900	92	35.	8		1100	180	23.	12		0300	268	1.
1		0400	5	15.	4		2000	93	35.	8		1200	181	23.	12		0400	269	1.
1		0500	6	15.	4		2100	94	36.	8		1300	182	22.	12		0500	270	1.
1		0600	7	15.	4		2200	95	37.	8		1400	183	22.	12		0600	271	1.
1		0700	8	15.	4		2300	96	38.	8		1500	184	22.	12		0700	272	1.
1		0800	9	15.	5		0000	97	39.	8		1600	185	22.	12		0800	273	1.
1		0900	10	15.	5		0100	98	40.	8		1700	186	22.	12		0900	274	1.
1		1000	11	15.	5		0200	99	41.	8		1800	187	21.	12		1000	275	1.
1		1100	12	16.	5		0300	100	42.	8		1900	188	21.	12		1100	276	1.
1		1200	13	16.	5		0400	101	43.	8		2000	189	21.	12		1200	277	1.
1		1300	14	16.	5		0500	102	45.	8		2100	190	21.	12		1300	278	1.
1		1400	15	16.	5		0600	103	46.	8		2200	191	21.	12		1400	279	1.
1		1500	16	16.	5		0700	104	48.	8		2300	192	20.	12		1500	280	1.
1		1600	17	16.	5		0800	105	49.	9		0000	193	20.	12		1600	281	1.
1		1700	18	16.	5		0900	106	51.	9		0100	194	20.	12		1700	282	1.
1		1800	19	16.	5		1000	107	53.	9		0200	195	20.	12		1800	283	1.
1		1900	20	16.	5		1100	108	56.	9		0300	196	20.	12		1900	284	1.
1		2000	21	16.	5		1200	109	58.	9		0400	197	20.	12		2000	285	1.
1		2100	22	17.	5		1300	110	61.	9		0500	198	19.	12		2100	286	1.
1		2200	23	17.	5		1400	111	65.	9		0600	199	19.	12		2200	287	1.
1		2300	24	17.	5		1500	112	69.	9		0700	200	19.	12		2300	288	1.
2		0000	25	17.	5		1600	113	74.	9		0800	201	19.	13		0000	289	1.
2		0100	26	17.	5		1700	114	80.	9		0900	202	19.	13		0100	290	1.
2		0200	27	17.	5		1800	115	87.	9		1000	203	19.	13		0200	291	1.
2		0300	28	17.	5		1900	116	96.	9		1100	204	19.	13		0300	292	1.
2		0400	29	17.	5		2000	117	109.	9		1200	205	18.	13		0400	293	1.
2		0500	30	17.	5		2100	118	127.	9		1300	206	18.	13		0500	294	1.
2		0600	31	17.	5		2200	119	157.	9		1400	207	18.	13		0600	295	1.
2		0700	32	18.	5		2300	120	219.	9		1500	208	18.	13		0700	296	1.
2		0800	33	18.	6		0000	121	850.	9		1600	209	18.	13		0800	297	1.
2		0900	34	18.	6		0100	122	479.	9		1700	210	18.	13		0900	298	1.
2		1000	35	18.	6		0200	123	259.	9		1800	211	18.	13		1000	299	1.
2		1100	36	18.	6		0300	124	172.	9		1900	212	17.	13		1100	300	1.
2		1200	37	18.	6		0400	125	132.	9		2000	213	17.	13		1200	301	1.
2		1300	38	18.	6		0500	126	111.	9		2100	214	17.	13		1300	302	1.
2		1400	39	18.	6		0600	127	98.	9		2200	215	17.	13		1400	303	1.
2		1500	40	19.	6		0700	128	88.	9		2300	216	17.	13		1500	304	1.
2		1600	41	19.	6		0800	129	81.	10		0000	217	17.	13		1600	305	1.
2		1700	42	19.	6		0900	130	75.	10		0100	218	17.	13		1700	306	1.
2		1800	43	19.	6		1000	131	70.	10		0200	219	17.	13		1800	307	1.
2		1900	44	19.	6		1100	132	65.	10		0300	220	17.	13		1900	308	1.
2		2000	45	19.	6		1200	133	62.	10		0400	221	17.	13		2000	309	1.
2		2100	46	20.	6		1300	134	59.	10		0500	222	16.	13		2100	310	1.
2		2200	47	20.	6		1400	135	56.	10		0600	223	16.	13		2200	311	1.
2		2300	48	20.	6		1500	136	54.	10		0700	224	16.	13		2300	312	1.
3		0000	49	20.	6		1600	137	51.	10		0800	225	16.	14		0000	313	1.
3		0100	50	20.	6		1700	138	50.	10		0900	226	16.	14		0100	314	1.
3		0200	51	20.	6		1800	139	48.	10		1000	227	16.	14		0200	315	1.
3		0300	52	21.	6		1900	140	46.	10		1100	228	16.	14		0300	316	1.
3		0400	53	21.	6		2000	141	45.	10		1200	229	16.	14		0400	317	1.
3		0500	54	21.	6		2100	142	43.	10		1300	230	16.	14		0500	318	1.
3		0600	55	21.	6		2200	143	42.	10		1400	231	16.	14		0600	319	1.
3		0700	56	21.	6		2300	144	41.	10		1500	232	15.	14		0700	320	1.
3		0800	57	21.	7		0000	145	40.	10		1600	233	15.	14		0800	321	1.
3		0900	58	22.	7		0100	146	39.	10		1700	234	15.	14		0900	322	1.
3		1000	59	22.	7		0200	147	38.	10		1800	235	15.	14		1000	323	1.
3		1100	60	22.	7		0300	148	37.	10		1900	236	15.	14		1100	324	1.
3		1200	61	22.	7		0400	149	36.	10		2000	237	15.	14		1200	325	1.
3		1300	62	23.	7		0500	150	35.	10		2100	238	15.	14		1300	326	1.
3		1400	63	23.	7		0600	151	35.	10		2200	239	15.	14		1400	327	1.
3		1500	64	23.	7		0700	152	34.	10		2300	240	15.	14		1500	328	1.
3		1600	65	23.	7		0800	153	33.	11		0000	241	15.	14		1600	329	1.
3		1700	66	24.	7		0900	154	33.	11		0100	242	4.	14		1700	330	1.
3		1800	67	24.	7		1000	155	32.	11		0200	243	1.	14		1800	331	1.
3		1900	68	24.	7		1100	156	32.	11		0300	244	1.	14		1900	332	1.
3		2000	69	24.	7		1200	157	31.	11		0400	245	1.	14		2000	333	1.
3		2100	70	25.	7		1300	158	30.	11		0500	246	1.	14		2100	334	1.
3		2200	71	25.	7		1400	159	30.	11		0600	247	1.	14		2200	335	1.
3		2300	72	25.	7		1500	160	29.	11		0700	248	1.	14		2300	336	1.
4		0000	73	26.	7		1600	161	29.	11		0800	249	1.	15		0000	337	1.
4		0100	74	26.	7		1700	162	29.	11		0900	250	1.	15		0100	338	1.
4		0200	75	26.	7		1800	163	28.	11		1000	251	1.	15		0200	339	1.
4		0300	76	27.	7		1900	164	28.	11		1100	252	1.	15		0300	340	1.
4		0400	77	27.	7		2000	165	27.	11		1200	253	1.	15		0400	341	1.
4		0500	78	27.	7		2100	166	27.	11		1300	254	1.	15		0500	342	1.
4		0600	79	28.	7		2200	167	27.	11		1400	255	1.	15		0600	343	1.
4		0700	80	28.	7		2300	168	26.	11		1500	256	1.	15		0700	344	1.

4	0800	81	29.	*	8	0000	169	26.	*	11	1600	257	1.	*	15	0800	345	1.	
4	0900	82	29.	*	8	0100	170	26.	*	11	1700	258	1.	*	15	0900	346	1.	
4	1000	83	29.	*	8	0200	171	25.	*	11	1800	259	1.	*	15	1000	347	1.	
4	1100	84	30.	*	8	0300	172	25.	*	11	1900	260	1.	*	15	1100	348	1.	
4	1200	85	30.	*	8	0400	173	25.	*	11	2000	261	1.	*	15	1200	349	1.	
4	1300	86	31.	*	8	0500	174	24.	*	11	2100	262	1.	*	15	1300	350	1.	
4	1400	87	31.	*	8	0600	175	24.	*	11	2200	263	1.	*					
4	1500	88	32.	*	8	0700	176	24.	*	11	2300	264	1.	*					
				*					*					*					

****

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	349.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 850.	120.00		354.	154.	79.	26.
		(INCHES)	.000	.000	.000	.000
		(AC-FT)	175.	305.	468.	757.

CUMULATIVE AREA = .00 SQ MI

****

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

****

DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
					*						*						*					
1		0000	1	0.	*	4		1600	89	33.	*	8		0800	177	24.	*	12		0000	265	1.
1		0100	2	11.	*	4		1700	90	33.	*	8		0900	178	23.	*	12		0100	266	1.
1		0200	3	14.	*	4		1800	91	34.	*	8		1000	179	23.	*	12		0200	267	1.
1		0300	4	15.	*	4		1900	92	35.	*	8		1100	180	23.	*	12		0300	268	1.
1		0400	5	15.	*	4		2000	93	35.	*	8		1200	181	23.	*	12		0400	269	1.
1		0500	6	15.	*	4		2100	94	36.	*	8		1300	182	22.	*	12		0500	270	1.
1		0600	7	15.	*	4		2200	95	37.	*	8		1400	183	22.	*	12		0600	271	1.
1		0700	8	15.	*	4		2300	96	38.	*	8		1500	184	22.	*	12		0700	272	1.
1		0800	9	15.	*	5		0000	97	39.	*	8		1600	185	22.	*	12		0800	273	1.
1		0900	10	15.	*	5		0100	98	40.	*	8		1700	186	22.	*	12		0900	274	1.
1		1000	11	15.	*	5		0200	99	41.	*	8		1800	187	21.	*	12		1000	275	1.
1		1100	12	16.	*	5		0300	100	42.	*	8		1900	188	21.	*	12		1100	276	1.
1		1200	13	16.	*	5		0400	101	43.	*	8		2000	189	21.	*	12		1200	277	1.
1		1300	14	16.	*	5		0500	102	45.	*	8		2100	190	21.	*	12		1300	278	1.
1		1400	15	16.	*	5		0600	103	46.	*	8		2200	191	21.	*	12		1400	279	1.
1		1500	16	16.	*	5		0700	104	48.	*	8		2300	192	20.	*	12		1500	280	1.
1		1600	17	16.	*	5		0800	105	49.	*	9		0000	193	20.	*	12		1600	281	1.
1		1700	18	16.	*	5		0900	106	51.	*	9		0100	194	20.	*	12		1700	282	1.
1		1800	19	16.	*	5		1000	107	53.	*	9		0200	195	20.	*	12		1800	283	1.
1		1900	20	16.	*	5		1100	108	56.	*	9		0300	196	20.	*	12		1900	284	1.
1		2000	21	16.	*	5		1200	109	58.	*	9		0400	197	20.	*	12		2000	285	1.
1		2100	22	17.	*	5		1300	110	61.	*	9		0500	198	19.	*	12		2100	286	1.
1		2200	23	17.	*	5		1400	111	65.	*	9		0600	199	19.	*	12		2200	287	1.
1		2300	24	17.	*	5		1500	112	69.	*	9		0700	200	19.	*	12		2300	288	1.
2		0000	25	17.	*	5		1600	113	74.	*	9		0800	201	19.	*	13		0000	289	1.
2		0100	26	17.	*	5		1700	114	80.	*	9		0900	202	19.	*	13		0100	290	1.
2		0200	27	17.	*	5		1800	115	87.	*	9		1000	203	19.	*	13		0200	291	1.
2		0300	28	17.	*	5		1900	116	96.	*	9		1100	204	19.	*	13		0300	292	1.
2		0400	29	17.	*	5		2000	117	109.	*	9		1200	205	18.	*	13		0400	293	1.
2		0500	30	17.	*	5		2100	118	127.	*	9		1300	206	18.	*	13		0500	294	1.
2		0600	31	17.	*	5		2200	119	157.	*	9		1400	207	18.	*	13		0600	295	1.
2		0700	32	18.	*	5		2300	120	219.	*	9		1500	208	18.	*	13		0700	296	1.
2		0800	33	18.	*	6		0000	121	850.	*	9		1600	209	18.	*	13		0800	297	1.
2		0900	34	18.	*	6		0100	122	479.	*	9		1700	210	18.	*	13		0900	298	1.
2		1000	35	18.	*	6		0200	123	259.	*	9		1800	211	18.	*	13		1000	299	1.
2		1100	36	18.	*	6		0300	124	172.	*	9		1900	212	17.	*	13		1100	300	1.
2		1200	37	18.	*	6		0400	125	132.	*	9		2000	213	17.	*	13		1200	301	1.
2		1300	38	18.	*	6		0500	126	111.	*	9		2100	214	17.	*	13		1300	302	1.
2		1400	39	18.	*	6		0600	127	98.	*	9		2200	215	17.	*	13		1400	303	1.
2		1500	40	19.	*	6		0700	128	88.	*	9		2300	216	17.	*	13		1500	304	1.
2		1600	41	19.	*	6		0800	129	81.	*	10		0000	217	17.	*	13		1600	305	1.
2		1700	42	19.	*	6		0900	130	75.	*	10		0100	218	17.	*	13		1700	306	1.
2		1800	43	19.	*	6		1000	131	70.	*	10		0200	219	17.	*	13		1800	307	1.
2		1900	44	19.	*	6		1100	132	65.	*	10		0300	220	17.	*	13		1900	308	1.
2		2000	45	19.	*	6		1200	133	62.	*	10		0400	221	17.	*	13		2000	309	1.
2		2100	46	20.	*	6		1300	134	59.	*	10		0500	222	16.	*	13		2100	310	1.
2		2200	47	20.	*	6		1400	135	56.	*	10		0600	223	16.	*	13		2200	311	1.
2		2300	48	20.	*	6		1500	136	54.	*	10		0700	224	16.	*	13		2300	312	1.
3		0000	49	20.	*	6		1600	137	51.	*	10		0800	225	16.	*	14		0000	313	1.
3		0100	50	20.	*	6		1700	138	50.	*	10		0900	226	16.	*	14		0100	314	1.
3		0200	51	20.	*	6		1800	139	48.	*	10		1000	227	16.	*	14		0200	315	1.
3		0300	52	21.	*	6		1900	140	46.	*	10		1100	228	16.	*	14		0300	316	1.
3		0400	53	21.	*	6		2000	141	45.	*	10		1200	229	16.	*	14		0400	317	1.
3		0500	54	21.	*	6		2100	142	43.	*	10		1300	230	16.	*	14		0500	318	1.
3		0600	55	21.	*	6		2200	143	42.	*	10		1400	231	16.	*	14		0600	319	1.
3		0700	56	21.	*	6		2300	144	41.	*	10		1500	232	15.	*	14		0700	320	1.
3		0800	57	21.	*	7		0000	145	40.	*	10		1600	233	15.	*	14		0800	321	1.
3		0900	58	22.	*	7		0100	146	39.	*	10		1700	234	15.	*	14		0900	322	1.
3		1000	59	22.	*	7		0200	147	38.	*	10		1800	235	15.	*	14		1000	323	1.
3		1100	60	22.	*	7		0300	148	37.	*	10		1900	236	15.	*	14		1100	324	1.
3		1200	61	22.	*	7		0400	149	36.	*	10		2000	237	15.	*	14		1200	325	1.

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    3     1300   62       23.   *    7     0500  150       35.   *   10     2100  238       15.   *   14     1300  326        1.
    3     1400   63       23.   *    7     0600  151       35.   *   10     2200  239       15.   *   14     1400  327        1.
    3     1500   64       23.   *    7     0700  152       34.   *   10     2300  240       15.   *   14     1500  328        1.
    3     1600   65       23.   *    7     0800  153       33.   *   11     0000  241       15.   *   14     1600  329        1.
    3     1700   66       24.   *    7     0900  154       33.   *   11     0100  242        4.   *   14     1700  330        1.
    3     1800   67       24.   *    7     1000  155       32.   *   11     0200  243        1.   *   14     1800  331        1.
    3     1900   68       24.   *    7     1100  156       32.   *   11     0300  244        1.   *   14     1900  332        1.
    3     2000   69       24.   *    7     1200  157       31.   *   11     0400  245        1.   *   14     2000  333        1.
    3     2100   70       25.   *    7     1300  158       30.   *   11     0500  246        1.   *   14     2100  334        1.
    3     2200   71       25.   *    7     1400  159       30.   *   11     0600  247        1.   *   14     2200  335        1.
    3     2300   72       25.   *    7     1500  160       29.   *   11     0700  248        1.   *   14     2300  336        1.
    4     0000   73       26.   *    7     1600  161       29.   *   11     0800  249        1.   *   15     0000  337        1.
    4     0100   74       26.   *    7     1700  162       29.   *   11     0900  250        1.   *   15     0100  338        1.
    4     0200   75       26.   *    7     1800  163       28.   *   11     1000  251        1.   *   15     0200  339        1.
    4     0300   76       27.   *    7     1900  164       28.   *   11     1100  252        1.   *   15     0300  340        1.
    4     0400   77       27.   *    7     2000  165       27.   *   11     1200  253        1.   *   15     0400  341        1.
    4     0500   78       27.   *    7     2100  166       27.   *   11     1300  254        1.   *   15     0500  342        1.
    4     0600   79       28.   *    7     2200  167       27.   *   11     1400  255        1.   *   15     0600  343        1.
    4     0700   80       28.   *    7     2300  168       26.   *   11     1500  256        1.   *   15     0700  344        1.
    4     0800   81       29.   *    8     0000  169       26.   *   11     1600  257        1.   *   15     0800  345        1.
    4     0900   82       29.   *    8     0100  170       26.   *   11     1700  258        1.   *   15     0900  346        1.
    4     1000   83       29.   *    8     0200  171       25.   *   11     1800  259        1.   *   15     1000  347        1.
    4     1100   84       30.   *    8     0300  172       25.   *   11     1900  260        1.   *   15     1100  348        1.
    4     1200   85       30.   *    8     0400  173       25.   *   11     2000  261        1.   *   15     1200  349        1.
    4     1300   86       31.   *    8     0500  174       24.   *   11     2100  262        1.   *   15     1300  350        1.
    4     1400   87       31.   *    8     0600  175       24.   *   11     2200  263        1.   *
    4     1500   88       32.   *    8     0700  176       24.   *   11     2300  264        1.   *
                             *                                  *                                 *
 ********************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                  6-HR        24-HR       72-HR    349.00-HR
+   (CFS)       (HR)
                     (CFS)
+     850.    120.00                354.         154.         79.          26.
                   (INCHES)        .000         .000        .000         .000
                    (AC-FT)        175.         305.        468.         757.

                    CUMULATIVE AREA =     .00 SQ MI


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
  43 KK    *     Cove   *     Reservoir
           *            *
           **************
                     Routing through Res'v

              HYDROGRAPH ROUTING DATA

  45 RS         STORAGE ROUTING
                     NSTPS           1  NUMBER OF SUBREACHES
                      ITYP        ELEV  TYPE OF INITIAL CONDITION
                     RSVRIC     5545.50  INITIAL CONDITION
                          X         .00 WORKING R AND D COEFFICIENT

  46 SV           STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

  48 SE         ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                              5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

  50 SL         LOW-LEVEL OUTLET
                     ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                     CAREA        4.91  CROSS-SECTIONAL AREA
                      COQL         .60  COEFFICIENT
                      EXPL         .50  EXPONENT OF HEAD

  51 SS         SPILLWAY
                      CREL     5549.20  SPILLWAY CREST ELEVATION
                     SPWID       30.00  SPILLWAY WIDTH
                      COQW        2.67  WEIR COEFFICIENT
                      EXPW        1.50  EXPONENT OF HEAD

  52 ST         TOP OF DAM
                     TOPEL     5552.00  ELEVATION AT TOP OF DAM
                    DAMWID     1892.00  DAM WIDTH
                      COQD        2.90  WEIR COEFFICIENT
                      EXPD        1.50  EXPONENT OF HEAD

                                                 ***

                                          COMPUTED OUTFLOW-ELEVATION DATA

                                            (EXCLUDING FLOW OVER DAM)

           OUTFLOW        .00       .00     25.78     27.48     29.42     31.65     34.25     37.31     40.98     45.44
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ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	5844.8	5545.5	5		2100	118	26.	5992.5	5546.7	10		1800	235	34.	6094.7	5547.6
1		0100	2	1.	5845.2	5545.5	5		2200	119	27.	6002.1	5546.8	10		1900	236	34.	6093.2	5547.5
1		0200	3	2.	5846.1	5545.5	5		2300	120	28.	6015.3	5546.9	10		2000	237	34.	6091.6	5547.5
1		0300	4	3.	5847.1	5545.5	6		0000	121	31.	6057.0	5547.2	10		2100	238	34.	6090.1	5547.5
1		0400	5	4.	5848.0	5545.5	6		0100	122	35.	6109.3	5547.7	10		2200	239	33.	6088.5	5547.5
1		0500	6	4.	5848.9	5545.5	6		0200	123	37.	6136.7	5547.9	10		2300	240	33.	6087.0	5547.5
1		0600	7	5.	5849.8	5545.5	6		0300	124	37.	6151.5	5548.0	11		0000	241	33.	6085.6	5547.5
1		0700	8	5.	5850.7	5545.5	6		0400	125	38.	6161.0	5548.0	11		0100	242	33.	6083.6	5547.5
1		0800	9	6.	5851.5	5545.6	6		0500	126	38.	6167.9	5548.1	11		0200	243	33.	6081.1	5547.4
1		0900	10	6.	5852.3	5545.6	6		0600	127	38.	6173.4	5548.1	11		0300	244	33.	6078.5	5547.4
1		1000	11	6.	5853.0	5545.6	6		0700	128	38.	6178.0	5548.1	11		0400	245	33.	6075.9	5547.4
1		1100	12	6.	5853.8	5545.6	6		0800	129	38.	6181.8	5548.1	11		0500	246	32.	6073.3	5547.4
1		1200	13	7.	5854.6	5545.6	6		0900	130	38.	6185.0	5548.1	11		0600	247	32.	6070.6	5547.4
1		1300	14	7.	5855.3	5545.6	6		1000	131	38.	6187.8	5548.1	11		0700	248	32.	6068.1	5547.3
1		1400	15	7.	5856.1	5545.6	6		1100	132	38.	6190.1	5548.1	11		0800	249	32.	6065.5	5547.3
1		1500	16	7.	5856.8	5545.6	6		1200	133	38.	6192.1	5548.1	11		0900	250	32.	6063.0	5547.3
1		1600	17	8.	5857.5	5545.6	6		1300	134	38.	6193.9	5548.1	11		1000	251	31.	6060.5	5547.3
1		1700	18	8.	5858.3	5545.6	6		1400	135	38.	6195.5	5548.2	11		1100	252	31.	6058.0	5547.3
1		1800	19	8.	5858.9	5545.6	6		1500	136	39.	6196.8	5548.2	11		1200	253	31.	6055.5	5547.2
1		1900	20	8.	5859.6	5545.6	6		1600	137	39.	6198.0	5548.2	11		1300	254	31.	6053.0	5547.2
1		2000	21	8.	5860.2	5545.6	6		1700	138	39.	6199.0	5548.2	11		1400	255	31.	6050.6	5547.2
1		2100	22	9.	5860.9	5545.6	6		1800	139	39.	6199.9	5548.2	11		1500	256	31.	6048.1	5547.2
1		2200	23	9.	5861.6	5545.6	6		1900	140	39.	6200.6	5548.2	11		1600	257	30.	6045.7	5547.2
1		2300	24	9.	5862.2	5545.6	6		2000	141	39.	6201.2	5548.2	11		1700	258	30.	6043.3	5547.1
2		0000	25	9.	5862.9	5545.6	6		2100	142	39.	6201.6	5548.2	11		1800	259	30.	6040.9	5547.1
2		0100	26	9.	5863.5	5545.7	6		2200	143	39.	6201.9	5548.2	11		1900	260	30.	6038.5	5547.1
2		0200	27	9.	5864.2	5545.7	6		2300	144	39.	6202.2	5548.2	11		2000	261	30.	6036.1	5547.1
2		0300	28	10.	5864.8	5545.7	7		0000	145	39.	6202.4	5548.2	11		2100	262	29.	6033.7	5547.1
2		0400	29	10.	5865.4	5545.7	7		0100	146	39.	6202.4	5548.2	11		2200	263	29.	6031.4	5547.0
2		0500	30	10.	5866.0	5545.7	7		0200	147	39.	6202.4	5548.2	11		2300	264	29.	6029.1	5547.0
2		0600	31	10.	5866.6	5545.7	7		0300	148	39.	6202.2	5548.2	12		0000	265	29.	6026.8	5547.0
2		0700	32	10.	5867.2	5545.7	7		0400	149	39.	6202.1	5548.2	12		0100	266	29.	6024.5	5547.0
2		0800	33	10.	5867.8	5545.7	7		0500	150	39.	6201.8	5548.2	12		0200	267	29.	6022.2	5547.0
2		0900	34	10.	5868.5	5545.7	7		0600	151	39.	6201.5	5548.2	12		0300	268	28.	6020.0	5546.9
2		1000	35	11.	5869.1	5545.7	7		0700	152	39.	6201.2	5548.2	12		0400	269	28.	6017.7	5546.9
2		1100	36	11.	5869.7	5545.7	7		0800	153	39.	6200.8	5548.2	12		0500	270	28.	6015.5	5546.9
2		1200	37	11.	5870.3	5545.7	7		0900	154	39.	6200.3	5548.2	12		0600	271	28.	6013.3	5546.9
2		1300	38	11.	5870.9	5545.7	7		1000	155	39.	6199.9	5548.2	12		0700	272	28.	6011.1	5546.9
2		1400	39	11.	5871.4	5545.7	7		1100	156	39.	6199.3	5548.2	12		0800	273	27.	6008.9	5546.8
2		1500	40	11.	5872.0	5545.7	7		1200	157	39.	6198.7	5548.2	12		0900	274	27.	6006.7	5546.8
2		1600	41	11.	5872.7	5545.7	7		1300	158	39.	6198.0	5548.2	12		1000	275	27.	6004.5	5546.8
2		1700	42	11.	5873.3	5545.7	7		1400	159	39.	6197.3	5548.2	12		1100	276	27.	6002.4	5546.8
2		1800	43	12.	5873.9	5545.7	7		1500	160	39.	6196.5	5548.2	12		1200	277	27.	6000.2	5546.8
2		1900	44	12.	5874.5	5545.7	7		1600	161	38.	6195.8	5548.2	12		1300	278	27.	5998.1	5546.8
2		2000	45	12.	5875.1	5545.7	7		1700	162	38.	6195.1	5548.2	12		1400	279	26.	5996.0	5546.7
2		2100	46	12.	5875.8	5545.8	7		1800	163	38.	6194.2	5548.2	12		1500	280	26.	5993.9	5546.7
2		2200	47	12.	5876.4	5545.8	7		1900	164	38.	6193.3	5548.1	12		1600	281	26.	5991.9	5546.7
2		2300	48	12.	5877.1	5545.8	7		2000	165	38.	6192.4	5548.1	12		1700	282	26.	5989.8	5546.7
3		0000	49	12.	5877.7	5545.8	7		2100	166	38.	6191.6	5548.1	12		1800	283	26.	5987.8	5546.7
3		0100	50	12.	5878.4	5545.8	7		2200	167	38.	6190.7	5548.1	12		1900	284	25.	5985.7	5546.7
3		0200	51	13.	5879.1	5545.8	7		2300	168	38.	6189.7	5548.1	12		2000	285	25.	5983.7	5546.6
3		0300	52	13.	5879.7	5545.8	8		0000	169	38.	6188.6	5548.1	12		2100	286	25.	5981.7	5546.6
3		0400	53	13.	5880.4	5545.8	8		0100	170	38.	6187.6	5548.1	12		2200	287	25.	5979.7	5546.6
3		0500	54	13.	5881.1	5545.8	8		0200	171	38.	6186.6	5548.1	12		2300	288	25.	5977.8	5546.6
3		0600	55	13.	5881.7	5545.8	8		0300	172	38.	6185.6	5548.1	13		0000	289	25.	5975.8	5546.6
3		0700	56	13.	5882.4	5545.8	8		0400	173	38.	6184.5	5548.1	13		0100	290	24.	5973.9	5546.6
3		0800	57	13.	5883.0	5545.8	8		0500	174	38.	6183.4	5548.1	13		0200	291	24.	5972.0	5546.5

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   3     0900  58      13.   5883.7  5545.8 *  8     0600 175      38.   6182.2  5548.1 * 13     0300 292      24.   5970.1  5546.5
   3     1000  59      13.   5884.4  5545.8 *  8     0700 176      38.   6181.0  5548.1 * 13     0400 293      24.   5968.2  5546.5
   3     1100  60      14.   5885.1  5545.8 *  8     0800 177      38.   6179.9  5548.1 * 13     0500 294      24.   5966.3  5546.5
   3     1200  61      14.   5885.8  5545.8 *  8     0900 178      38.   6178.7  5548.1 * 13     0600 295      23.   5964.4  5546.5
   3     1300  62      14.   5886.5  5545.8 *  8     1000 179      38.   6177.4  5548.1 * 13     0700 296      23.   5962.6  5546.5
   3     1400  63      14.   5887.3  5545.8 *  8     1100 180      38.   6176.2  5548.1 * 13     0800 297      23.   5960.7  5546.5
   3     1500  64      14.   5888.1  5545.9 *  8     1200 181      38.   6175.0  5548.1 * 13     0900 298      23.   5958.9  5546.4
   3     1600  65      14.   5888.8  5545.9 *  8     1300 182      38.   6173.7  5548.1 * 13     1000 299      23.   5957.1  5546.4
   3     1700  66      14.   5889.6  5545.9 *  8     1400 183      38.   6172.4  5548.1 * 13     1100 300      23.   5955.3  5546.4
   3     1800  67      14.   5890.3  5545.9 *  8     1500 184      38.   6171.1  5548.1 * 13     1200 301      22.   5953.5  5546.4
   3     1900  68      15.   5891.1  5545.9 *  8     1600 185      38.   6169.8  5548.1 * 13     1300 302      22.   5951.8  5546.4
   3     2000  69      15.   5891.9  5545.9 *  8     1700 186      38.   6168.5  5548.1 * 13     1400 303      22.   5950.0  5546.4
   3     2100  70      15.   5892.7  5545.9 *  8     1800 187      38.   6167.1  5548.1 * 13     1500 304      22.   5948.3  5546.4
   3     2200  71      15.   5893.5  5545.9 *  8     1900 188      38.   6165.8  5548.1 * 13     1600 305      22.   5946.6  5546.3
   3     2300  72      15.   5894.4  5545.9 *  8     2000 189      38.   6164.5  5548.1 * 13     1700 306      21.   5944.9  5546.3
   4     0000  73      15.   5895.2  5545.9 *  8     2100 190      38.   6163.2  5548.0 * 13     1800 307      21.   5943.2  5546.3
   4     0100  74      15.   5896.1  5545.9 *  8     2200 191      38.   6161.9  5548.0 * 13     1900 308      21.   5941.5  5546.3
   4     0200  75      15.   5897.0  5545.9 *  8     2300 192      38.   6160.4  5548.0 * 13     2000 309      21.   5939.9  5546.3
   4     0300  76      16.   5897.9  5545.9 *  9     0000 193      38.   6158.9  5548.0 * 13     2100 310      21.   5938.2  5546.3
   4     0400  77      16.   5898.8  5545.9 *  9     0100 194      38.   6157.5  5548.0 * 13     2200 311      21.   5936.6  5546.3
   4     0500  78      16.   5899.8  5546.0 *  9     0200 195      38.   6156.0  5548.0 * 13     2300 312      20.   5935.0  5546.2
   4     0600  79      16.   5900.7  5546.0 *  9     0300 196      37.   6154.6  5548.0 * 14     0000 313      20.   5933.4  5546.2
   4     0700  80      16.   5901.7  5546.0 *  9     0400 197      37.   6153.1  5548.0 * 14     0100 314      20.   5931.8  5546.2
   4     0800  81      16.   5902.8  5546.0 *  9     0500 198      37.   6151.6  5548.0 * 14     0200 315      20.   5930.3  5546.2
   4     0900  82      16.   5903.8  5546.0 *  9     0600 199      37.   6150.2  5548.0 * 14     0300 316      20.   5928.7  5546.2
   4     1000  83      17.   5904.8  5546.0 *  9     0700 200      37.   6148.6  5548.0 * 14     0400 317      19.   5927.2  5546.2
   4     1100  84      17.   5905.9  5546.0 *  9     0800 201      37.   6147.2  5548.0 * 14     0500 318      19.   5925.6  5546.2
   4     1200  85      17.   5907.0  5546.0 *  9     0900 202      37.   6145.7  5548.0 * 14     0600 319      19.   5924.1  5546.2
   4     1300  86      17.   5908.1  5546.0 *  9     1000 203      37.   6144.2  5548.0 * 14     0700 320      19.   5922.7  5546.1
   4     1400  87      17.   5909.2  5546.0 *  9     1100 204      37.   6142.7  5547.9 * 14     0800 321      19.   5921.2  5546.1
   4     1500  88      17.   5910.4  5546.0 *  9     1200 205      37.   6141.2  5547.9 * 14     0900 322      19.   5919.7  5546.1
   4     1600  89      18.   5911.7  5546.0 *  9     1300 206      37.   6139.6  5547.9 * 14     1000 323      18.   5918.3  5546.1
   4     1700  90      18.   5912.9  5546.1 *  9     1400 207      37.   6138.1  5547.9 * 14     1100 324      18.   5916.8  5546.1
   4     1800  91      18.   5914.2  5546.1 *  9     1500 208      37.   6136.5  5547.9 * 14     1200 325      18.   5915.4  5546.1
   4     1900  92      18.   5915.6  5546.1 *  9     1600 209      36.   6135.0  5547.9 * 14     1300 326      18.   5914.0  5546.1
   4     2000  93      18.   5917.0  5546.1 *  9     1700 210      36.   6133.4  5547.9 * 14     1400 327      18.   5912.6  5546.1
   4     2100  94      18.   5918.4  5546.1 *  9     1800 211      36.   6131.9  5547.9 * 14     1500 328      17.   5911.3  5546.0
   4     2200  95      19.   5919.9  5546.1 *  9     1900 212      36.   6130.3  5547.8 * 14     1600 329      17.   5909.9  5546.0
   4     2300  96      19.   5921.5  5546.1 *  9     2000 213      36.   6128.7  5547.8 * 14     1700 330      17.   5908.5  5546.0
   5     0000  97      19.   5923.1  5546.1 *  9     2100 214      36.   6127.2  5547.8 * 14     1800 331      17.   5907.2  5546.0
   5     0100  98      19.   5924.7  5546.2 *  9     2200 215      36.   6125.7  5547.8 * 14     1900 332      17.   5905.9  5546.0
   5     0200  99      19.   5926.5  5546.2 *  9     2300 216      36.   6124.1  5547.8 * 14     2000 333      17.   5904.6  5546.0
   5     0300 100      20.   5928.4  5546.2 * 10     0000 217      36.   6122.6  5547.8 * 14     2100 334      16.   5903.3  5546.0
   5     0400 101      20.   5930.3  5546.2 * 10     0100 218      36.   6121.0  5547.8 * 14     2200 335      16.   5902.0  5546.0
   5     0500 102      20.   5932.3  5546.2 * 10     0200 219      35.   6119.5  5547.8 * 14     2300 336      16.   5900.8  5546.0
   5     0600 103      20.   5934.4  5546.2 * 10     0300 220      35.   6117.9  5547.7 * 15     0000 337      16.   5899.5  5545.9
   5     0700 104      21.   5936.6  5546.3 * 10     0400 221      35.   6116.4  5547.7 * 15     0100 338      16.   5898.3  5545.9
   5     0800 105      21.   5938.9  5546.3 * 10     0500 222      35.   6114.8  5547.7 * 15     0200 339      15.   5897.1  5545.9
   5     0900 106      21.   5941.3  5546.3 * 10     0600 223      35.   6113.2  5547.7 * 15     0300 340      15.   5895.9  5545.9
   5     1000 107      21.   5943.9  5546.3 * 10     0700 224      35.   6111.7  5547.7 * 15     0400 341      15.   5894.7  5545.9
   5     1100 108      22.   5946.6  5546.3 * 10     0800 225      35.   6110.1  5547.7 * 15     0500 342      15.   5893.5  5545.9
   5     1200 109      22.   5949.5  5546.4 * 10     0900 226      35.   6108.6  5547.7 * 15     0600 343      15.   5892.4  5545.9
   5     1300 110      22.   5952.6  5546.4 * 10     1000 227      35.   6107.1  5547.7 * 15     0700 344      15.   5891.3  5545.9
   5     1400 111      23.   5956.0  5546.4 * 10     1100 228      35.   6105.5  5547.6 * 15     0800 345      14.   5890.2  5545.9
   5     1500 112      23.   5959.7  5546.4 * 10     1200 229      34.   6104.0  5547.6 * 15     0900 346      14.   5889.0  5545.9
   5     1600 113      23.   5963.6  5546.5 * 10     1300 230      34.   6102.4  5547.6 * 15     1000 347      14.   5888.0  5545.9
   5     1700 114      24.   5968.0  5546.5 * 10     1400 231      34.   6100.9  5547.6 * 15     1100 348      14.   5886.9  5545.8
   5     1800 115      24.   5973.0  5546.6 * 10     1500 232      34.   6099.4  5547.6 * 15     1200 349      14.   5885.8  5545.8
   5     1900 116      25.   5978.5  5546.6 * 10     1600 233      34.   6097.8  5547.6 * 15     1300 350      14.   5884.8  5545.8
   5     2000 117      25.   5984.9  5546.7 * 10     1700 234      34.   6096.2  5547.6 *
                                       *                                       *
 ********************************************************************************************************************************************************

 PEAK OUTFLOW IS       39. AT TIME 144.00 HOURS


  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                  6-HR        24-HR        72-HR     349.00-HR
+   (CFS)       (HR)
                        (CFS)
+      39.    144.00                39.          39.          38.          25.
                      (INCHES)      .000         .000         .000         .000
                       (AC-FT)       19.          77.         228.         718.

 PEAK STORAGE   TIME                      MAXIMUM AVERAGE STORAGE
                                  6-HR        24-HR        72-HR     349.00-HR
+  (AC-FT)      (HR)
     6202.    144.00               6202.        6200.        6186.        6010.

  PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                  6-HR        24-HR        72-HR     349.00-HR
+   (FEET)      (HR)
   5548.18    144.00             5548.18      5548.17      5548.13      5546.82

                       CUMULATIVE AREA =     .00 SQ MI

1

               PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
                           FLOWS IN CUBIC FEET PER SECOND,  AREA IN SQUARE MILES
                                        TIME TO PEAK IN HOURS
```

```
                                                    RATIOS APPLIED TO PRECIPITATION
 OPERATION       STATION     AREA    PLAN            RATIO 1
                                                       1.00

 HYDROGRAPH AT
+                 Cove        .00     1   FLOW          850.
                                           TIME       120.00

 ROUTED TO
+                 Cove        .00     1   FLOW           39.
                                           TIME       144.00

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     5548.18
                                           TIME       144.00
1                                   SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                                  (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


      PLAN  1 ..............                  INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                  ELEVATION        5545.50            5549.20          5552.00
                                  STORAGE             5845.              6508.            7347.
                                  OUTFLOW                0.                45.             435.

                      RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                        OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                       PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                      1.00      5548.18         .00       6202.        39.       .00       144.00         .00


 *** NORMAL END OF HEC-1 ***
```

Storm Event 13. Local Auxiliary Spillway Hydrograph

```
1****************************************                                  ****************************************
 *                                      *                                  *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                  *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                  *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1               *                                  *         609 SECOND STREET            *
 *                                      *                                  *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   06AUG20  TIME  02:58:03  *                                  *           (916) 756-1104             *
 *                                      *                                  *                                      *
 ****************************************                                  ****************************************

                                          X     X  XXXXXXX   XXXXX           X
                                          X     X  X        X     X         XX
                                          X     X  X        X                X
                                          XXXXXXX  XXXX     X        XXXXX   X
                                          X     X  X        X                X
                                          X     X  X        X     X          X
                                          X     X  XXXXXXX   XXXXX          XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   Local ASH
           13           ID
                        *
           14           JR    PREC     1.0
           15           IT      18       0       0     100
           16           IO       0
           17           IN      18
                        *

           18           KK   B1
           19           KM   Runoff from Basin 1
           20           BA   0.503
           21           PB    4.09
           22           PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
           23           PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
           24           PC   1.000
           25           LS       0    72.8
           26           UD    0.51
                        *

           27           KK   RB1
           28           KM   Route B1
           29           RD    4928    .045    .050           TRAP      20      20
                        *

           30           KK   B2
           31           KM   Runoff from Basin 2
           32           BA   0.436
           33           LS       0    72.5
           34           UD    0.52
                        *

           35           KK   B3
           36           KM   Runoff from Basin 3
           37           BA   0.279
           38           LS       0    71.0
           39           UD    0.39
                        *
1                                                HEC-1 INPUT                                                PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
 40          KK   C1
 41          KM   Combine RB1, B2, B3
 42          HC       3
             *

 43          KK   RC1
 44          KM   Route RC1
 45          RD    7255    .060    .030           TRAP      20      20
             *

 46          KK   B4
 47          KM   Runoff from Basin 4
 48          BA   0.453
 49          LS       0    73.3
 50          UD    0.48
             *

 51          KK   B5
 52          KM   Runoff from Basin 5
 53          BA   0.805
 54          LS       0    74.1
 55          UD    0.63
             *

 56          KK   C2
 57          KM   Combine RC1, B4, B5
 58          HC       3
             *

 59          KK   RC2
 60          KM   Route C2
 61          RD    2380    .039    .030           TRAP      40       2
             *

 62          KK   B6
 63          KM   Runoff from Basin 6
 64          BA   0.150
 65          LS       0    84.3
 66          UD    0.19
             *

 67          KK   B7
 68          KM   Runoff from Basin 7
 69          BA   0.327
 70          LS       0    75.7
 71          UD    0.46
             *

 72          KK   C3
 73          KM   Combine RC2, B6, B7
 74          HC       3
             *
1                                        HEC-1 INPUT                                          PAGE  3

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 75          KK   RC3
 76          KM   Route C3
 77          RD   11323    .023    .030           TRAP      40      20
             *

 78          KK   B8
 79          KM   Runoff from Basin 8
 80          BA   1.012
 81          LS       0    84.0
 82          UD    0.67
             *

 83          KK   B9
 84          KM   Runoff from Basin 9
 85          BA   0.242
 86          LS       0    85.5
 87          UD    0.26
             *

 88          KK   B10
 89          KM   Runoff from Basin 10
 90          BA   0.129
 91          LS       0    86.7
 92          UD    0.18
             *

 93          KK   C4
 94          KM   Combine B9, B10
 95          HC       2
             *

 96          KK   RC4
 97          KM   Route C4
 98          RD    3380    .037    .030           TRAP      40      20
             *
```

```
             99           KK   B11
            100           KM   Runoff from Basin 11
            101           BA   0.279
            102           LS       0    84.8
            103           UD    0.39
                          *

            104           KK   C5
            105           KM   Combine RC3, B8, RC4, B11
            106           HC       4
                          *

            107           KK   B12
            108           KM   Runoff from Basin 12
            109           BA   0.127
            110           LS       0    81.2
            111           UD    0.40
                          *
1                                              HEC-1 INPUT                                              PAGE  4

          LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            115           KK   Cove Reservoir
            116           KM   Routing through Res'v
            117           RS       1    ELEV  5545.5
            118           SV       0      19      95     240     453     738    1105    1563    2217    2773
            119           SV    3542    4423    5419    6149    7347    8000
            120           SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
            121           SE    5530    5536    5542    5548    5552    5558
            122           SL  5545.5   4.909     0.6     0.5
            123           SS  5549.2      30    2.67     1.5
            124           ST  5552.0    1892     2.9     1.5
                          *
            125           ZZ
1*************************************                                          *************************************
 *                                   *                                          *                                   *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                      *    U.S. ARMY CORPS OF ENGINEERS     *
 *               JUN   1998            *                                      *    HYDROLOGIC ENGINEERING CENTER    *
 *            VERSION 4.1              *                                      *          609 SECOND STREET          *
 *                                     *                                      *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   06AUG20  TIME  02:58:03   *                                    *           (916) 756-1104            *
 *                                     *                                      *                                     *
 *************************************                                          *************************************


                          HYDROLOGY STUDY for COVE RESERVOIR
                          Located in KANE COUNTY, UTAH

                          AUG 2020

                          PREPARED BY ALPHA ENGINEERING
                          43 SOUTH 100 EAST, SUITE 100
                          ST. GEORGE, UTAH  84770
                          TEL: (435) 628-6500
                          FAX: (435) 628-6553

                          Local ASH


   16 IO          OUTPUT CONTROL VARIABLES
                       IPRNT           0  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

      IT          HYDROGRAPH TIME DATA
                        NMIN          18  MINUTES IN COMPUTATION INTERVAL
                       IDATE      1    0  STARTING DATE
                       ITIME        0000  STARTING TIME
                          NQ         100  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE      2    0  ENDING DATE
                      NDTIME        0542  ENDING TIME
                      ICENT           19  CENTURY MARK

                    COMPUTATION INTERVAL     .30 HOURS
                         TOTAL TIME BASE   29.70 HOURS

            ENGLISH UNITS
                 DRAINAGE AREA         SQUARE MILES
                 PRECIPITATION DEPTH   INCHES
                 LENGTH, ELEVATION     FEET
                 FLOW                  CUBIC FEET PER SECOND
                 STORAGE VOLUME        ACRE-FEET
```

```
             SURFACE AREA          ACRES
             TEMPERATURE           DEGREES FAHRENHEIT

     JP        MULTI-PLAN OPTION
                   NPLAN           1  NUMBER OF PLANS

     JR        MULTI-RATIO OPTION
                 RATIOS OF PRECIPITATION
                1.00


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 112 KK    *     Call   *
           *            *
           **************
                      Combine C5, B12

 114 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

**********************************************************************************************************************************************

                                              HYDROGRAPH AT STATION    Call
                                                   SUM OF  2 HYDROGRAPHS
                                                 PLAN 1,   RATIO =  1.00

**********************************************************************************************************************************************
                                    *                                    *                                    *
   DA MON HRMN  ORD      FLOW     *   DA MON HRMN  ORD      FLOW     *   DA MON HRMN  ORD      FLOW     *   DA MON HRMN  ORD      FLOW
                                    *                                    *                                    *
    1     0000    1        0.     *    1     0730   26      180.     *    1     1500   51        0.     *    1     2230   76        0.
    1     0018    2        0.     *    1     0748   27      112.     *    1     1518   52        0.     *    1     2248   77        0.
    1     0036    3        0.     *    1     0806   28       73.     *    1     1536   53        0.     *    1     2306   78        0.
    1     0054    4        0.     *    1     0824   29       47.     *    1     1554   54        0.     *    1     2324   79        0.
    1     0112    5        0.     *    1     0842   30       28.     *    1     1612   55        0.     *    1     2342   80        0.
    1     0130    6        6.     *    1     0900   31       16.     *    1     1630   56        0.     *    2     0000   81        0.
    1     0148    7       39.     *    1     0918   32        9.     *    1     1648   57        0.     *    2     0018   82        0.
    1     0206    8      194.     *    1     0936   33        5.     *    1     1706   58        0.     *    2     0036   83        0.
    1     0224    9      687.     *    1     0954   34        3.     *    1     1724   59        0.     *    2     0054   84        0.
    1     0242   10     1365.     *    1     1012   35        1.     *    1     1742   60        0.     *    2     0112   85        0.
    1     0300   11     2027.     *    1     1030   36        1.     *    1     1800   61        0.     *    2     0130   86        0.
    1     0318   12     2180.     *    1     1048   37        0.     *    1     1818   62        0.     *    2     0148   87        0.
    1     0336   13     1955.     *    1     1106   38        0.     *    1     1836   63        0.     *    2     0206   88        0.
    1     0354   14     1683.     *    1     1124   39        0.     *    1     1854   64        0.     *    2     0224   89        0.
    1     0412   15     1441.     *    1     1142   40        0.     *    1     1912   65        0.     *    2     0242   90        0.
    1     0430   16     1248.     *    1     1200   41        0.     *    1     1930   66        0.     *    2     0300   91        0.
    1     0448   17     1107.     *    1     1218   42        0.     *    1     1948   67        0.     *    2     0318   92        0.
    1     0506   18     1001.     *    1     1236   43        0.     *    1     2006   68        0.     *    2     0336   93        0.
    1     0524   19      924.     *    1     1254   44        0.     *    1     2024   69        0.     *    2     0354   94        0.
    1     0542   20      874.     *    1     1312   45        0.     *    1     2042   70        0.     *    2     0412   95        0.
    1     0600   21      833.     *    1     1330   46        0.     *    1     2100   71        0.     *    2     0430   96        0.
    1     0618   22      748.     *    1     1348   47        0.     *    1     2118   72        0.     *    2     0448   97        0.
    1     0636   23      589.     *    1     1406   48        0.     *    1     2136   73        0.     *    2     0506   98        0.
    1     0654   24      423.     *    1     1424   49        0.     *    1     2154   74        0.     *    2     0524   99        0.
    1     0712   25      283.     *    1     1442   50        0.     *    1     2212   75        0.     *    2     0542  100        0.
                                    *                                    *                                    *
**********************************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR     29.70-HR
+   (CFS)       (HR)
                    (CFS)
+    2180.      3.30                 991.        251.        203.         203.
                  (INCHES)         1.943       1.969       1.969        1.969
                   (AC-FT)          491.        498.        498.         498.

                    CUMULATIVE AREA =    4.74 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 115 KK    *     Cove   *     Reservoir
           *            *
           **************
                      Routing through Res'v

              HYDROGRAPH ROUTING DATA
```

```
117 RS          STORAGE ROUTING
                     NSTPS           1  NUMBER OF SUBREACHES
                      ITYP        ELEV  TYPE OF INITIAL CONDITION
                     RSVRIC     5545.50  INITIAL CONDITION
                         X         .00 WORKING R AND D COEFFICIENT

118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                             3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                              5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

122 SL          LOW-LEVEL OUTLET
                     ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                     CAREA        4.91  CROSS-SECTIONAL AREA
                      COQL         .60  COEFFICIENT
                      EXPL         .50  EXPONENT OF HEAD

123 SS          SPILLWAY
                     CREL     5549.20  SPILLWAY CREST ELEVATION
                    SPWID       30.00  SPILLWAY WIDTH
                     COQW        2.67  WEIR COEFFICIENT
                     EXPW        1.50  EXPONENT OF HEAD

124 ST          TOP OF DAM
                     TOPEL     5552.00  ELEVATION AT TOP OF DAM
                    DAMWID     1892.00  DAM WIDTH
                      COQD        2.90  WEIR COEFFICIENT
                      EXPD        1.50  EXPONENT OF HEAD
```

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

****

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	5844.8	5545.5	1		1012	35	41.	6318.9	5548.6	1		2024	69	41.	6284.1	5548.5
1		0018	2	0.	5844.8	5545.5	1		1030	36	41.	6317.9	5548.6	1		2042	70	41.	6283.1	5548.4
1		0036	3	0.	5844.8	5545.5	1		1048	37	41.	6316.9	5548.6	1		2100	71	41.	6282.1	5548.4
1		0054	4	0.	5844.8	5545.5	1		1106	38	41.	6315.9	5548.6	1		2118	72	41.	6281.1	5548.4
1		0112	5	0.	5844.8	5545.5	1		1124	39	41.	6314.8	5548.6	1		2136	73	40.	6280.0	5548.4
1		0130	6	1.	5844.9	5545.5	1		1142	40	41.	6313.8	5548.6	1		2154	74	40.	6279.0	5548.4
1		0148	7	2.	5845.4	5545.5	1		1200	41	41.	6312.8	5548.5	1		2212	75	40.	6278.0	5548.4
1		0206	8	4.	5848.3	5545.5	1		1218	42	41.	6311.8	5548.5	1		2230	76	40.	6277.0	5548.4
1		0224	9	8.	5859.1	5545.6	1		1236	43	41.	6310.7	5548.5	1		2248	77	40.	6275.9	5548.4
1		0242	10	13.	5884.3	5545.8	1		1254	44	41.	6309.7	5548.5	1		2306	78	40.	6274.9	5548.4
1		0300	11	19.	5925.9	5546.2	1		1312	45	41.	6308.7	5548.5	1		2324	79	40.	6273.9	5548.4
1		0318	12	25.	5977.5	5546.6	1		1330	46	41.	6307.7	5548.5	1		2342	80	40.	6272.9	5548.4
1		0336	13	29.	6028.2	5547.0	1		1348	47	41.	6306.6	5548.5	2		0000	81	40.	6271.8	5548.4
1		0354	14	32.	6072.5	5547.4	1		1406	48	41.	6305.6	5548.5	2		0018	82	40.	6270.8	5548.4
1		0412	15	35.	6110.4	5547.7	1		1424	49	41.	6304.6	5548.5	2		0036	83	40.	6269.8	5548.4
1		0430	16	37.	6142.7	5547.9	1		1442	50	41.	6303.6	5548.5	2		0054	84	40.	6268.8	5548.4
1		0448	17	38.	6170.9	5548.1	1		1500	51	41.	6302.6	5548.5	2		0112	85	40.	6267.7	5548.4
1		0506	18	39.	6196.1	5548.2	1		1518	52	41.	6301.5	5548.5	2		0130	86	40.	6266.7	5548.4
1		0524	19	39.	6219.0	5548.2	1		1536	53	41.	6300.5	5548.5	2		0148	87	40.	6265.7	5548.4
1		0542	20	40.	6240.4	5548.3	1		1554	54	41.	6299.5	5548.5	2		0206	88	40.	6264.7	5548.4

```
   1     0600  21      40.   6260.6  5548.4 *  1     1612  55      41.   6298.5  5548.5 *  2     0224  89      40.   6263.7  5548.4
   1     0618  22      40.   6279.2  5548.4 *  1     1630  56      41.   6297.4  5548.5 *  2     0242  90      40.   6262.6  5548.4
   1     0636  23      41.   6294.7  5548.5 *  1     1648  57      41.   6296.4  5548.5 *  2     0300  91      40.   6261.6  5548.4
   1     0654  24      41.   6306.2  5548.5 *  1     1706  58      41.   6295.4  5548.5 *  2     0318  92      40.   6260.6  5548.4
   1     0712  25      41.   6314.0  5548.6 *  1     1724  59      41.   6294.4  5548.5 *  2     0336  93      40.   6259.6  5548.4
   1     0730  26      41.   6318.6  5548.6 *  1     1742  60      41.   6293.3  5548.5 *  2     0354  94      40.   6258.5  5548.4
   1     0748  27      41.   6321.3  5548.6 *  1     1800  61      41.   6292.3  5548.5 *  2     0412  95      40.   6257.5  5548.4
   1     0806  28      41.   6322.6  5548.6 *  1     1818  62      41.   6291.3  5548.5 *  2     0430  96      40.   6256.5  5548.4
   1     0824  29      41.   6323.0  5548.6 *  1     1836  63      41.   6290.3  5548.5 *  2     0448  97      40.   6255.5  5548.4
   1     0842  30      41.   6322.9  5548.6 *  1     1854  64      41.   6289.2  5548.5 *  2     0506  98      40.   6254.4  5548.4
   1     0900  31      41.   6322.4  5548.6 *  1     1912  65      41.   6288.2  5548.5 *  2     0524  99      40.   6253.4  5548.3
   1     0918  32      41.   6321.7  5548.6 *  1     1930  66      41.   6287.2  5548.5 *  2     0542 100      40.   6252.4  5548.3
   1     0936  33      41.   6320.8  5548.6 *  1     1948  67      41.   6286.2  5548.5 *
   1     0954  34      41.   6320.0  5548.6 *  1     2006  68      41.   6285.1  5548.5 *
                                            *                                            *
 ********************************************************************************************************************************************

 PEAK OUTFLOW IS       41. AT TIME   8.40 HOURS


  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                  6-HR        24-HR       72-HR     29.70-HR
+   (CFS)       (HR)
                     (CFS)
+      41.      8.40                41.         41.         36.          36.
                        (INCHES)     .081        .319        .353         .353
                         (AC-FT)      20.         81.         89.          89.

 PEAK STORAGE   TIME                       MAXIMUM AVERAGE STORAGE
                                  6-HR        24-HR       72-HR     29.70-HR
+  (AC-FT)      (HR)
     6323.      8.40              6317.       6290.       6230.        6230.

  PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                  6-HR        24-HR       72-HR     29.70-HR
+   (FEET)      (HR)
   5548.58      8.40            5548.56     5548.47     5548.10      5548.10

                        CUMULATIVE AREA =    4.74 SQ MI

1

               PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
                                   FLOWS IN CUBIC FEET PER SECOND,  AREA IN SQUARE MILES
                                                TIME TO PEAK IN HOURS


                                                                          RATIOS APPLIED TO PRECIPITATION
 OPERATION       STATION     AREA    PLAN            RATIO 1
                                                        1.00

 HYDROGRAPH AT
+                B1          .50     1   FLOW         221.
                                         TIME         3.00

 ROUTED TO
+                RB1         .50     1   FLOW         215.
                                         TIME         3.30

 HYDROGRAPH AT
+                B2          .44     1   FLOW         187.
                                         TIME         3.00

 HYDROGRAPH AT
+                B3          .28     1   FLOW         116.
                                         TIME         3.00

  3 COMBINED AT
+                C1         1.22     1   FLOW         493.
                                         TIME         3.00

 ROUTED TO
+                RC1        1.22     1   FLOW         478.
                                         TIME         3.30

 HYDROGRAPH AT
+                B4          .45     1   FLOW         209.
                                         TIME         3.00

 HYDROGRAPH AT
+                B5          .81     1   FLOW         334.
                                         TIME         3.00

  3 COMBINED AT
+                C2         2.48     1   FLOW         983.
                                         TIME         3.30

 ROUTED TO
+                RC2        2.48     1   FLOW         977.
                                         TIME         3.30

 HYDROGRAPH AT
```

```
+                 B6          .15     1   FLOW         141.
                                          TIME         2.70

 HYDROGRAPH AT
+                 B7          .33     1   FLOW         172.
                                          TIME         3.00

  3 COMBINED AT
+                 C3         2.95     1   FLOW        1173.
                                          TIME         3.30

 ROUTED TO
+                 RC3        2.95     1   FLOW        1135.
                                          TIME         3.30

 HYDROGRAPH AT
+                 B8         1.01     1   FLOW         669.
                                          TIME         3.00

 HYDROGRAPH AT
+                 B9          .24     1   FLOW         237.
                                          TIME         2.70

 HYDROGRAPH AT
+                 B10         .13     1   FLOW         138.
                                          TIME         2.40

  2 COMBINED AT
+                 C4          .37     1   FLOW         368.
                                          TIME         2.70

 ROUTED TO
+                 RC4         .37     1   FLOW         354.
                                          TIME         2.70

 HYDROGRAPH AT
+                 B11         .28     1   FLOW         237.
                                          TIME         2.70

  4 COMBINED AT
+                 C5         4.61     1   FLOW        2118.
                                          TIME         3.30

 HYDROGRAPH AT
+                 B12         .13     1   FLOW          90.
                                          TIME         2.70

  2 COMBINED AT
+                 Call       4.74     1   FLOW        2180.
                                          TIME         3.30

 ROUTED TO
+                 Cove       4.74     1   FLOW          41.
                                          TIME         8.40

                                    ** PEAK STAGES IN FEET **
                                    1   STAGE     5548.58
                                        TIME         8.40
1
                                        SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                            (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                INTERPOLATED TO
                                                                              COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

          FOR PLAN = 1  RATIO=  .00
             RB1    MANE         3.60    218.47    194.40      1.58     18.00    214.54    198.00        1.58


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .4234E+02 EXCESS= .0000E+00 OUTFLOW= .4236E+02 BASIN STORAGE= .4004E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
             RC1    MANE         3.60    494.09    190.80      1.54     18.00    478.26    198.00        1.53


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1002E+03 EXCESS= .0000E+00 OUTFLOW= .1002E+03 BASIN STORAGE= .2965E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC2    MANE         2.55    978.48    199.17      1.59     18.00    977.20    198.00        1.60


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2103E+03 EXCESS= .0000E+00 OUTFLOW= .2103E+03 BASIN STORAGE= .2799E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC3    MANE         7.20   1186.64    208.80      1.66     18.00   1135.13    198.00        1.66
```

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2617E+03 EXCESS= .0000E+00 OUTFLOW= .2619E+03 BASIN STORAGE= .9925E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RC4	MANE	5.40	361.92	167.40	2.62	18.00	354.00	162.00	2.62

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5187E+02 EXCESS= .0000E+00 OUTFLOW= .5189E+02 BASIN STORAGE= .2315E-02 PERCENT ERROR= .0

1 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION Cove
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	5545.50	5549.20	5552.00
STORAGE	5845.	6508.	7347.
OUTFLOW	0.	45.	435.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	5548.58	.00	6323.	41.	.00	8.40	.00

*** NORMAL END OF HEC-1 ***

Storm Event 14. General Auxiliary Spillway Hydrograph

```
1****************************************                                    ****************************************
 *                                      *                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                    *    HYDROLOGIC ENGINEERING CENTER     *
 *           VERSION 4.1                *                                    *          609 SECOND STREET           *
 *                                      *                                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   06AUG20  TIME  03:33:46  *                                    *           (916) 756-1104             *
 *                                      *                                    *                                      *
 ****************************************                                    ****************************************

                                        X     X  XXXXXXX   XXXXX           X
                                        X     X  X        X     X         XX
                                        X     X  X        X                X
                                        XXXXXXX  XXXX     X        XXXXX   X
                                        X     X  X        X                X
                                        X     X  X        X     X          X
                                        X     X  XXXXXXX   XXXXX          XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                              HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   General ASH (NEH)
           13           ID
                        *
           14           JR    PREC     1.0
           15           IT      12       0       0     200
           16           IO       0
           17           IN      12
                        *
           18           QI       0       0       0       0       0       0       0       0       0       0
           19           QI       0       0       0       0       0       0       0       0       0       0
           20           QI       0       0       0       0       0       0       0       0       0       0
           21           QI       0       0       2      11      35      83     155     249     357     473
           22           QI     589     701     807     907     999    1084    1163    1234    1300    1359
           23           QI    1414    1464    1510    1552    1590    1626    1658    1689    1716    1742
           24           QI    1766    1764    1708    1564    1350    1117     898     713     581     489
           25           QI     423     374     339     314     296     283     274     267     263     259
           26           QI     257     255     254     253     253     253     253     253     254     254
           27           QI     254     253     251     244     236     226     218     210     205     201
           28           QI     199     197     196     195     194     194     194     193     193     193
           29           QI     193     193     193     193     193     194     194     194     194     194
           30           QI     194     191     182     163     136     107      80      57      41      29
           31           QI      21      15      11       8       6       4       3       2       1       1
           32           QI       1
                        *

           33           KK   Cove Reservoir
           34           KM   Routing through Res'v
           35           RS       1    ELEV  5545.5
           36           SV       0      19      95     240     453     738    1105    1563    2217    2773
           37           SV    3542    4423    5419    6149    7347    8000
           38           SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
           39           SE    5530    5536    5542    5548    5552    5558
           40           SL  5545.5   4.909     0.6     0.5
           41           SS  5549.2      30    2.67     1.5
           42           ST  5552.0    1892     2.9     1.5
                        *
           43           ZZ
1****************************************                                    ****************************************
 *                                      *                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                    *    HYDROLOGIC ENGINEERING CENTER     *
 *           VERSION 4.1                *                                    *          609 SECOND STREET           *
 *                                      *                                    *       DAVIS, CALIFORNIA 95616        *
```

```
*  RUN DATE   06AUG20  TIME  03:33:46   *                                                    *           (916) 756-1104            *
*                                       *                                                    *                                     *
*****************************************                                                    *************************************
```

HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

General ASH (NEH)

```
 16 IO          OUTPUT CONTROL VARIABLES
                     IPRNT           0  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                      NMIN          12  MINUTES IN COMPUTATION INTERVAL
                     IDATE      1    0  STARTING DATE
                     ITIME        0000  STARTING TIME
                        NQ         200  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE      2    0  ENDING DATE
                    NDTIME        1548  ENDING TIME
                    ICENT           19  CENTURY MARK

                  COMPUTATION INTERVAL     .20 HOURS
                       TOTAL TIME BASE   39.80 HOURS

         ENGLISH UNITS
              DRAINAGE AREA         SQUARE MILES
              PRECIPITATION DEPTH   INCHES
              LENGTH, ELEVATION     FEET
              FLOW                  CUBIC FEET PER SECOND
              STORAGE VOLUME        ACRE-FEET
              SURFACE AREA          ACRES
              TEMPERATURE           DEGREES FAHRENHEIT

    JP          MULTI-PLAN OPTION
                     NPLAN           1  NUMBER OF PLANS

    JR          MULTI-RATIO OPTION
                    RATIOS OF PRECIPITATION
                   1.00

 17 IN          TIME DATA FOR INPUT TIME SERIES
                     JXMIN          12  TIME INTERVAL IN MINUTES
                    JXDATE      1    0  STARTING DATE
                    JXTIME           0  STARTING TIME

              SUBBASIN RUNOFF DATA

  0 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .00  SUBBASIN AREA
```

***

HYDROGRAPH AT STATION Cove

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		1000	51	1414.	1		2000	101	199.	2		0600	151	1.
1		0012	2	0.	1		1012	52	1464.	1		2012	102	197.	2		0612	152	1.
1		0024	3	0.	1		1024	53	1510.	1		2024	103	196.	2		0624	153	1.
1		0036	4	0.	1		1036	54	1552.	1		2036	104	195.	2		0636	154	1.
1		0048	5	0.	1		1048	55	1590.	1		2048	105	194.	2		0648	155	1.
1		0100	6	0.	1		1100	56	1626.	1		2100	106	194.	2		0700	156	1.
1		0112	7	0.	1		1112	57	1658.	1		2112	107	194.	2		0712	157	1.
1		0124	8	0.	1		1124	58	1689.	1		2124	108	193.	2		0724	158	1.
1		0136	9	0.	1		1136	59	1716.	1		2136	109	193.	2		0736	159	1.
1		0148	10	0.	1		1148	60	1742.	1		2148	110	193.	2		0748	160	1.
1		0200	11	0.	1		1200	61	1766.	1		2200	111	193.	2		0800	161	1.
1		0212	12	0.	1		1212	62	1764.	1		2212	112	193.	2		0812	162	1.
1		0224	13	0.	1		1224	63	1708.	1		2224	113	193.	2		0824	163	1.
1		0236	14	0.	1		1236	64	1564.	1		2236	114	193.	2		0836	164	1.
1		0248	15	0.	1		1248	65	1350.	1		2248	115	193.	2		0848	165	1.
1		0300	16	0.	1		1300	66	1117.	1		2300	116	194.	2		0900	166	1.
1		0312	17	0.	1		1312	67	898.	1		2312	117	194.	2		0912	167	1.

1	0324	18	0.	*	1	1324	68	713.	*	1	2324	118	194.	*	2	0924	168	1.
1	0336	19	0.	*	1	1336	69	581.	*	1	2336	119	194.	*	2	0936	169	1.
1	0348	20	0.	*	1	1348	70	489.	*	1	2348	120	194.	*	2	0948	170	1.
1	0400	21	0.	*	1	1400	71	423.	*	2	0000	121	194.	*	2	1000	171	1.
1	0412	22	0.	*	1	1412	72	374.	*	2	0012	122	191.	*	2	1012	172	1.
1	0424	23	0.	*	1	1424	73	339.	*	2	0024	123	182.	*	2	1024	173	1.
1	0436	24	0.	*	1	1436	74	314.	*	2	0036	124	163.	*	2	1036	174	1.
1	0448	25	0.	*	1	1448	75	296.	*	2	0048	125	136.	*	2	1048	175	1.
1	0500	26	0.	*	1	1500	76	283.	*	2	0100	126	107.	*	2	1100	176	1.
1	0512	27	0.	*	1	1512	77	274.	*	2	0112	127	80.	*	2	1112	177	1.
1	0524	28	0.	*	1	1524	78	267.	*	2	0124	128	57.	*	2	1124	178	1.
1	0536	29	0.	*	1	1536	79	263.	*	2	0136	129	41.	*	2	1136	179	1.
1	0548	30	0.	*	1	1548	80	259.	*	2	0148	130	29.	*	2	1148	180	1.
1	0600	31	0.	*	1	1600	81	257.	*	2	0200	131	21.	*	2	1200	181	1.
1	0612	32	0.	*	1	1612	82	255.	*	2	0212	132	15.	*	2	1212	182	1.
1	0624	33	2.	*	1	1624	83	254.	*	2	0224	133	11.	*	2	1224	183	1.
1	0636	34	11.	*	1	1636	84	253.	*	2	0236	134	8.	*	2	1236	184	1.
1	0648	35	35.	*	1	1648	85	253.	*	2	0248	135	6.	*	2	1248	185	1.
1	0700	36	83.	*	1	1700	86	253.	*	2	0300	136	4.	*	2	1300	186	1.
1	0712	37	155.	*	1	1712	87	253.	*	2	0312	137	3.	*	2	1312	187	1.
1	0724	38	249.	*	1	1724	88	253.	*	2	0324	138	2.	*	2	1324	188	1.
1	0736	39	357.	*	1	1736	89	254.	*	2	0336	139	1.	*	2	1336	189	1.
1	0748	40	473.	*	1	1748	90	254.	*	2	0348	140	1.	*	2	1348	190	1.
1	0800	41	589.	*	1	1800	91	254.	*	2	0400	141	1.	*	2	1400	191	1.
1	0812	42	701.	*	1	1812	92	253.	*	2	0412	142	1.	*	2	1412	192	1.
1	0824	43	807.	*	1	1824	93	251.	*	2	0424	143	1.	*	2	1424	193	1.
1	0836	44	907.	*	1	1836	94	244.	*	2	0436	144	1.	*	2	1436	194	1.
1	0848	45	999.	*	1	1848	95	236.	*	2	0448	145	1.	*	2	1448	195	1.
1	0900	46	1084.	*	1	1900	96	226.	*	2	0500	146	1.	*	2	1500	196	1.
1	0912	47	1163.	*	1	1912	97	218.	*	2	0512	147	1.	*	2	1512	197	1.
1	0924	48	1234.	*	1	1924	98	210.	*	2	0524	148	1.	*	2	1524	198	1.
1	0936	49	1300.	*	1	1936	99	205.	*	2	0536	149	1.	*	2	1536	199	1.
1	0948	50	1359.	*	1	1948	100	201.	*	2	0548	150	1.	*	2	1548	200	1.

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	39.80-HR
+ (CFS)	(HR)				
		(CFS)			
+ 1766.	12.00	1268.	437.	264.	264.
		(INCHES) .000	.000	.000	.000
		(AC-FT) 629.	868.	868.	868.

CUMULATIVE AREA = .00 SQ MI

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	*	1		1000	51	1414.	*	1		2000	101	199.	*	2		0600	151	1.
1		0012	2	0.	*	1		1012	52	1464.	*	1		2012	102	197.	*	2		0612	152	1.
1		0024	3	0.	*	1		1024	53	1510.	*	1		2024	103	196.	*	2		0624	153	1.
1		0036	4	0.	*	1		1036	54	1552.	*	1		2036	104	195.	*	2		0636	154	1.
1		0048	5	0.	*	1		1048	55	1590.	*	1		2048	105	194.	*	2		0648	155	1.
1		0100	6	0.	*	1		1100	56	1626.	*	1		2100	106	194.	*	2		0700	156	1.
1		0112	7	0.	*	1		1112	57	1658.	*	1		2112	107	194.	*	2		0712	157	1.
1		0124	8	0.	*	1		1124	58	1689.	*	1		2124	108	193.	*	2		0724	158	1.
1		0136	9	0.	*	1		1136	59	1716.	*	1		2136	109	193.	*	2		0736	159	1.
1		0148	10	0.	*	1		1148	60	1742.	*	1		2148	110	193.	*	2		0748	160	1.
1		0200	11	0.	*	1		1200	61	1766.	*	1		2200	111	193.	*	2		0800	161	1.
1		0212	12	0.	*	1		1212	62	1764.	*	1		2212	112	193.	*	2		0812	162	1.
1		0224	13	0.	*	1		1224	63	1708.	*	1		2224	113	193.	*	2		0824	163	1.
1		0236	14	0.	*	1		1236	64	1564.	*	1		2236	114	193.	*	2		0836	164	1.
1		0248	15	0.	*	1		1248	65	1350.	*	1		2248	115	193.	*	2		0848	165	1.
1		0300	16	0.	*	1		1300	66	1117.	*	1		2300	116	194.	*	2		0900	166	1.
1		0312	17	0.	*	1		1312	67	898.	*	1		2312	117	194.	*	2		0912	167	1.
1		0324	18	0.	*	1		1324	68	713.	*	1		2324	118	194.	*	2		0924	168	1.
1		0336	19	0.	*	1		1336	69	581.	*	1		2336	119	194.	*	2		0936	169	1.
1		0348	20	0.	*	1		1348	70	489.	*	1		2348	120	194.	*	2		0948	170	1.
1		0400	21	0.	*	1		1400	71	423.	*	2		0000	121	194.	*	2		1000	171	1.
1		0412	22	0.	*	1		1412	72	374.	*	2		0012	122	191.	*	2		1012	172	1.
1		0424	23	0.	*	1		1424	73	339.	*	2		0024	123	182.	*	2		1024	173	1.
1		0436	24	0.	*	1		1436	74	314.	*	2		0036	124	163.	*	2		1036	174	1.
1		0448	25	0.	*	1		1448	75	296.	*	2		0048	125	136.	*	2		1048	175	1.
1		0500	26	0.	*	1		1500	76	283.	*	2		0100	126	107.	*	2		1100	176	1.
1		0512	27	0.	*	1		1512	77	274.	*	2		0112	127	80.	*	2		1112	177	1.
1		0524	28	0.	*	1		1524	78	267.	*	2		0124	128	57.	*	2		1124	178	1.
1		0536	29	0.	*	1		1536	79	263.	*	2		0136	129	41.	*	2		1136	179	1.
1		0548	30	0.	*	1		1548	80	259.	*	2		0148	130	29.	*	2		1148	180	1.
1		0600	31	0.	*	1		1600	81	257.	*	2		0200	131	21.	*	2		1200	181	1.
1		0612	32	0.	*	1		1612	82	255.	*	2		0212	132	15.	*	2		1212	182	1.
1		0624	33	2.	*	1		1624	83	254.	*	2		0224	133	11.	*	2		1224	183	1.
1		0636	34	11.	*	1		1636	84	253.	*	2		0236	134	8.	*	2		1236	184	1.
1		0648	35	35.	*	1		1648	85	253.	*	2		0248	135	6.	*	2		1248	185	1.
1		0700	36	83.	*	1		1700	86	253.	*	2		0300	136	4.	*	2		1300	186	1.

```
    1     0712   37      155.   *    1     1712   87      253.   *    2     0312  137        3.   *    2     1312  187        1.
    1     0724   38      249.   *    1     1724   88      253.   *    2     0324  138        2.   *    2     1324  188        1.
    1     0736   39      357.   *    1     1736   89      254.   *    2     0336  139        1.   *    2     1336  189        1.
    1     0748   40      473.   *    1     1748   90      254.   *    2     0348  140        1.   *    2     1348  190        1.
    1     0800   41      589.   *    1     1800   91      254.   *    2     0400  141        1.   *    2     1400  191        1.
    1     0812   42      701.   *    1     1812   92      253.   *    2     0412  142        1.   *    2     1412  192        1.
    1     0824   43      807.   *    1     1824   93      251.   *    2     0424  143        1.   *    2     1424  193        1.
    1     0836   44      907.   *    1     1836   94      244.   *    2     0436  144        1.   *    2     1436  194        1.
    1     0848   45      999.   *    1     1848   95      236.   *    2     0448  145        1.   *    2     1448  195        1.
    1     0900   46     1084.   *    1     1900   96      226.   *    2     0500  146        1.   *    2     1500  196        1.
    1     0912   47     1163.   *    1     1912   97      218.   *    2     0512  147        1.   *    2     1512  197        1.
    1     0924   48     1234.   *    1     1924   98      210.   *    2     0524  148        1.   *    2     1524  198        1.
    1     0936   49     1300.   *    1     1936   99      205.   *    2     0536  149        1.   *    2     1536  199        1.
    1     0948   50     1359.   *    1     1948  100      201.   *    2     0548  150        1.   *    2     1548  200        1.
                                 *                                 *                                 *
 ********************************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                  6-HR        24-HR       72-HR     39.80-HR
+   (CFS)       (HR)
                     (CFS)
+    1766.     12.00               1268.        437.        264.         264.
                    (INCHES)       .000        .000        .000         .000
                     (AC-FT)       629.        868.        868.         868.

                    CUMULATIVE AREA =     .00 SQ MI



 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
  33 KK    *     Cove   *     Reservoir
           *            *
           **************
                        Routing through Res'v

              HYDROGRAPH ROUTING DATA

  35 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC     5545.50  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

  36 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                  3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

  38 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                               5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

  40 SL          LOW-LEVEL OUTLET
                       ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                       CAREA        4.91  CROSS-SECTIONAL AREA
                        COQL         .60  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

  41 SS          SPILLWAY
                        CREL     5549.20  SPILLWAY CREST ELEVATION
                       SPWID       30.00  SPILLWAY WIDTH
                        COQW        2.67  WEIR COEFFICIENT
                        EXPW        1.50  EXPONENT OF HEAD

  42 ST          TOP OF DAM
                       TOPEL     5552.00  ELEVATION AT TOP OF DAM
                      DAMWID     1892.00  DAM WIDTH
                        COQD        2.90  WEIR COEFFICIENT
                        EXPD        1.50  EXPONENT OF HEAD

                                                    ***

                                          COMPUTED OUTFLOW-ELEVATION DATA

                                            (EXCLUDING FLOW OVER DAM)

            OUTFLOW        .00       .00     25.78     27.48     29.42     31.65     34.25     37.31     40.98     45.44
          ELEVATION    5470.00   5545.50   5546.69   5546.85   5547.05   5547.30   5547.60   5548.00   5548.51   5549.20

            OUTFLOW      49.37     68.29    113.97    198.20    332.85    529.64    800.37   1156.85   1610.93   2174.46
          ELEVATION    5549.32   5549.60   5550.06   5550.68   5551.48   5552.44   5553.58   5554.88   5556.36   5558.00


                                          COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

                                            (INCLUDING FLOW OVER DAM)

            STORAGE        .00     19.00     95.00    240.00    453.00    738.00   1105.00   1563.00   2217.00   2773.00
            OUTFLOW        .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
          ELEVATION    5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
```

STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	5844.8	5545.5	1		1324	68	44.	6457.6	5549.0	2		0248	135	69.	6632.9	5549.6
1		0012	2	0.	5844.8	5545.5	1		1336	69	45.	6467.5	5549.1	2		0300	136	69.	6631.9	5549.6
1		0024	3	0.	5844.8	5545.5	1		1348	70	45.	6475.6	5549.1	2		0312	137	69.	6630.9	5549.6
1		0036	4	0.	5844.8	5545.5	1		1400	71	45.	6482.3	5549.1	2		0324	138	69.	6629.8	5549.6
1		0048	5	0.	5844.8	5545.5	1		1412	72	45.	6488.1	5549.1	2		0336	139	68.	6628.7	5549.6
1		0100	6	0.	5844.8	5545.5	1		1424	73	45.	6493.2	5549.1	2		0348	140	68.	6627.5	5549.6
1		0112	7	0.	5844.8	5545.5	1		1436	74	45.	6497.9	5549.2	2		0400	141	68.	6626.3	5549.6
1		0124	8	0.	5844.8	5545.5	1		1448	75	45.	6502.2	5549.2	2		0412	142	67.	6625.2	5549.6
1		0136	9	0.	5844.8	5545.5	1		1500	76	45.	6506.3	5549.2	2		0424	143	67.	6624.1	5549.6
1		0148	10	0.	5844.8	5545.5	1		1512	77	46.	6510.1	5549.2	2		0436	144	67.	6623.1	5549.6
1		0200	11	0.	5844.8	5545.5	1		1524	78	46.	6513.7	5549.2	2		0448	145	66.	6622.1	5549.6
1		0212	12	0.	5844.8	5545.5	1		1536	79	46.	6517.4	5549.2	2		0500	146	66.	6621.1	5549.6
1		0224	13	0.	5844.8	5545.5	1		1548	80	46.	6520.9	5549.2	2		0512	147	66.	6620.0	5549.6
1		0236	14	0.	5844.8	5545.5	1		1600	81	47.	6524.4	5549.3	2		0524	148	66.	6619.0	5549.6
1		0248	15	0.	5844.8	5545.5	1		1612	82	47.	6527.9	5549.3	2		0536	149	65.	6618.0	5549.6
1		0300	16	0.	5844.8	5545.5	1		1624	83	48.	6531.3	5549.3	2		0548	150	65.	6617.0	5549.6
1		0312	17	0.	5844.8	5545.5	1		1636	84	48.	6534.6	5549.3	2		0600	151	65.	6615.9	5549.6
1		0324	18	0.	5844.8	5545.5	1		1648	85	49.	6538.0	5549.3	2		0612	152	65.	6614.9	5549.6
1		0336	19	0.	5844.8	5545.5	1		1700	86	49.	6541.4	5549.3	2		0624	153	64.	6613.9	5549.6
1		0348	20	0.	5844.8	5545.5	1		1712	87	50.	6544.7	5549.3	2		0636	154	64.	6612.9	5549.5
1		0400	21	0.	5844.8	5545.5	1		1724	88	50.	6548.1	5549.3	2		0648	155	64.	6611.9	5549.5
1		0412	22	0.	5844.8	5545.5	1		1736	89	51.	6551.5	5549.3	2		0700	156	63.	6610.8	5549.5
1		0424	23	0.	5844.8	5545.5	1		1748	90	51.	6554.8	5549.4	2		0712	157	63.	6609.8	5549.5
1		0436	24	0.	5844.8	5545.5	1		1800	91	52.	6558.2	5549.4	2		0724	158	63.	6608.8	5549.5
1		0448	25	0.	5844.8	5545.5	1		1812	92	52.	6561.5	5549.4	2		0736	159	63.	6607.8	5549.5
1		0500	26	0.	5844.8	5545.5	1		1824	93	53.	6564.9	5549.4	2		0748	160	62.	6606.7	5549.5
1		0512	27	0.	5844.8	5545.5	1		1836	94	54.	6568.1	5549.4	2		0800	161	62.	6605.7	5549.5
1		0524	28	0.	5844.8	5545.5	1		1848	95	54.	6571.2	5549.4	2		0812	162	62.	6604.7	5549.5
1		0536	29	0.	5844.8	5545.5	1		1900	96	55.	6574.1	5549.4	2		0824	163	62.	6603.7	5549.5
1		0548	30	0.	5844.8	5545.5	1		1912	97	56.	6576.9	5549.4	2		0836	164	61.	6602.6	5549.5
1		0600	31	0.	5844.8	5545.5	1		1924	98	56.	6579.5	5549.4	2		0848	165	61.	6601.6	5549.5
1		0612	32	0.	5844.8	5545.5	1		1936	99	57.	6582.0	5549.4	2		0900	166	61.	6600.6	5549.5
1		0624	33	0.	5844.8	5545.5	1		1948	100	57.	6584.5	5549.5	2		0912	167	61.	6599.6	5549.5
1		0636	34	1.	5845.0	5545.5	1		2000	101	58.	6586.8	5549.5	2		0924	168	60.	6598.5	5549.5
1		0648	35	1.	5845.3	5545.5	1		2012	102	58.	6589.2	5549.5	2		0936	169	60.	6597.5	5549.5
1		0700	36	3.	5846.3	5545.5	1		2024	103	59.	6591.5	5549.5	2		0948	170	60.	6596.5	5549.5
1		0712	37	4.	5848.2	5545.5	1		2036	104	59.	6593.7	5549.5	2		1000	171	60.	6595.5	5549.5
1		0724	38	5.	5851.4	5545.6	1		2048	105	60.	6595.9	5549.5	2		1012	172	59.	6594.4	5549.5
1		0736	39	7.	5856.4	5545.6	1		2100	106	60.	6598.1	5549.5	2		1024	173	59.	6593.4	5549.5
1		0748	40	9.	5863.1	5545.6	1		2112	107	61.	6600.3	5549.5	2		1036	174	59.	6592.4	5549.5
1		0800	41	11.	5871.7	5545.7	1		2124	108	61.	6602.5	5549.5	2		1048	175	59.	6591.4	5549.5
1		0812	42	13.	5882.1	5545.8	1		2136	109	62.	6604.7	5549.5	2		1100	176	59.	6590.4	5549.5
1		0824	43	15.	5894.4	5545.9	1		2148	110	63.	6606.9	5549.5	2		1112	177	58.	6589.5	5549.5
1		0836	44	17.	5908.3	5546.0	1		2200	111	63.	6609.1	5549.5	2		1124	178	58.	6588.6	5549.5
1		0848	45	19.	5923.7	5546.1	1		2212	112	64.	6611.3	5549.5	2		1136	179	58.	6587.7	5549.5
1		0900	46	21.	5940.6	5546.3	1		2224	113	64.	6613.5	5549.6	2		1148	180	58.	6586.8	5549.5
1		0912	47	23.	5958.8	5546.4	1		2236	114	65.	6615.7	5549.6	2		1200	181	58.	6586.0	5549.5
1		0924	48	25.	5978.3	5546.6	1		2248	115	65.	6617.7	5549.6	2		1212	182	57.	6585.1	5549.5
1		0936	49	27.	5998.8	5546.8	1		2300	116	66.	6619.7	5549.6	2		1224	183	57.	6584.2	5549.5
1		0948	50	28.	6020.3	5546.9	1		2312	117	66.	6621.8	5549.6	2		1236	184	57.	6583.3	5549.5
1		1000	51	30.	6042.7	5547.1	1		2324	118	67.	6623.8	5549.6	2		1248	185	57.	6582.5	5549.4
1		1012	52	32.	6066.0	5547.3	1		2336	119	67.	6625.9	5549.6	2		1300	186	57.	6581.6	5549.4
1		1024	53	34.	6090.1	5547.5	1		2348	120	68.	6627.9	5549.6	2		1312	187	56.	6580.7	5549.4
1		1036	54	35.	6114.7	5547.7	2		0000	121	69.	6630.0	5549.6	2		1324	188	56.	6579.8	5549.4
1		1048	55	37.	6140.0	5547.9	2		0012	122	69.	6632.0	5549.6	2		1336	189	56.	6578.9	5549.4
1		1100	56	38.	6166.0	5548.1	2		0024	123	70.	6633.9	5549.6	2		1348	190	56.	6578.1	5549.4
1		1112	57	38.	6192.4	5548.1	2		0036	124	70.	6635.7	5549.6	2		1400	191	56.	6577.2	5549.4
1		1124	58	39.	6219.5	5548.2	2		0048	125	71.	6637.0	5549.6	2		1412	192	55.	6576.3	5549.4
1		1136	59	40.	6247.0	5548.3	2		0100	126	71.	6637.9	5549.6	2		1424	193	55.	6575.4	5549.4
1		1148	60	40.	6274.9	5548.4	2		0112	127	71.	6638.3	5549.6	2		1436	194	55.	6574.6	5549.4
1		1200	61	41.	6303.3	5548.5	2		0124	128	71.	6638.3	5549.6	2		1448	195	55.	6573.7	5549.4
1		1212	62	42.	6331.8	5548.6	2		0136	129	71.	6638.0	5549.6	2		1500	196	55.	6572.8	5549.4
1		1224	63	42.	6359.7	5548.7	2		0148	130	71.	6637.4	5549.6	2		1512	197	55.	6571.9	5549.4
1		1236	64	43.	6386.1	5548.8	2		0200	131	70.	6636.7	5549.6	2		1524	198	54.	6571.0	5549.4
1		1248	65	43.	6409.5	5548.9	2		0212	132	70.	6635.8	5549.6	2		1536	199	54.	6570.2	5549.4
1		1300	66	44.	6429.0	5548.9	2		0224	133	70.	6635.0	5549.6	2		1548	200	54.	6569.3	5549.4
1		1312	67	44.	6445.0	5549.0	2		0236	134	70.	6633.9	5549.6							

PEAK OUTFLOW IS 71. AT TIME 25.20 HOURS

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	39.80-HR
+ (CFS)	(HR)					
		(CFS)				
+ 71.	25.20		69.	61.	44.	44.
		(INCHES)	.000	.000	.000	.000
		(AC-FT)	34.	121.	145.	145.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	39.80-HR
+ (AC-FT)	(HR)				
6638.	25.20	6631.	6598.	6379.	6379.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	39.80-HR
+ (FEET)	(HR)				
5549.63	25.20	5549.61	5549.50	5548.41	5548.41

CUMULATIVE AREA = .00 SQ MI

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1
					1.00
HYDROGRAPH AT					
+	Cove	.00	1	FLOW	1766.
				TIME	12.00
ROUTED TO					
+	Cove	.00	1	FLOW	71.
				TIME	25.20

** PEAK STAGES IN FEET **

1	STAGE	5549.63
	TIME	25.20

1 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION Cove
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	5545.50	5549.20	5552.00
STORAGE	5845.	6508.	7347.
OUTFLOW	0.	45.	435.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	5549.63	.00	6638.	71.	.00	25.20	.00

*** NORMAL END OF HEC-1 ***

Storm Event 15. Local Freeboard Hydrograph

```
1****************************************                                  ****************************************
 *                                      *                                  *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                  *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                  *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1               *                                  *         609 SECOND STREET            *
 *                                      *                                  *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   06AUG20  TIME  02:59:11  *                                  *           (916) 756-1104             *
 *                                      *                                  *                                      *
 ****************************************                                  ****************************************

                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X        X     X        XX
                                                X     X  X        X              X
                                                XXXXXXX  XXXX     X        XXXXX  X
                                                X     X  X        X              X
                                                X     X  X        X     X        X
                                                X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   Local FBH
           13           ID
                        *
           14           JR    PREC     1.0
           15           IT      18       0       0     100
           16           IO       0
           17           IN      18
                        *

           18           KK   B1
           19           KM   Runoff from Basin 1
           20           BA   0.503
           21           PB    7.67
           22           PC       0   0.020   0.046   0.070   0.095   0.130   0.180   0.300   0.520   0.650
           23           PC   0.700   0.745   0.785   0.820   0.850   0.880   0.905   0.930   0.955   0.980
           24           PC   1.000
           25           LS       0    72.8
           26           UD    0.51
                        *

           27           KK   RB1
           28           KM   Route B1
           29           RD    4928    .045    .050           TRAP      20      20
                        *

           30           KK   B2
           31           KM   Runoff from Basin 2
           32           BA   0.436
           33           LS       0    72.5
           34           UD    0.52
                        *

           35           KK   B3
           36           KM   Runoff from Basin 3
           37           BA   0.279
           38           LS       0    71.0
           39           UD    0.39
                        *
1                                                HEC-1 INPUT                                                PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
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```
 40          KK   C1
 41          KM   Combine RB1, B2, B3
 42          HC       3
             *

 43          KK   RC1
 44          KM   Route RC1
 45          RD    7255    .060    .030           TRAP      20      20
             *

 46          KK   B4
 47          KM   Runoff from Basin 4
 48          BA   0.453
 49          LS       0    73.3
 50          UD    0.48
             *

 51          KK   B5
 52          KM   Runoff from Basin 5
 53          BA   0.805
 54          LS       0    74.1
 55          UD    0.63
             *

 56          KK   C2
 57          KM   Combine RC1, B4, B5
 58          HC       3
             *

 59          KK   RC2
 60          KM   Route C2
 61          RD    2380    .039    .030           TRAP      40       2
             *

 62          KK   B6
 63          KM   Runoff from Basin 6
 64          BA   0.150
 65          LS       0    84.3
 66          UD    0.19
             *

 67          KK   B7
 68          KM   Runoff from Basin 7
 69          BA   0.327
 70          LS       0    75.7
 71          UD    0.46
             *

 72          KK   C3
 73          KM   Combine RC2, B6, B7
 74          HC       3
             *
1                                        HEC-1 INPUT                                          PAGE  3

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 75          KK   RC3
 76          KM   Route C3
 77          RD   11323    .023    .030           TRAP      40      20
             *

 78          KK   B8
 79          KM   Runoff from Basin 8
 80          BA   1.012
 81          LS       0    84.0
 82          UD    0.67
             *

 83          KK   B9
 84          KM   Runoff from Basin 9
 85          BA   0.242
 86          LS       0    85.5
 87          UD    0.26
             *

 88          KK   B10
 89          KM   Runoff from Basin 10
 90          BA   0.129
 91          LS       0    86.7
 92          UD    0.18
             *

 93          KK   C4
 94          KM   Combine B9, B10
 95          HC       2
             *

 96          KK   RC4
 97          KM   Route C4
 98          RD    3380    .037    .030           TRAP      40      20
             *
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```
             99           KK   B11
            100           KM   Runoff from Basin 11
            101           BA   0.279
            102           LS       0    84.8
            103           UD    0.39
                          *

            104           KK   C5
            105           KM   Combine RC3, B8, RC4, B11
            106           HC       4
                          *

            107           KK   B12
            108           KM   Runoff from Basin 12
            109           BA   0.127
            110           LS       0    81.2
            111           UD    0.40
                          *
1                                              HEC-1 INPUT                                              PAGE  4

          LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            115           KK   Cove Reservoir
            116           KM   Routing through Res'v
            117           RS       1    ELEV  5545.5
            118           SV       0      19      95     240     453     738    1105    1563    2217    2773
            119           SV    3542    4423    5419    6149    7347    8000
            120           SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
            121           SE    5530    5536    5542    5548    5552    5558
            122           SL  5545.5   4.909     0.6     0.5
            123           SS  5549.2      30    2.67     1.5
            124           ST  5552.0    1892     2.9     1.5
                          *
            125           ZZ
1*************************************                                          *************************************
 *                                   *                                          *                                   *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                      *    U.S. ARMY CORPS OF ENGINEERS     *
 *              JUN   1998           *                                          *    HYDROLOGIC ENGINEERING CENTER    *
 *           VERSION 4.1             *                                          *         609 SECOND STREET           *
 *                                   *                                          *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   06AUG20  TIME  02:59:11   *                                      *          (916) 756-1104           *
 *                                   *                                          *                                   *
 *************************************                                          *************************************



                        HYDROLOGY STUDY for COVE RESERVOIR
                        Located in KANE COUNTY, UTAH

                        AUG 2020

                        PREPARED BY ALPHA ENGINEERING
                        43 SOUTH 100 EAST, SUITE 100
                        ST. GEORGE, UTAH  84770
                        TEL: (435) 628-6500
                        FAX: (435) 628-6553

                        Local FBH


  16 IO          OUTPUT CONTROL VARIABLES
                      IPRNT          0  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                      NMIN         18  MINUTES IN COMPUTATION INTERVAL
                     IDATE      1    0  STARTING DATE
                     ITIME        0000  STARTING TIME
                        NQ         100  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE      2    0  ENDING DATE
                    NDTIME        0542  ENDING TIME
                     ICENT          19  CENTURY MARK

                  COMPUTATION INTERVAL     .30 HOURS
                       TOTAL TIME BASE   29.70 HOURS

         ENGLISH UNITS
              DRAINAGE AREA         SQUARE MILES
              PRECIPITATION DEPTH   INCHES
              LENGTH, ELEVATION     FEET
              FLOW                  CUBIC FEET PER SECOND
              STORAGE VOLUME        ACRE-FEET
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             SURFACE AREA          ACRES
             TEMPERATURE           DEGREES FAHRENHEIT

     JP        MULTI-PLAN OPTION
                 NPLAN           1  NUMBER OF PLANS

     JR        MULTI-RATIO OPTION
                 RATIOS OF PRECIPITATION
               1.00


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 112 KK    *     Call   *
           *            *
           **************
                       Combine C5, B12

 114 HC          HYDROGRAPH COMBINATION
                   ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

*********************************************************************************************************************************************

                                              HYDROGRAPH AT STATION    Call
                                                   SUM OF  2 HYDROGRAPHS
                                                 PLAN 1,   RATIO =  1.00

*********************************************************************************************************************************************
                                  *                                  *                                  *
   DA MON HRMN  ORD      FLOW    *   DA MON HRMN  ORD      FLOW    *   DA MON HRMN  ORD      FLOW    *   DA MON HRMN  ORD      FLOW
                                  *                                  *                                  *
    1     0000    1        0.    *    1     0730   26       332.    *    1     1500   51        0.    *    1     2230   76        0.
    1     0018    2        0.    *    1     0748   27       201.    *    1     1518   52        0.    *    1     2248   77        0.
    1     0036    3        0.    *    1     0806   28       113.    *    1     1536   53        0.    *    1     2306   78        0.
    1     0054    4        8.    *    1     0824   29        62.    *    1     1554   54        0.    *    1     2324   79        0.
    1     0112    5       43.    *    1     0842   30        34.    *    1     1612   55        0.    *    1     2342   80        0.
    1     0130    6      129.    *    1     0900   31        18.    *    1     1630   56        0.    *    2     0000   81        0.
    1     0148    7      306.    *    1     0918   32         9.    *    1     1648   57        0.    *    2     0018   82        0.
    1     0206    8      824.    *    1     0936   33         5.    *    1     1706   58        0.    *    2     0036   83        0.
    1     0224    9     2325.    *    1     0954   34         2.    *    1     1724   59        0.    *    2     0054   84        0.
    1     0242   10     4867.    *    1     1012   35         1.    *    1     1742   60        0.    *    2     0112   85        0.
    1     0300   11     6395.    *    1     1030   36         0.    *    1     1800   61        0.    *    2     0130   86        0.
    1     0318   12     6123.    *    1     1048   37         0.    *    1     1818   62        0.    *    2     0148   87        0.
    1     0336   13     5053.    *    1     1106   38         0.    *    1     1836   63        0.    *    2     0206   88        0.
    1     0354   14     4063.    *    1     1124   39         0.    *    1     1854   64        0.    *    2     0224   89        0.
    1     0412   15     3364.    *    1     1142   40         0.    *    1     1912   65        0.    *    2     0242   90        0.
    1     0430   16     2855.    *    1     1200   41         0.    *    1     1930   66        0.    *    2     0300   91        0.
    1     0448   17     2500.    *    1     1218   42         0.    *    1     1948   67        0.    *    2     0318   92        0.
    1     0506   18     2228.    *    1     1236   43         0.    *    1     2006   68        0.    *    2     0336   93        0.
    1     0524   19     2039.    *    1     1254   44         0.    *    1     2024   69        0.    *    2     0354   94        0.
    1     0542   20     1913.    *    1     1312   45         0.    *    1     2042   70        0.    *    2     0412   95        0.
    1     0600   21     1819.    *    1     1330   46         0.    *    1     2100   71        0.    *    2     0430   96        0.
    1     0618   22     1614.    *    1     1348   47         0.    *    1     2118   72        0.    *    2     0448   97        0.
    1     0636   23     1240.    *    1     1406   48         0.    *    1     2136   73        0.    *    2     0506   98        0.
    1     0654   24      851.    *    1     1424   49         0.    *    1     2154   74        0.    *    2     0524   99        0.
    1     0712   25      540.    *    1     1442   50         0.    *    1     2212   75        0.    *    2     0542  100        0.
                                  *                                  *                                  *
*********************************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR     29.70-HR
+   (CFS)       (HR)
                    (CFS)
+    6395.      3.00              2560.        648.        524.         524.
                 (INCHES)        5.019       5.085       5.085        5.085
                  (AC-FT)        1269.       1286.       1286.        1286.

                       CUMULATIVE AREA =    4.74 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 115 KK    *     Cove   *     Reservoir
           *            *
           **************
                       Routing through Res'v

              HYDROGRAPH ROUTING DATA
```

```
117 RS          STORAGE ROUTING
                     NSTPS           1  NUMBER OF SUBREACHES
                      ITYP        ELEV  TYPE OF INITIAL CONDITION
                     RSVRIC     5545.50  INITIAL CONDITION
                         X         .00 WORKING R AND D COEFFICIENT

118 SV            STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                               3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

120 SE          ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                              5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

122 SL          LOW-LEVEL OUTLET
                     ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                     CAREA        4.91  CROSS-SECTIONAL AREA
                      COQL         .60  COEFFICIENT
                      EXPL         .50  EXPONENT OF HEAD

123 SS          SPILLWAY
                     CREL     5549.20  SPILLWAY CREST ELEVATION
                     SPWID       30.00  SPILLWAY WIDTH
                      COQW        2.67  WEIR COEFFICIENT
                      EXPW        1.50  EXPONENT OF HEAD

124 ST          TOP OF DAM
                     TOPEL     5552.00  ELEVATION AT TOP OF DAM
                     DAMWID    1892.00  DAM WIDTH
                      COQD        2.90  WEIR COEFFICIENT
                      EXPD        1.50  EXPONENT OF HEAD
```

***

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

****

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	5844.8	5545.5	1		1012	35	233.	7019.3	5550.9	1		2024	69	154.	6859.6	5550.4
1		0018	2	0.	5844.8	5545.5	1		1030	36	230.	7013.6	5550.9	1		2042	70	152.	6855.8	5550.4
1		0036	3	0.	5844.8	5545.5	1		1048	37	227.	7007.9	5550.9	1		2100	71	150.	6852.0	5550.3
1		0054	4	1.	5845.0	5545.5	1		1106	38	224.	7002.3	5550.8	1		2118	72	149.	6848.3	5550.3
1		0112	5	2.	5845.5	5545.5	1		1124	39	221.	6996.8	5550.8	1		2136	73	147.	6844.7	5550.3
1		0130	6	4.	5847.6	5545.5	1		1142	40	218.	6991.3	5550.8	1		2154	74	146.	6841.0	5550.3
1		0148	7	6.	5852.9	5545.6	1		1200	41	216.	6985.9	5550.8	1		2212	75	144.	6837.4	5550.3
1		0206	8	10.	5866.8	5545.7	1		1218	42	213.	6980.7	5550.8	1		2230	76	142.	6833.8	5550.3
1		0224	9	17.	5905.5	5546.0	1		1236	43	210.	6975.4	5550.8	1		2248	77	141.	6830.3	5550.3
1		0242	10	26.	5994.1	5546.7	1		1254	44	207.	6970.3	5550.7	1		2306	78	139.	6826.8	5550.3
1		0300	11	36.	6133.0	5547.9	1		1312	45	205.	6965.2	5550.7	1		2324	79	138.	6823.5	5550.3
1		0318	12	41.	6287.2	5548.5	1		1330	46	202.	6960.0	5550.7	1		2342	80	136.	6820.1	5550.2
1		0336	13	44.	6424.7	5548.9	1		1348	47	200.	6955.1	5550.7	2		0000	81	135.	6816.7	5550.2
1		0354	14	48.	6536.5	5549.3	1		1406	48	197.	6950.1	5550.7	2		0018	82	134.	6813.4	5550.2
1		0412	15	68.	6627.1	5549.6	1		1424	49	195.	6945.3	5550.7	2		0036	83	132.	6810.0	5550.2
1		0430	16	91.	6702.2	5549.8	1		1442	50	192.	6940.5	5550.6	2		0054	84	131.	6806.8	5550.2
1		0448	17	114.	6766.0	5550.1	1		1500	51	190.	6935.8	5550.6	2		0112	85	129.	6803.6	5550.2
1		0506	18	137.	6821.4	5550.2	1		1518	52	188.	6931.1	5550.6	2		0130	86	128.	6800.4	5550.2
1		0524	19	159.	6870.7	5550.4	1		1536	53	185.	6926.4	5550.6	2		0148	87	127.	6797.1	5550.2
1		0542	20	180.	6915.4	5550.6	1		1554	54	183.	6921.9	5550.6	2		0206	88	126.	6794.1	5550.2

```
   1     0600  21     201.   6957.0  5550.7 *  1     1612  55     181.   6917.3  5550.6 *  2     0224  89     124.   6791.0  5550.1
   1     0618  22     220.   6994.3  5550.8 *  1     1630  56     179.   6913.0  5550.6 *  2     0242  90     123.   6787.9  5550.1
   1     0636  23     236.   7024.0  5550.9 *  1     1648  57     177.   6908.6  5550.5 *  2     0300  91     122.   6784.9  5550.1
   1     0654  24     247.   7043.8  5551.0 *  1     1706  58     175.   6904.2  5550.5 *  2     0318  92     121.   6781.8  5550.1
   1     0712  25     253.   7054.8  5551.0 *  1     1724  59     173.   6899.9  5550.5 *  2     0336  93     119.   6778.9  5550.1
   1     0730  26     255.   7059.3  5551.0 *  1     1742  60     171.   6895.7  5550.5 *  2     0354  94     118.   6775.9  5550.1
   1     0748  27     256.   7059.6  5551.0 *  1     1800  61     169.   6891.5  5550.5 *  2     0412  95     117.   6773.0  5550.1
   1     0806  28     254.   7057.2  5551.0 *  1     1818  62     167.   6887.4  5550.5 *  2     0430  96     116.   6770.1  5550.1
   1     0824  29     252.   7053.1  5551.0 *  1     1836  63     165.   6883.3  5550.5 *  2     0448  97     115.   6767.2  5550.1
   1     0842  30     249.   7048.1  5551.0 *  1     1854  64     163.   6879.2  5550.4 *  2     0506  98     114.   6764.4  5550.1
   1     0900  31     246.   7042.5  5551.0 *  1     1912  65     161.   6875.2  5550.4 *  2     0524  99     113.   6761.6  5550.0
   1     0918  32     243.   7036.8  5551.0 *  1     1930  66     159.   6871.3  5550.4 *  2     0542 100     112.   6758.8  5550.0
   1     0936  33     240.   7031.0  5550.9 *  1     1948  67     157.   6867.3  5550.4 *
   1     0954  34     237.   7025.1  5550.9 *  1     2006  68     156.   6863.4  5550.4 *
                                            *                                            *
 ********************************************************************************************************************************************

 PEAK OUTFLOW IS      256. AT TIME   7.80 HOURS


  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                  6-HR       24-HR       72-HR     29.70-HR
+   (CFS)       (HR)
                     (CFS)
+     256.      7.80                238.        178.        151.        151.
                     (INCHES)      .466       1.393       1.470       1.470
                      (AC-FT)      118.        352.        372.        372.

 PEAK STORAGE   TIME                      MAXIMUM AVERAGE STORAGE
                                  6-HR       24-HR       72-HR     29.70-HR
+  (AC-FT)      (HR)
     7060.      7.80               7027.       6906.       6774.       6774.

  PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                  6-HR       24-HR       72-HR     29.70-HR
+   (FEET)      (HR)
   5551.04      7.80             5550.93     5550.53     5549.96     5549.96

                         CUMULATIVE AREA =    4.74 SQ MI

1

               PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
                                   FLOWS IN CUBIC FEET PER SECOND,  AREA IN SQUARE MILES
                                                TIME TO PEAK IN HOURS


                                                                          RATIOS APPLIED TO PRECIPITATION
 OPERATION       STATION     AREA    PLAN            RATIO 1
                                                        1.00

 HYDROGRAPH AT
+                B1          .50     1   FLOW         689.
                                         TIME         3.00

 ROUTED TO
+                RB1         .50     1   FLOW         657.
                                         TIME         3.00

 HYDROGRAPH AT
+                B2          .44     1   FLOW         589.
                                         TIME         3.00

 HYDROGRAPH AT
+                B3          .28     1   FLOW         393.
                                         TIME         2.70

  3 COMBINED AT
+                C1         1.22     1   FLOW        1608.
                                         TIME         3.00

 ROUTED TO
+                RC1        1.22     1   FLOW        1507.
                                         TIME         3.00

 HYDROGRAPH AT
+                B4          .45     1   FLOW         636.
                                         TIME         3.00

 HYDROGRAPH AT
+                B5          .81     1   FLOW        1050.
                                         TIME         3.00

  3 COMBINED AT
+                C2         2.48     1   FLOW        3194.
                                         TIME         3.00

 ROUTED TO
+                RC2        2.48     1   FLOW        3137.
                                         TIME         3.00

 HYDROGRAPH AT
```

```
+                 B6          .15     1   FLOW         351.
                                          TIME         2.40

 HYDROGRAPH AT
+                 B7          .33     1   FLOW         490.
                                          TIME         3.00

  3 COMBINED AT
+                 C3         2.95     1   FLOW        3813.
                                          TIME         3.00

 ROUTED TO
+                 RC3        2.95     1   FLOW        3723.
                                          TIME         3.30

 HYDROGRAPH AT
+                 B8         1.01     1   FLOW        1656.
                                          TIME         3.00

 HYDROGRAPH AT
+                 B9          .24     1   FLOW         547.
                                          TIME         2.70

 HYDROGRAPH AT
+                 B10         .13     1   FLOW         326.
                                          TIME         2.40

  2 COMBINED AT
+                 C4          .37     1   FLOW         835.
                                          TIME         2.70

 ROUTED TO
+                 RC4         .37     1   FLOW         819.
                                          TIME         2.70

 HYDROGRAPH AT
+                 B11         .28     1   FLOW         575.
                                          TIME         2.70

  4 COMBINED AT
+                 C5         4.61     1   FLOW        6184.
                                          TIME         3.00

 HYDROGRAPH AT
+                 B12         .13     1   FLOW         238.
                                          TIME         2.70

  2 COMBINED AT
+                 Call       4.74     1   FLOW        6395.
                                          TIME         3.00

 ROUTED TO
+                 Cove       4.74     1   FLOW         256.
                                          TIME         7.80

                                    ** PEAK STAGES IN FEET **
                                    1   STAGE     5551.04
                                        TIME         7.80
1
                                        SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                            (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                INTERPOLATED TO
                                                                              COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

          FOR PLAN = 1  RATIO=  .00
             RB1    MANE         5.40    673.41    189.00      4.50     18.00    657.41    180.00        4.48


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1206E+03 EXCESS= .0000E+00 OUTFLOW= .1207E+03 BASIN STORAGE= .3686E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC1    MANE         5.40   1594.30    189.00      4.43     18.00   1507.33    180.00        4.43


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2880E+03 EXCESS= .0000E+00 OUTFLOW= .2881E+03 BASIN STORAGE= .3547E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC2    MANE         1.67   3186.21    182.05      4.52     18.00   3137.38    180.00        4.53


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5970E+03 EXCESS= .0000E+00 OUTFLOW= .5970E+03 BASIN STORAGE= .3099E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RC3    MANE         7.20   3778.09    194.40      4.63     18.00   3723.23    198.00        4.64
```

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7287E+03 EXCESS= .0000E+00 OUTFLOW= .7291E+03 BASIN STORAGE= .1048E-01 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RC4	MANE	5.53	841.55	154.72	6.01	18.00	818.78	162.00	6.02

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1188E+03 EXCESS= .0000E+00 OUTFLOW= .1189E+03 BASIN STORAGE= .2808E-02 PERCENT ERROR= .0

1 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION Cove
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	5545.50	5549.20	5552.00
STORAGE	5845.	6508.	7347.
OUTFLOW	0.	45.	435.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	5551.04	.00	7060.	256.	.00	7.80	.00

*** NORMAL END OF HEC-1 ***

Storm Event 16. General Freeboard Hydrograph

```
1****************************************                                    ****************************************
 *                                      *                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                    *   U.S. ARMY CORPS OF ENGINEERS       *
 *              JUN   1998              *                                    *   HYDROLOGIC ENGINEERING CENTER      *
 *           VERSION 4.1                *                                    *         609 SECOND STREET            *
 *                                      *                                    *      DAVIS, CALIFORNIA 95616         *
 *  RUN DATE   06AUG20  TIME  03:41:08  *                                    *          (916) 756-1104              *
 *                                      *                                    *                                      *
 ****************************************                                    ****************************************

                                                X     X  XXXXXXX   XXXXX          X
                                                X     X  X       X     X        XX
                                                X     X  X       X              X
                                                XXXXXXX  XXXX    X       XXXXX  X
                                                X     X  X       X              X
                                                X     X  X       X     X        X
                                                X     X  XXXXXXX   XXXXX        XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID   HYDROLOGY STUDY for COVE RESERVOIR
            2           ID   Located in KANE COUNTY, UTAH
            3           ID
            4           ID   AUG 2020
            5           ID
            6           ID   PREPARED BY ALPHA ENGINEERING
            7           ID   43 SOUTH 100 EAST, SUITE 100
            8           ID   ST. GEORGE, UTAH  84770
            9           ID   TEL: (435) 628-6500
           10           ID   FAX: (435) 628-6553
           11           ID
           12           ID   General FBH (NEH)
           13           ID
                        *
           14           JR    PREC     1.0
           15           IT      12       0       0     600
           16           IO       0
           17           IN      12
                        *
           18           QI       0       0       0       0       0       0       0       0       0       0
           19           QI       0       0       0       0       0       0       0       0       0       0
           20           QI       0       0       0       0       0       1       2       4       7      10
           21           QI      15      30      74     175     342     567     829    1108    1380    1634
           22           QI    1866    2071    2260    2424    2568    2696    2807    2906    2993    3069
           23           QI    3137    3198    3252    3300    3343    3381    3416    3447    3475    3501
           24           QI    3524    3498    3371    3075    2649    2187    1755    1392    1131     950
           25           QI     820     724     655     606     570     545     526     513     503     496
           26           QI     492     488     485     483     483     483     483     483     483     484
           27           QI     484     482     477     465     448     431     414     400     390     383
           28           QI     378     375     372     370     369     368     368     367     367     367
           29           QI     367     366     366     366     367     367     367     367     367     367
           30           QI     367     362     345     308     257     202     151     108      77      56
           31           QI      40      29      21      15      11       8       5       4       3       2
           32           QI       1       1       0
                        *

           33           KK   Cove Reservoir
           34           KM   Routing through Res'v
           35           RS       1    ELEV  5545.5
           36           SV       0      19      95     240     453     738    1105    1563    2217    2773
           37           SV    3542    4423    5419    6149    7347    8000
           38           SE    5470    5476    5482    5488    5494    5500    5506    5512    5518    5524
           39           SE    5530    5536    5542    5548    5552    5558
           40           SL  5545.5   4.909     0.6     0.5
           41           SS  5549.2      30    2.67     1.5
           42           ST  5552.0    1892     2.9     1.5
                        *
           43           ZZ
1****************************************                                    ****************************************
 *                                      *                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                    *   U.S. ARMY CORPS OF ENGINEERS       *
 *              JUN   1998              *                                    *   HYDROLOGIC ENGINEERING CENTER      *
 *           VERSION 4.1                *                                    *         609 SECOND STREET            *
 *                                      *                                    *      DAVIS, CALIFORNIA 95616         *
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*  RUN DATE   06AUG20  TIME  03:41:08   *                                          *          (916) 756-1104           *
*                                       *                                          *                                   *
*****************************************                                          *************************************
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HYDROLOGY STUDY for COVE RESERVOIR
Located in KANE COUNTY, UTAH

AUG 2020

PREPARED BY ALPHA ENGINEERING
43 SOUTH 100 EAST, SUITE 100
ST. GEORGE, UTAH 84770
TEL: (435) 628-6500
FAX: (435) 628-6553

General FBH (NEH)

```
 16 IO          OUTPUT CONTROL VARIABLES
                     IPRNT           0  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                      NMIN          12  MINUTES IN COMPUTATION INTERVAL
                     IDATE      1    0  STARTING DATE
                     ITIME        0000  STARTING TIME
                        NQ         600  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE      5    0  ENDING DATE
                    NDTIME        2348  ENDING TIME
                    ICENT           19  CENTURY MARK

                  COMPUTATION INTERVAL     .20 HOURS
                       TOTAL TIME BASE  119.80 HOURS

         ENGLISH UNITS
              DRAINAGE AREA         SQUARE MILES
              PRECIPITATION DEPTH   INCHES
              LENGTH, ELEVATION     FEET
              FLOW                  CUBIC FEET PER SECOND
              STORAGE VOLUME        ACRE-FEET
              SURFACE AREA          ACRES
              TEMPERATURE           DEGREES FAHRENHEIT

    JP          MULTI-PLAN OPTION
                     NPLAN           1  NUMBER OF PLANS

    JR          MULTI-RATIO OPTION
                    RATIOS OF PRECIPITATION
                   1.00

 17 IN          TIME DATA FOR INPUT TIME SERIES
                     JXMIN          12  TIME INTERVAL IN MINUTES
                    JXDATE      1    0  STARTING DATE
                    JXTIME           0  STARTING TIME

              SUBBASIN RUNOFF DATA

  0 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .00  SUBBASIN AREA
```

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HYDROGRAPH AT STATION Cove

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	2		0600	151	1.	3		1200	301	1.	4		1800	451	1.
1		0012	2	0.	2		0612	152	1.	3		1212	302	1.	4		1812	452	1.
1		0024	3	0.	2		0624	153	1.	3		1224	303	1.	4		1824	453	1.
1		0036	4	0.	2		0636	154	1.	3		1236	304	1.	4		1836	454	1.
1		0048	5	0.	2		0648	155	1.	3		1248	305	1.	4		1848	455	1.
1		0100	6	0.	2		0700	156	1.	3		1300	306	1.	4		1900	456	1.
1		0112	7	0.	2		0712	157	1.	3		1312	307	1.	4		1912	457	1.
1		0124	8	0.	2		0724	158	1.	3		1324	308	1.	4		1924	458	1.
1		0136	9	0.	2		0736	159	1.	3		1336	309	1.	4		1936	459	1.
1		0148	10	0.	2		0748	160	1.	3		1348	310	1.	4		1948	460	1.
1		0200	11	0.	2		0800	161	1.	3		1400	311	1.	4		2000	461	1.
1		0212	12	0.	2		0812	162	1.	3		1412	312	1.	4		2012	462	1.
1		0224	13	0.	2		0824	163	1.	3		1424	313	1.	4		2024	463	1.
1		0236	14	0.	2		0836	164	1.	3		1436	314	1.	4		2036	464	1.
1		0248	15	0.	2		0848	165	1.	3		1448	315	1.	4		2048	465	1.
1		0300	16	0.	2		0900	166	1.	3		1500	316	1.	4		2100	466	1.
1		0312	17	0.	2		0912	167	1.	3		1512	317	1.	4		2112	467	1.

1	0324	18	0.	*	2	0924	168	1.	*	3	1524	318	1.	*	4	2124	468	1.
1	0336	19	0.	*	2	0936	169	1.	*	3	1536	319	1.	*	4	2136	469	1.
1	0348	20	0.	*	2	0948	170	1.	*	3	1548	320	1.	*	4	2148	470	1.
1	0400	21	0.	*	2	1000	171	1.	*	3	1600	321	1.	*	4	2200	471	1.
1	0412	22	0.	*	2	1012	172	1.	*	3	1612	322	1.	*	4	2212	472	1.
1	0424	23	0.	*	2	1024	173	1.	*	3	1624	323	1.	*	4	2224	473	1.
1	0436	24	0.	*	2	1036	174	1.	*	3	1636	324	1.	*	4	2236	474	1.
1	0448	25	0.	*	2	1048	175	1.	*	3	1648	325	1.	*	4	2248	475	1.
1	0500	26	1.	*	2	1100	176	1.	*	3	1700	326	1.	*	4	2300	476	1.
1	0512	27	2.	*	2	1112	177	1.	*	3	1712	327	1.	*	4	2312	477	1.
1	0524	28	4.	*	2	1124	178	1.	*	3	1724	328	1.	*	4	2324	478	1.
1	0536	29	7.	*	2	1136	179	1.	*	3	1736	329	1.	*	4	2336	479	1.
1	0548	30	10.	*	2	1148	180	1.	*	3	1748	330	1.	*	4	2348	480	1.
1	0600	31	15.	*	2	1200	181	1.	*	3	1800	331	1.	*	5	0000	481	1.
1	0612	32	30.	*	2	1212	182	1.	*	3	1812	332	1.	*	5	0012	482	1.
1	0624	33	74.	*	2	1224	183	1.	*	3	1824	333	1.	*	5	0024	483	1.
1	0636	34	175.	*	2	1236	184	1.	*	3	1836	334	1.	*	5	0036	484	1.
1	0648	35	342.	*	2	1248	185	1.	*	3	1848	335	1.	*	5	0048	485	1.
1	0700	36	567.	*	2	1300	186	1.	*	3	1900	336	1.	*	5	0100	486	1.
1	0712	37	829.	*	2	1312	187	1.	*	3	1912	337	1.	*	5	0112	487	1.
1	0724	38	1108.	*	2	1324	188	1.	*	3	1924	338	1.	*	5	0124	488	1.
1	0736	39	1380.	*	2	1336	189	1.	*	3	1936	339	1.	*	5	0136	489	1.
1	0748	40	1634.	*	2	1348	190	1.	*	3	1948	340	1.	*	5	0148	490	1.
1	0800	41	1866.	*	2	1400	191	1.	*	3	2000	341	1.	*	5	0200	491	1.
1	0812	42	2071.	*	2	1412	192	1.	*	3	2012	342	1.	*	5	0212	492	1.
1	0824	43	2260.	*	2	1424	193	1.	*	3	2024	343	1.	*	5	0224	493	1.
1	0836	44	2424.	*	2	1436	194	1.	*	3	2036	344	1.	*	5	0236	494	1.
1	0848	45	2568.	*	2	1448	195	1.	*	3	2048	345	1.	*	5	0248	495	1.
1	0900	46	2696.	*	2	1500	196	1.	*	3	2100	346	1.	*	5	0300	496	1.
1	0912	47	2807.	*	2	1512	197	1.	*	3	2112	347	1.	*	5	0312	497	1.
1	0924	48	2906.	*	2	1524	198	1.	*	3	2124	348	1.	*	5	0324	498	1.
1	0936	49	2993.	*	2	1536	199	1.	*	3	2136	349	1.	*	5	0336	499	1.
1	0948	50	3069.	*	2	1548	200	1.	*	3	2148	350	1.	*	5	0348	500	1.
1	1000	51	3137.	*	2	1600	201	1.	*	3	2200	351	1.	*	5	0400	501	1.
1	1012	52	3198.	*	2	1612	202	1.	*	3	2212	352	1.	*	5	0412	502	1.
1	1024	53	3252.	*	2	1624	203	1.	*	3	2224	353	1.	*	5	0424	503	1.
1	1036	54	3300.	*	2	1636	204	1.	*	3	2236	354	1.	*	5	0436	504	1.
1	1048	55	3343.	*	2	1648	205	1.	*	3	2248	355	1.	*	5	0448	505	1.
1	1100	56	3381.	*	2	1700	206	1.	*	3	2300	356	1.	*	5	0500	506	1.
1	1112	57	3416.	*	2	1712	207	1.	*	3	2312	357	1.	*	5	0512	507	1.
1	1124	58	3447.	*	2	1724	208	1.	*	3	2324	358	1.	*	5	0524	508	1.
1	1136	59	3475.	*	2	1736	209	1.	*	3	2336	359	1.	*	5	0536	509	1.
1	1148	60	3501.	*	2	1748	210	1.	*	3	2348	360	1.	*	5	0548	510	1.
1	1200	61	3524.	*	2	1800	211	1.	*	4	0000	361	1.	*	5	0600	511	1.
1	1212	62	3498.	*	2	1812	212	1.	*	4	0012	362	1.	*	5	0612	512	1.
1	1224	63	3371.	*	2	1824	213	1.	*	4	0024	363	1.	*	5	0624	513	1.
1	1236	64	3075.	*	2	1836	214	1.	*	4	0036	364	1.	*	5	0636	514	1.
1	1248	65	2649.	*	2	1848	215	1.	*	4	0048	365	1.	*	5	0648	515	1.
1	1300	66	2187.	*	2	1900	216	1.	*	4	0100	366	1.	*	5	0700	516	1.
1	1312	67	1755.	*	2	1912	217	1.	*	4	0112	367	1.	*	5	0712	517	1.
1	1324	68	1392.	*	2	1924	218	1.	*	4	0124	368	1.	*	5	0724	518	1.
1	1336	69	1131.	*	2	1936	219	1.	*	4	0136	369	1.	*	5	0736	519	1.
1	1348	70	950.	*	2	1948	220	1.	*	4	0148	370	1.	*	5	0748	520	1.
1	1400	71	820.	*	2	2000	221	1.	*	4	0200	371	1.	*	5	0800	521	1.
1	1412	72	724.	*	2	2012	222	1.	*	4	0212	372	1.	*	5	0812	522	1.
1	1424	73	655.	*	2	2024	223	1.	*	4	0224	373	1.	*	5	0824	523	1.
1	1436	74	606.	*	2	2036	224	1.	*	4	0236	374	1.	*	5	0836	524	1.
1	1448	75	570.	*	2	2048	225	1.	*	4	0248	375	1.	*	5	0848	525	1.
1	1500	76	545.	*	2	2100	226	1.	*	4	0300	376	1.	*	5	0900	526	1.
1	1512	77	526.	*	2	2112	227	1.	*	4	0312	377	1.	*	5	0912	527	1.
1	1524	78	513.	*	2	2124	228	1.	*	4	0324	378	1.	*	5	0924	528	1.
1	1536	79	503.	*	2	2136	229	1.	*	4	0336	379	1.	*	5	0936	529	1.
1	1548	80	496.	*	2	2148	230	1.	*	4	0348	380	1.	*	5	0948	530	1.
1	1600	81	492.	*	2	2200	231	1.	*	4	0400	381	1.	*	5	1000	531	1.
1	1612	82	488.	*	2	2212	232	1.	*	4	0412	382	1.	*	5	1012	532	1.
1	1624	83	485.	*	2	2224	233	1.	*	4	0424	383	1.	*	5	1024	533	1.
1	1636	84	483.	*	2	2236	234	1.	*	4	0436	384	1.	*	5	1036	534	1.
1	1648	85	483.	*	2	2248	235	1.	*	4	0448	385	1.	*	5	1048	535	1.
1	1700	86	483.	*	2	2300	236	1.	*	4	0500	386	1.	*	5	1100	536	1.
1	1712	87	483.	*	2	2312	237	1.	*	4	0512	387	1.	*	5	1112	537	1.
1	1724	88	483.	*	2	2324	238	1.	*	4	0524	388	1.	*	5	1124	538	1.
1	1736	89	483.	*	2	2336	239	1.	*	4	0536	389	1.	*	5	1136	539	1.
1	1748	90	484.	*	2	2348	240	1.	*	4	0548	390	1.	*	5	1148	540	1.
1	1800	91	484.	*	3	0000	241	1.	*	4	0600	391	1.	*	5	1200	541	1.
1	1812	92	482.	*	3	0012	242	1.	*	4	0612	392	1.	*	5	1212	542	1.
1	1824	93	477.	*	3	0024	243	1.	*	4	0624	393	1.	*	5	1224	543	1.
1	1836	94	465.	*	3	0036	244	1.	*	4	0636	394	1.	*	5	1236	544	1.
1	1848	95	448.	*	3	0048	245	1.	*	4	0648	395	1.	*	5	1248	545	1.
1	1900	96	431.	*	3	0100	246	1.	*	4	0700	396	1.	*	5	1300	546	1.
1	1912	97	414.	*	3	0112	247	1.	*	4	0712	397	1.	*	5	1312	547	1.
1	1924	98	400.	*	3	0124	248	1.	*	4	0724	398	1.	*	5	1324	548	1.
1	1936	99	390.	*	3	0136	249	1.	*	4	0736	399	1.	*	5	1336	549	1.
1	1948	100	383.	*	3	0148	250	1.	*	4	0748	400	1.	*	5	1348	550	1.
1	2000	101	378.	*	3	0200	251	1.	*	4	0800	401	1.	*	5	1400	551	1.
1	2012	102	375.	*	3	0212	252	1.	*	4	0812	402	1.	*	5	1412	552	1.
1	2024	103	372.	*	3	0224	253	1.	*	4	0824	403	1.	*	5	1424	553	1.
1	2036	104	370.	*	3	0236	254	1.	*	4	0836	404	1.	*	5	1436	554	1.
1	2048	105	369.	*	3	0248	255	1.	*	4	0848	405	1.	*	5	1448	555	1.
1	2100	106	368.	*	3	0300	256	1.	*	4	0900	406	1.	*	5	1500	556	1.
1	2112	107	368.	*	3	0312	257	1.	*	4	0912	407	1.	*	5	1512	557	1.
1	2124	108	367.	*	3	0324	258	1.	*	4	0924	408	1.	*	5	1524	558	1.
1	2136	109	367.	*	3	0336	259	1.	*	4	0936	409	1.	*	5	1536	559	1.

1	2148	110	367.	*	3	0348	260	1.	*	4	0948	410	1.	*	5	1548	560	1.
1	2200	111	367.	*	3	0400	261	1.	*	4	1000	411	1.	*	5	1600	561	1.
1	2212	112	366.	*	3	0412	262	1.	*	4	1012	412	1.	*	5	1612	562	1.
1	2224	113	366.	*	3	0424	263	1.	*	4	1024	413	1.	*	5	1624	563	1.
1	2236	114	366.	*	3	0436	264	1.	*	4	1036	414	1.	*	5	1636	564	1.
1	2248	115	367.	*	3	0448	265	1.	*	4	1048	415	1.	*	5	1648	565	1.
1	2300	116	367.	*	3	0500	266	1.	*	4	1100	416	1.	*	5	1700	566	1.
1	2312	117	367.	*	3	0512	267	1.	*	4	1112	417	1.	*	5	1712	567	1.
1	2324	118	367.	*	3	0524	268	1.	*	4	1124	418	1.	*	5	1724	568	1.
1	2336	119	367.	*	3	0536	269	1.	*	4	1136	419	1.	*	5	1736	569	1.
1	2348	120	367.	*	3	0548	270	1.	*	4	1148	420	1.	*	5	1748	570	1.
2	0000	121	367.	*	3	0600	271	1.	*	4	1200	421	1.	*	5	1800	571	1.
2	0012	122	362.	*	3	0612	272	1.	*	4	1212	422	1.	*	5	1812	572	1.
2	0024	123	345.	*	3	0624	273	1.	*	4	1224	423	1.	*	5	1824	573	1.
2	0036	124	308.	*	3	0636	274	1.	*	4	1236	424	1.	*	5	1836	574	1.
2	0048	125	257.	*	3	0648	275	1.	*	4	1248	425	1.	*	5	1848	575	1.
2	0100	126	202.	*	3	0700	276	1.	*	4	1300	426	1.	*	5	1900	576	1.
2	0112	127	151.	*	3	0712	277	1.	*	4	1312	427	1.	*	5	1912	577	1.
2	0124	128	108.	*	3	0724	278	1.	*	4	1324	428	1.	*	5	1924	578	1.
2	0136	129	77.	*	3	0736	279	1.	*	4	1336	429	1.	*	5	1936	579	1.
2	0148	130	56.	*	3	0748	280	1.	*	4	1348	430	1.	*	5	1948	580	1.
2	0200	131	40.	*	3	0800	281	1.	*	4	1400	431	1.	*	5	2000	581	1.
2	0212	132	29.	*	3	0812	282	1.	*	4	1412	432	1.	*	5	2012	582	1.
2	0224	133	21.	*	3	0824	283	1.	*	4	1424	433	1.	*	5	2024	583	1.
2	0236	134	15.	*	3	0836	284	1.	*	4	1436	434	1.	*	5	2036	584	1.
2	0248	135	11.	*	3	0848	285	1.	*	4	1448	435	1.	*	5	2048	585	1.
2	0300	136	8.	*	3	0900	286	1.	*	4	1500	436	1.	*	5	2100	586	1.
2	0312	137	5.	*	3	0912	287	1.	*	4	1512	437	1.	*	5	2112	587	1.
2	0324	138	4.	*	3	0924	288	1.	*	4	1524	438	1.	*	5	2124	588	1.
2	0336	139	3.	*	3	0936	289	1.	*	4	1536	439	1.	*	5	2136	589	1.
2	0348	140	2.	*	3	0948	290	1.	*	4	1548	440	1.	*	5	2148	590	1.
2	0400	141	1.	*	3	1000	291	1.	*	4	1600	441	1.	*	5	2200	591	1.
2	0412	142	1.	*	3	1012	292	1.	*	4	1612	442	1.	*	5	2212	592	1.
2	0424	143	1.	*	3	1024	293	1.	*	4	1624	443	1.	*	5	2224	593	1.
2	0436	144	1.	*	3	1036	294	1.	*	4	1636	444	1.	*	5	2236	594	1.
2	0448	145	1.	*	3	1048	295	1.	*	4	1648	445	1.	*	5	2248	595	1.
2	0500	146	1.	*	3	1100	296	1.	*	4	1700	446	1.	*	5	2300	596	1.
2	0512	147	1.	*	3	1112	297	1.	*	4	1712	447	1.	*	5	2312	597	1.
2	0524	148	1.	*	3	1124	298	1.	*	4	1724	448	1.	*	5	2324	598	1.
2	0536	149	1.	*	3	1136	299	1.	*	4	1736	449	1.	*	5	2336	599	1.
2	0548	150	1.	*	3	1148	300	1.	*	4	1748	450	1.	*	5	2348	600	1.

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW				
		6-HR	24-HR	72-HR	119.80-HR	
+ (CFS)	(HR)					
		(CFS)				
+ 3524.	12.00	2782.	948.	317.	191.	
		(INCHES)	.000	.000	.000	.000
		(AC-FT)	1379.	1880.	1884.	1888.

CUMULATIVE AREA = .00 SQ MI

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	2		0600	151	1.	3		1200	301	1.	4		1800	451	1.
1		0012	2	0.	2		0612	152	1.	3		1212	302	1.	4		1812	452	1.
1		0024	3	0.	2		0624	153	1.	3		1224	303	1.	4		1824	453	1.
1		0036	4	0.	2		0636	154	1.	3		1236	304	1.	4		1836	454	1.
1		0048	5	0.	2		0648	155	1.	3		1248	305	1.	4		1848	455	1.
1		0100	6	0.	2		0700	156	1.	3		1300	306	1.	4		1900	456	1.
1		0112	7	0.	2		0712	157	1.	3		1312	307	1.	4		1912	457	1.
1		0124	8	0.	2		0724	158	1.	3		1324	308	1.	4		1924	458	1.
1		0136	9	0.	2		0736	159	1.	3		1336	309	1.	4		1936	459	1.
1		0148	10	0.	2		0748	160	1.	3		1348	310	1.	4		1948	460	1.
1		0200	11	0.	2		0800	161	1.	3		1400	311	1.	4		2000	461	1.
1		0212	12	0.	2		0812	162	1.	3		1412	312	1.	4		2012	462	1.
1		0224	13	0.	2		0824	163	1.	3		1424	313	1.	4		2024	463	1.
1		0236	14	0.	2		0836	164	1.	3		1436	314	1.	4		2036	464	1.
1		0248	15	0.	2		0848	165	1.	3		1448	315	1.	4		2048	465	1.
1		0300	16	0.	2		0900	166	1.	3		1500	316	1.	4		2100	466	1.
1		0312	17	0.	2		0912	167	1.	3		1512	317	1.	4		2112	467	1.
1		0324	18	0.	2		0924	168	1.	3		1524	318	1.	4		2124	468	1.
1		0336	19	0.	2		0936	169	1.	3		1536	319	1.	4		2136	469	1.
1		0348	20	0.	2		0948	170	1.	3		1548	320	1.	4		2148	470	1.
1		0400	21	0.	2		1000	171	1.	3		1600	321	1.	4		2200	471	1.
1		0412	22	0.	2		1012	172	1.	3		1612	322	1.	4		2212	472	1.
1		0424	23	0.	2		1024	173	1.	3		1624	323	1.	4		2224	473	1.
1		0436	24	0.	2		1036	174	1.	3		1636	324	1.	4		2236	474	1.
1		0448	25	0.	2		1048	175	1.	3		1648	325	1.	4		2248	475	1.
1		0500	26	1.	2		1100	176	1.	3		1700	326	1.	4		2300	476	1.
1		0512	27	2.	2		1112	177	1.	3		1712	327	1.	4		2312	477	1.
1		0524	28	4.	2		1124	178	1.	3		1724	328	1.	4		2324	478	1.

1	0536	29	7.	*	2	1136	179	1.	*	3	1736	329	1.	*	4	2336	479	1.
1	0548	30	10.	*	2	1148	180	1.	*	3	1748	330	1.	*	4	2348	480	1.
1	0600	31	15.	*	2	1200	181	1.	*	3	1800	331	1.	*	5	0000	481	1.
1	0612	32	30.	*	2	1212	182	1.	*	3	1812	332	1.	*	5	0012	482	1.
1	0624	33	74.	*	2	1224	183	1.	*	3	1824	333	1.	*	5	0024	483	1.
1	0636	34	175.	*	2	1236	184	1.	*	3	1836	334	1.	*	5	0036	484	1.
1	0648	35	342.	*	2	1248	185	1.	*	3	1848	335	1.	*	5	0048	485	1.
1	0700	36	567.	*	2	1300	186	1.	*	3	1900	336	1.	*	5	0100	486	1.
1	0712	37	829.	*	2	1312	187	1.	*	3	1912	337	1.	*	5	0112	487	1.
1	0724	38	1108.	*	2	1324	188	1.	*	3	1924	338	1.	*	5	0124	488	1.
1	0736	39	1380.	*	2	1336	189	1.	*	3	1936	339	1.	*	5	0136	489	1.
1	0748	40	1634.	*	2	1348	190	1.	*	3	1948	340	1.	*	5	0148	490	1.
1	0800	41	1866.	*	2	1400	191	1.	*	3	2000	341	1.	*	5	0200	491	1.
1	0812	42	2071.	*	2	1412	192	1.	*	3	2012	342	1.	*	5	0212	492	1.
1	0824	43	2260.	*	2	1424	193	1.	*	3	2024	343	1.	*	5	0224	493	1.
1	0836	44	2424.	*	2	1436	194	1.	*	3	2036	344	1.	*	5	0236	494	1.
1	0848	45	2568.	*	2	1448	195	1.	*	3	2048	345	1.	*	5	0248	495	1.
1	0900	46	2696.	*	2	1500	196	1.	*	3	2100	346	1.	*	5	0300	496	1.
1	0912	47	2807.	*	2	1512	197	1.	*	3	2112	347	1.	*	5	0312	497	1.
1	0924	48	2906.	*	2	1524	198	1.	*	3	2124	348	1.	*	5	0324	498	1.
1	0936	49	2993.	*	2	1536	199	1.	*	3	2136	349	1.	*	5	0336	499	1.
1	0948	50	3069.	*	2	1548	200	1.	*	3	2148	350	1.	*	5	0348	500	1.
1	1000	51	3137.	*	2	1600	201	1.	*	3	2200	351	1.	*	5	0400	501	1.
1	1012	52	3198.	*	2	1612	202	1.	*	3	2212	352	1.	*	5	0412	502	1.
1	1024	53	3252.	*	2	1624	203	1.	*	3	2224	353	1.	*	5	0424	503	1.
1	1036	54	3300.	*	2	1636	204	1.	*	3	2236	354	1.	*	5	0436	504	1.
1	1048	55	3343.	*	2	1648	205	1.	*	3	2248	355	1.	*	5	0448	505	1.
1	1100	56	3381.	*	2	1700	206	1.	*	3	2300	356	1.	*	5	0500	506	1.
1	1112	57	3416.	*	2	1712	207	1.	*	3	2312	357	1.	*	5	0512	507	1.
1	1124	58	3447.	*	2	1724	208	1.	*	3	2324	358	1.	*	5	0524	508	1.
1	1136	59	3475.	*	2	1736	209	1.	*	3	2336	359	1.	*	5	0536	509	1.
1	1148	60	3501.	*	2	1748	210	1.	*	3	2348	360	1.	*	5	0548	510	1.
1	1200	61	3524.	*	2	1800	211	1.	*	4	0000	361	1.	*	5	0600	511	1.
1	1212	62	3498.	*	2	1812	212	1.	*	4	0012	362	1.	*	5	0612	512	1.
1	1224	63	3371.	*	2	1824	213	1.	*	4	0024	363	1.	*	5	0624	513	1.
1	1236	64	3075.	*	2	1836	214	1.	*	4	0036	364	1.	*	5	0636	514	1.
1	1248	65	2649.	*	2	1848	215	1.	*	4	0048	365	1.	*	5	0648	515	1.
1	1300	66	2187.	*	2	1900	216	1.	*	4	0100	366	1.	*	5	0700	516	1.
1	1312	67	1755.	*	2	1912	217	1.	*	4	0112	367	1.	*	5	0712	517	1.
1	1324	68	1392.	*	2	1924	218	1.	*	4	0124	368	1.	*	5	0724	518	1.
1	1336	69	1131.	*	2	1936	219	1.	*	4	0136	369	1.	*	5	0736	519	1.
1	1348	70	950.	*	2	1948	220	1.	*	4	0148	370	1.	*	5	0748	520	1.
1	1400	71	820.	*	2	2000	221	1.	*	4	0200	371	1.	*	5	0800	521	1.
1	1412	72	724.	*	2	2012	222	1.	*	4	0212	372	1.	*	5	0812	522	1.
1	1424	73	655.	*	2	2024	223	1.	*	4	0224	373	1.	*	5	0824	523	1.
1	1436	74	606.	*	2	2036	224	1.	*	4	0236	374	1.	*	5	0836	524	1.
1	1448	75	570.	*	2	2048	225	1.	*	4	0248	375	1.	*	5	0848	525	1.
1	1500	76	545.	*	2	2100	226	1.	*	4	0300	376	1.	*	5	0900	526	1.
1	1512	77	526.	*	2	2112	227	1.	*	4	0312	377	1.	*	5	0912	527	1.
1	1524	78	513.	*	2	2124	228	1.	*	4	0324	378	1.	*	5	0924	528	1.
1	1536	79	503.	*	2	2136	229	1.	*	4	0336	379	1.	*	5	0936	529	1.
1	1548	80	496.	*	2	2148	230	1.	*	4	0348	380	1.	*	5	0948	530	1.
1	1600	81	492.	*	2	2200	231	1.	*	4	0400	381	1.	*	5	1000	531	1.
1	1612	82	488.	*	2	2212	232	1.	*	4	0412	382	1.	*	5	1012	532	1.
1	1624	83	485.	*	2	2224	233	1.	*	4	0424	383	1.	*	5	1024	533	1.
1	1636	84	483.	*	2	2236	234	1.	*	4	0436	384	1.	*	5	1036	534	1.
1	1648	85	483.	*	2	2248	235	1.	*	4	0448	385	1.	*	5	1048	535	1.
1	1700	86	483.	*	2	2300	236	1.	*	4	0500	386	1.	*	5	1100	536	1.
1	1712	87	483.	*	2	2312	237	1.	*	4	0512	387	1.	*	5	1112	537	1.
1	1724	88	483.	*	2	2324	238	1.	*	4	0524	388	1.	*	5	1124	538	1.
1	1736	89	483.	*	2	2336	239	1.	*	4	0536	389	1.	*	5	1136	539	1.
1	1748	90	484.	*	2	2348	240	1.	*	4	0548	390	1.	*	5	1148	540	1.
1	1800	91	484.	*	3	0000	241	1.	*	4	0600	391	1.	*	5	1200	541	1.
1	1812	92	482.	*	3	0012	242	1.	*	4	0612	392	1.	*	5	1212	542	1.
1	1824	93	477.	*	3	0024	243	1.	*	4	0624	393	1.	*	5	1224	543	1.
1	1836	94	465.	*	3	0036	244	1.	*	4	0636	394	1.	*	5	1236	544	1.
1	1848	95	448.	*	3	0048	245	1.	*	4	0648	395	1.	*	5	1248	545	1.
1	1900	96	431.	*	3	0100	246	1.	*	4	0700	396	1.	*	5	1300	546	1.
1	1912	97	414.	*	3	0112	247	1.	*	4	0712	397	1.	*	5	1312	547	1.
1	1924	98	400.	*	3	0124	248	1.	*	4	0724	398	1.	*	5	1324	548	1.
1	1936	99	390.	*	3	0136	249	1.	*	4	0736	399	1.	*	5	1336	549	1.
1	1948	100	383.	*	3	0148	250	1.	*	4	0748	400	1.	*	5	1348	550	1.
1	2000	101	378.	*	3	0200	251	1.	*	4	0800	401	1.	*	5	1400	551	1.
1	2012	102	375.	*	3	0212	252	1.	*	4	0812	402	1.	*	5	1412	552	1.
1	2024	103	372.	*	3	0224	253	1.	*	4	0824	403	1.	*	5	1424	553	1.
1	2036	104	370.	*	3	0236	254	1.	*	4	0836	404	1.	*	5	1436	554	1.
1	2048	105	369.	*	3	0248	255	1.	*	4	0848	405	1.	*	5	1448	555	1.
1	2100	106	368.	*	3	0300	256	1.	*	4	0900	406	1.	*	5	1500	556	1.
1	2112	107	368.	*	3	0312	257	1.	*	4	0912	407	1.	*	5	1512	557	1.
1	2124	108	367.	*	3	0324	258	1.	*	4	0924	408	1.	*	5	1524	558	1.
1	2136	109	367.	*	3	0336	259	1.	*	4	0936	409	1.	*	5	1536	559	1.
1	2148	110	367.	*	3	0348	260	1.	*	4	0948	410	1.	*	5	1548	560	1.
1	2200	111	367.	*	3	0400	261	1.	*	4	1000	411	1.	*	5	1600	561	1.
1	2212	112	366.	*	3	0412	262	1.	*	4	1012	412	1.	*	5	1612	562	1.
1	2224	113	366.	*	3	0424	263	1.	*	4	1024	413	1.	*	5	1624	563	1.
1	2236	114	366.	*	3	0436	264	1.	*	4	1036	414	1.	*	5	1636	564	1.
1	2248	115	367.	*	3	0448	265	1.	*	4	1048	415	1.	*	5	1648	565	1.
1	2300	116	367.	*	3	0500	266	1.	*	4	1100	416	1.	*	5	1700	566	1.
1	2312	117	367.	*	3	0512	267	1.	*	4	1112	417	1.	*	5	1712	567	1.
1	2324	118	367.	*	3	0524	268	1.	*	4	1124	418	1.	*	5	1724	568	1.
1	2336	119	367.	*	3	0536	269	1.	*	4	1136	419	1.	*	5	1736	569	1.
1	2348	120	367.	*	3	0548	270	1.	*	4	1148	420	1.	*	5	1748	570	1.

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    2     0000  121      367.   *    3     0600  271        1.   *    4     1200  421        1.   *    5     1800  571        1.
    2     0012  122      362.   *    3     0612  272        1.   *    4     1212  422        1.   *    5     1812  572        1.
    2     0024  123      345.   *    3     0624  273        1.   *    4     1224  423        1.   *    5     1824  573        1.
    2     0036  124      308.   *    3     0636  274        1.   *    4     1236  424        1.   *    5     1836  574        1.
    2     0048  125      257.   *    3     0648  275        1.   *    4     1248  425        1.   *    5     1848  575        1.
    2     0100  126      202.   *    3     0700  276        1.   *    4     1300  426        1.   *    5     1900  576        1.
    2     0112  127      151.   *    3     0712  277        1.   *    4     1312  427        1.   *    5     1912  577        1.
    2     0124  128      108.   *    3     0724  278        1.   *    4     1324  428        1.   *    5     1924  578        1.
    2     0136  129       77.   *    3     0736  279        1.   *    4     1336  429        1.   *    5     1936  579        1.
    2     0148  130       56.   *    3     0748  280        1.   *    4     1348  430        1.   *    5     1948  580        1.
    2     0200  131       40.   *    3     0800  281        1.   *    4     1400  431        1.   *    5     2000  581        1.
    2     0212  132       29.   *    3     0812  282        1.   *    4     1412  432        1.   *    5     2012  582        1.
    2     0224  133       21.   *    3     0824  283        1.   *    4     1424  433        1.   *    5     2024  583        1.
    2     0236  134       15.   *    3     0836  284        1.   *    4     1436  434        1.   *    5     2036  584        1.
    2     0248  135       11.   *    3     0848  285        1.   *    4     1448  435        1.   *    5     2048  585        1.
    2     0300  136        8.   *    3     0900  286        1.   *    4     1500  436        1.   *    5     2100  586        1.
    2     0312  137        5.   *    3     0912  287        1.   *    4     1512  437        1.   *    5     2112  587        1.
    2     0324  138        4.   *    3     0924  288        1.   *    4     1524  438        1.   *    5     2124  588        1.
    2     0336  139        3.   *    3     0936  289        1.   *    4     1536  439        1.   *    5     2136  589        1.
    2     0348  140        2.   *    3     0948  290        1.   *    4     1548  440        1.   *    5     2148  590        1.
    2     0400  141        1.   *    3     1000  291        1.   *    4     1600  441        1.   *    5     2200  591        1.
    2     0412  142        1.   *    3     1012  292        1.   *    4     1612  442        1.   *    5     2212  592        1.
    2     0424  143        1.   *    3     1024  293        1.   *    4     1624  443        1.   *    5     2224  593        1.
    2     0436  144        1.   *    3     1036  294        1.   *    4     1636  444        1.   *    5     2236  594        1.
    2     0448  145        1.   *    3     1048  295        1.   *    4     1648  445        1.   *    5     2248  595        1.
    2     0500  146        1.   *    3     1100  296        1.   *    4     1700  446        1.   *    5     2300  596        1.
    2     0512  147        1.   *    3     1112  297        1.   *    4     1712  447        1.   *    5     2312  597        1.
    2     0524  148        1.   *    3     1124  298        1.   *    4     1724  448        1.   *    5     2324  598        1.
    2     0536  149        1.   *    3     1136  299        1.   *    4     1736  449        1.   *    5     2336  599        1.
    2     0548  150        1.   *    3     1148  300        1.   *    4     1748  450        1.   *    5     2348  600        1.
                             *                                  *                                  *
 ********************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR    119.80-HR
+   (CFS)       (HR)
                      (CFS)
+    3524.     12.00                2782.        948.        317.         191.
                    (INCHES)       .000        .000        .000         .000
                     (AC-FT)     1379.       1880.       1884.        1888.

                     CUMULATIVE AREA =     .00 SQ MI


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
  33 KK    *     Cove   *     Reservoir
           *            *
           **************
                        Routing through Res'v

              HYDROGRAPH ROUTING DATA

  35 RS         STORAGE ROUTING
                     NSTPS           1  NUMBER OF SUBREACHES
                      ITYP        ELEV  TYPE OF INITIAL CONDITION
                     RSVRIC     5545.50  INITIAL CONDITION
                          X         .00 WORKING R AND D COEFFICIENT

  36 SV           STORAGE          .0      19.0      95.0     240.0     453.0     738.0    1105.0    1563.0    2217.0    2773.0
                                3542.0    4423.0    5419.0    6149.0    7347.0    8000.0

  38 SE         ELEVATION     5470.00   5476.00   5482.00   5488.00   5494.00   5500.00   5506.00   5512.00   5518.00   5524.00
                              5530.00   5536.00   5542.00   5548.00   5552.00   5558.00

  40 SL         LOW-LEVEL OUTLET
                     ELEVL     5545.50  ELEVATION AT CENTER OF OUTLET
                     CAREA        4.91  CROSS-SECTIONAL AREA
                      COQL         .60  COEFFICIENT
                      EXPL         .50  EXPONENT OF HEAD

  41 SS         SPILLWAY
                     CREL     5549.20  SPILLWAY CREST ELEVATION
                    SPWID       30.00  SPILLWAY WIDTH
                      COQW       2.67  WEIR COEFFICIENT
                      EXPW       1.50  EXPONENT OF HEAD

  42 ST         TOP OF DAM
                     TOPEL     5552.00  ELEVATION AT TOP OF DAM
                    DAMWID     1892.00  DAM WIDTH
                      COQD       2.90  WEIR COEFFICIENT
                      EXPD       1.50  EXPONENT OF HEAD

                                                  ***

                                  COMPUTED OUTFLOW-ELEVATION DATA
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(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31	40.98	45.44
ELEVATION	5470.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00	5548.51	5549.20
OUTFLOW	49.37	68.29	113.97	198.20	332.85	529.64	800.37	1156.85	1610.93	2174.46
ELEVATION	5549.32	5549.60	5550.06	5550.68	5551.48	5552.44	5553.58	5554.88	5556.36	5558.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	19.00	95.00	240.00	453.00	738.00	1105.00	1563.00	2217.00	2773.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	5470.00	5476.00	5482.00	5488.00	5494.00	5500.00	5506.00	5512.00	5518.00	5524.00
STORAGE	3542.00	4423.00	5419.00	5844.83	5989.79	6009.51	6033.57	6063.27	6100.64	6148.41
OUTFLOW	.00	.00	.00	.00	25.78	27.48	29.42	31.65	34.25	37.31
ELEVATION	5530.00	5536.00	5542.00	5545.50	5546.69	5546.85	5547.05	5547.30	5547.60	5548.00
STORAGE	6301.53	6508.46	6543.56	6628.96	6765.11	6952.15	7190.23	7347.00	7395.04	7518.54
OUTFLOW	40.98	45.44	49.37	68.29	113.97	198.20	332.85	435.48	2138.72	11657.74
ELEVATION	5548.51	5549.20	5549.32	5549.60	5550.06	5550.68	5551.48	5552.00	5552.44	5553.58
STORAGE	7660.53	7821.02	8000.00							
OUTFLOW	27985.71	51484.63	82813.63							
ELEVATION	5554.88	5556.36	5558.00							

HYDROGRAPH AT STATION Cove
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	5844.8	5545.5	2		1600	201	195.	6946.4	5550.7	4		0800	401	60.	6596.5	5549.5
1		0012	2	0.	5844.8	5545.5	2		1612	202	194.	6943.2	5550.7	4		0812	402	60.	6595.5	5549.5
1		0024	3	0.	5844.8	5545.5	2		1624	203	192.	6940.0	5550.6	4		0824	403	59.	6594.4	5549.5
1		0036	4	0.	5844.8	5545.5	2		1636	204	191.	6936.8	5550.6	4		0836	404	59.	6593.4	5549.5
1		0048	5	0.	5844.8	5545.5	2		1648	205	189.	6933.7	5550.6	4		0848	405	59.	6592.4	5549.5
1		0100	6	0.	5844.8	5545.5	2		1700	206	187.	6930.7	5550.6	4		0900	406	59.	6591.4	5549.5
1		0112	7	0.	5844.8	5545.5	2		1712	207	186.	6927.6	5550.6	4		0912	407	59.	6590.4	5549.5
1		0124	8	0.	5844.8	5545.5	2		1724	208	184.	6924.5	5550.6	4		0924	408	58.	6589.5	5549.5
1		0136	9	0.	5844.8	5545.5	2		1736	209	183.	6921.4	5550.6	4		0936	409	58.	6588.6	5549.5
1		0148	10	0.	5844.8	5545.5	2		1748	210	182.	6918.5	5550.6	4		0948	410	58.	6587.7	5549.5
1		0200	11	0.	5844.8	5545.5	2		1800	211	180.	6915.6	5550.6	4		1000	411	58.	6586.8	5549.5
1		0212	12	0.	5844.8	5545.5	2		1812	212	179.	6912.7	5550.5	4		1012	412	58.	6586.0	5549.5
1		0224	13	0.	5844.8	5545.5	2		1824	213	177.	6909.7	5550.5	4		1024	413	57.	6585.1	5549.5
1		0236	14	0.	5844.8	5545.5	2		1836	214	176.	6906.8	5550.5	4		1036	414	57.	6584.2	5549.5
1		0248	15	0.	5844.8	5545.5	2		1848	215	174.	6903.9	5550.5	4		1048	415	57.	6583.3	5549.5
1		0300	16	0.	5844.8	5545.5	2		1900	216	173.	6901.0	5550.5	4		1100	416	57.	6582.5	5549.4
1		0312	17	0.	5844.8	5545.5	2		1912	217	172.	6898.2	5550.5	4		1112	417	57.	6581.6	5549.4
1		0324	18	0.	5844.8	5545.5	2		1924	218	170.	6895.4	5550.5	4		1124	418	56.	6580.7	5549.4
1		0336	19	0.	5844.8	5545.5	2		1936	219	169.	6892.6	5550.5	4		1136	419	56.	6579.8	5549.4
1		0348	20	0.	5844.8	5545.5	2		1948	220	168.	6889.9	5550.5	4		1148	420	56.	6578.9	5549.4
1		0400	21	0.	5844.8	5545.5	2		2000	221	166.	6887.1	5550.5	4		1200	421	56.	6578.1	5549.4
1		0412	22	0.	5844.8	5545.5	2		2012	222	165.	6884.3	5550.5	4		1212	422	56.	6577.2	5549.4
1		0424	23	0.	5844.8	5545.5	2		2024	223	164.	6881.7	5550.4	4		1224	423	55.	6576.3	5549.4
1		0436	24	0.	5844.8	5545.5	2		2036	224	163.	6879.0	5550.4	4		1236	424	55.	6575.4	5549.4
1		0448	25	0.	5844.8	5545.5	2		2048	225	162.	6876.4	5550.4	4		1248	425	55.	6574.6	5549.4
1		0500	26	0.	5844.8	5545.5	2		2100	226	160.	6873.8	5550.4	4		1300	426	55.	6573.7	5549.4
1		0512	27	0.	5844.8	5545.5	2		2112	227	159.	6871.1	5550.4	4		1312	427	55.	6572.8	5549.4
1		0524	28	1.	5844.9	5545.5	2		2124	228	158.	6868.5	5550.4	4		1324	428	55.	6571.9	5549.4
1		0536	29	1.	5845.0	5545.5	2		2136	229	157.	6865.9	5550.4	4		1336	429	54.	6571.0	5549.4
1		0548	30	1.	5845.1	5545.5	2		2148	230	155.	6863.2	5550.4	4		1348	430	54.	6570.2	5549.4
1		0600	31	1.	5845.2	5545.5	2		2200	231	154.	6860.8	5550.4	4		1400	431	54.	6569.3	5549.4
1		0612	32	2.	5845.6	5545.5	2		2212	232	153.	6858.3	5550.4	4		1412	432	54.	6568.4	5549.4
1		0624	33	3.	5846.4	5545.5	2		2224	233	152.	6855.8	5550.4	4		1424	433	54.	6567.5	5549.4
1		0636	34	4.	5848.5	5545.5	2		2236	234	151.	6853.3	5550.4	4		1436	434	53.	6566.7	5549.4
1		0648	35	6.	5852.7	5545.6	2		2248	235	150.	6850.8	5550.3	4		1448	435	53.	6565.8	5549.4
1		0700	36	8.	5860.1	5545.6	2		2300	236	149.	6848.3	5550.3	4		1500	436	53.	6564.9	5549.4
1		0712	37	11.	5871.5	5545.7	2		2312	237	148.	6845.8	5550.3	4		1512	437	53.	6564.0	5549.4
1		0724	38	14.	5887.3	5545.8	2		2324	238	147.	6843.3	5550.3	4		1524	438	53.	6563.2	5549.4
1		0736	39	17.	5907.6	5546.0	2		2336	239	146.	6841.0	5550.3	4		1536	439	53.	6562.3	5549.4
1		0748	40	20.	5932.2	5546.2	2		2348	240	144.	6838.7	5550.3	4		1548	440	52.	6561.4	5549.4
1		0800	41	23.	5960.8	5546.5	3		0000	241	143.	6836.3	5550.3	4		1600	441	52.	6560.5	5549.4
1		0812	42	26.	5992.9	5546.7	3		0012	242	142.	6834.0	5550.3	4		1612	442	52.	6559.6	5549.4
1		0824	43	29.	6028.3	5547.0	3		0024	243	141.	6831.6	5550.3	4		1624	443	52.	6558.8	5549.4
1		0836	44	32.	6066.5	5547.3	3		0036	244	140.	6829.3	5550.3	4		1636	444	52.	6557.9	5549.4
1		0848	45	35.	6107.2	5547.7	3		0048	245	139.	6827.0	5550.3	4		1648	445	52.	6557.0	5549.4
1		0900	46	37.	6150.0	5548.0	3		0100	246	138.	6824.6	5550.3	4		1700	446	51.	6556.1	5549.4
1		0912	47	38.	6194.9	5548.2	3		0112	247	137.	6822.4	5550.2	4		1712	447	51.	6555.3	5549.4
1		0924	48	40.	6241.4	5548.3	3		0124	248	137.	6820.2	5550.2	4		1724	448	51.	6554.4	5549.4
1		0936	49	41.	6289.5	5548.5	3		0136	249	136.	6818.0	5550.2	4		1736	449	51.	6553.5	5549.4
1		0948	50	42.	6339.0	5548.6	3		0148	250	135.	6815.9	5550.2	4		1748	450	51.	6552.6	5549.3
1		1000	51	43.	6389.6	5548.8	3		0200	251	134.	6813.7	5550.2	4		1800	451	51.	6551.7	5549.3
1		1012	52	44.	6441.2	5549.0	3		0212	252	133.	6811.5	5550.2	4		1812	452	51.	6550.9	5549.3
1		1024	53	45.	6493.7	5549.2	3		0224	253	132.	6809.3	5550.2	4		1824	453	50.	6550.0	5549.3
1		1036	54	50.	6547.1	5549.3	3		0236	254	131.	6807.1	5550.2	4		1836	454	50.	6549.1	5549.3

1	1048	55	61.	6601.0	5549.5	*	3	0248	255	130.	6804.9	5550.2	*	4	1848	455	50.	6548.2	5549.3
1	1100	56	76.	6655.4	5549.7	*	3	0300	256	129.	6802.7	5550.2	*	4	1900	456	50.	6547.4	5549.3
1	1112	57	94.	6710.1	5549.9	*	3	0312	257	128.	6800.6	5550.2	*	4	1912	457	50.	6546.5	5549.3
1	1124	58	114.	6765.1	5550.1	*	3	0324	258	127.	6798.6	5550.2	*	4	1924	458	50.	6545.6	5549.3
1	1136	59	137.	6820.2	5550.2	*	3	0336	259	127.	6796.6	5550.2	*	4	1936	459	50.	6544.9	5549.3
1	1148	60	161.	6875.4	5550.4	*	3	0348	260	126.	6794.5	5550.2	*	4	1948	460	49.	6544.1	5549.3
1	1200	61	187.	6930.5	5550.6	*	3	0400	261	125.	6792.5	5550.1	*	4	2000	461	49.	6543.4	5549.3
1	1212	62	215.	6985.2	5550.8	*	3	0412	262	124.	6790.4	5550.1	*	4	2012	462	49.	6542.7	5549.3
1	1224	63	244.	7038.1	5551.0	*	3	0424	263	123.	6788.4	5550.1	*	4	2024	463	49.	6541.9	5549.3
1	1236	64	271.	7087.1	5551.1	*	3	0436	264	122.	6786.3	5550.1	*	4	2036	464	49.	6541.2	5549.3
1	1248	65	296.	7129.7	5551.3	*	3	0448	265	122.	6784.3	5550.1	*	4	2048	465	49.	6540.5	5549.3
1	1300	66	317.	7164.6	5551.4	*	3	0500	266	121.	6782.2	5550.1	*	4	2100	466	49.	6539.8	5549.3
1	1312	67	334.	7191.8	5551.5	*	3	0512	267	120.	6780.3	5550.1	*	4	2112	467	49.	6539.0	5549.3
1	1324	68	347.	7212.2	5551.5	*	3	0524	268	119.	6778.4	5550.1	*	4	2124	468	49.	6538.3	5549.3
1	1336	69	356.	7227.2	5551.6	*	3	0536	269	118.	6776.5	5550.1	*	4	2136	469	48.	6537.6	5549.3
1	1348	70	363.	7238.5	5551.6	*	3	0548	270	118.	6774.6	5550.1	*	4	2148	470	48.	6536.8	5549.3
1	1400	71	369.	7247.1	5551.7	*	3	0600	271	117.	6772.7	5550.1	*	4	2200	471	48.	6536.1	5549.3
1	1412	72	373.	7253.7	5551.7	*	3	0612	272	116.	6770.8	5550.1	*	4	2212	472	48.	6535.4	5549.3
1	1424	73	377.	7259.0	5551.7	*	3	0624	273	115.	6768.9	5550.1	*	4	2224	473	48.	6534.6	5549.3
1	1436	74	379.	7263.2	5551.7	*	3	0636	274	115.	6767.0	5550.1	*	4	2236	474	48.	6533.9	5549.3
1	1448	75	382.	7266.6	5551.7	*	3	0648	275	114.	6765.1	5550.1	*	4	2248	475	48.	6533.2	5549.3
1	1500	76	383.	7269.5	5551.7	*	3	0700	276	113.	6763.2	5550.1	*	4	2300	476	48.	6532.4	5549.3
1	1512	77	385.	7272.0	5551.7	*	3	0712	277	112.	6761.3	5550.0	*	4	2312	477	48.	6531.7	5549.3
1	1524	78	387.	7274.2	5551.8	*	3	0724	278	112.	6759.4	5550.0	*	4	2324	478	48.	6531.0	5549.3
1	1536	79	388.	7276.2	5551.8	*	3	0736	279	111.	6757.7	5550.0	*	4	2336	479	47.	6530.2	5549.3
1	1548	80	389.	7278.1	5551.8	*	3	0748	280	110.	6755.9	5550.0	*	4	2348	480	47.	6529.5	5549.3
1	1600	81	390.	7279.9	5551.8	*	3	0800	281	110.	6754.1	5550.0	*	5	0000	481	47.	6528.8	5549.3
1	1612	82	391.	7281.5	5551.8	*	3	0812	282	109.	6752.4	5550.0	*	5	0012	482	47.	6528.1	5549.3
1	1624	83	392.	7283.1	5551.8	*	3	0824	283	108.	6750.6	5550.0	*	5	0024	483	47.	6527.3	5549.3
1	1636	84	393.	7284.6	5551.8	*	3	0836	284	108.	6748.9	5550.0	*	5	0036	484	47.	6526.6	5549.3
1	1648	85	394.	7286.0	5551.8	*	3	0848	285	107.	6747.1	5550.0	*	5	0048	485	47.	6525.9	5549.3
1	1700	86	395.	7287.5	5551.8	*	3	0900	286	106.	6745.4	5550.0	*	5	0100	486	47.	6525.1	5549.3
1	1712	87	396.	7288.9	5551.8	*	3	0912	287	106.	6743.6	5550.0	*	5	0112	487	47.	6524.4	5549.3
1	1724	88	397.	7290.4	5551.8	*	3	0924	288	105.	6741.9	5550.0	*	5	0124	488	47.	6523.7	5549.3
1	1736	89	398.	7291.9	5551.8	*	3	0936	289	104.	6740.1	5550.0	*	5	0136	489	47.	6522.9	5549.2
1	1748	90	399.	7293.3	5551.8	*	3	0948	290	104.	6738.3	5550.0	*	5	0148	490	47.	6522.2	5549.2
1	1800	91	400.	7294.8	5551.8	*	3	1000	291	103.	6736.6	5550.0	*	5	0200	491	46.	6521.5	5549.2
1	1812	92	401.	7296.1	5551.8	*	3	1012	292	103.	6734.8	5550.0	*	5	0212	492	46.	6520.7	5549.2
1	1824	93	402.	7297.4	5551.8	*	3	1024	293	102.	6733.2	5550.0	*	5	0224	493	46.	6520.0	5549.2
1	1836	94	403.	7298.6	5551.8	*	3	1036	294	101.	6731.6	5549.9	*	5	0236	494	46.	6519.3	5549.2
1	1848	95	403.	7299.5	5551.8	*	3	1048	295	101.	6730.0	5549.9	*	5	0248	495	46.	6518.5	5549.2
1	1900	96	404.	7300.1	5551.8	*	3	1100	296	100.	6728.4	5549.9	*	5	0300	496	46.	6517.8	5549.2
1	1912	97	404.	7300.3	5551.8	*	3	1112	297	100.	6726.8	5549.9	*	5	0312	497	46.	6517.1	5549.2
1	1924	98	404.	7300.3	5551.8	*	3	1124	298	99.	6725.2	5549.9	*	5	0324	498	46.	6516.4	5549.2
1	1936	99	404.	7300.2	5551.8	*	3	1136	299	98.	6723.6	5549.9	*	5	0336	499	46.	6515.6	5549.2
1	1948	100	404.	7299.9	5551.8	*	3	1148	300	98.	6722.0	5549.9	*	5	0348	500	46.	6514.9	5549.2
1	2000	101	403.	7299.5	5551.8	*	3	1200	301	97.	6720.4	5549.9	*	5	0400	501	46.	6514.2	5549.2
1	2012	102	403.	7299.0	5551.8	*	3	1212	302	97.	6718.8	5549.9	*	5	0412	502	46.	6513.4	5549.2
1	2024	103	403.	7298.6	5551.8	*	3	1224	303	96.	6717.1	5549.9	*	5	0424	503	46.	6512.7	5549.2
1	2036	104	402.	7298.0	5551.8	*	3	1236	304	96.	6715.5	5549.9	*	5	0436	504	46.	6512.0	5549.2
1	2048	105	402.	7297.4	5551.8	*	3	1248	305	95.	6713.9	5549.9	*	5	0448	505	46.	6511.2	5549.2
1	2100	106	402.	7296.8	5551.8	*	3	1300	306	94.	6712.3	5549.9	*	5	0500	506	46.	6510.5	5549.2
1	2112	107	401.	7296.3	5551.8	*	3	1312	307	94.	6710.7	5549.9	*	5	0512	507	45.	6509.8	5549.2
1	2124	108	401.	7295.7	5551.8	*	3	1324	308	93.	6709.2	5549.9	*	5	0524	508	45.	6509.0	5549.2
1	2136	109	400.	7295.1	5551.8	*	3	1336	309	93.	6707.8	5549.9	*	5	0536	509	45.	6508.3	5549.2
1	2148	110	400.	7294.5	5551.8	*	3	1348	310	92.	6706.3	5549.9	*	5	0548	510	45.	6507.6	5549.2
1	2200	111	400.	7293.9	5551.8	*	3	1400	311	92.	6704.9	5549.9	*	5	0600	511	45.	6506.8	5549.2
1	2212	112	399.	7293.3	5551.8	*	3	1412	312	91.	6703.4	5549.9	*	5	0612	512	45.	6506.1	5549.2
1	2224	113	399.	7292.7	5551.8	*	3	1424	313	91.	6701.9	5549.8	*	5	0624	513	45.	6505.4	5549.2
1	2236	114	398.	7292.2	5551.8	*	3	1436	314	90.	6700.5	5549.8	*	5	0636	514	45.	6504.7	5549.2
1	2248	115	398.	7291.6	5551.8	*	3	1448	315	90.	6699.0	5549.8	*	5	0648	515	45.	6503.9	5549.2
1	2300	116	398.	7291.1	5551.8	*	3	1500	316	89.	6697.5	5549.8	*	5	0700	516	45.	6503.2	5549.2
1	2312	117	397.	7290.7	5551.8	*	3	1512	317	89.	6696.1	5549.8	*	5	0712	517	45.	6502.5	5549.2
1	2324	118	397.	7290.3	5551.8	*	3	1524	318	88.	6694.6	5549.8	*	5	0724	518	45.	6501.7	5549.2
1	2336	119	397.	7289.8	5551.8	*	3	1536	319	88.	6693.2	5549.8	*	5	0736	519	45.	6501.0	5549.2
1	2348	120	397.	7289.4	5551.8	*	3	1548	320	87.	6691.7	5549.8	*	5	0748	520	45.	6500.3	5549.2
2	0000	121	396.	7288.9	5551.8	*	3	1600	321	87.	6690.2	5549.8	*	5	0800	521	45.	6499.5	5549.2
2	0012	122	396.	7288.4	5551.8	*	3	1612	322	86.	6688.8	5549.8	*	5	0812	522	45.	6498.8	5549.2
2	0024	123	395.	7287.6	5551.8	*	3	1624	323	86.	6687.3	5549.8	*	5	0824	523	45.	6498.1	5549.2
2	0036	124	395.	7286.5	5551.8	*	3	1636	324	85.	6685.8	5549.8	*	5	0836	524	45.	6497.3	5549.2
2	0048	125	393.	7284.6	5551.8	*	3	1648	325	85.	6684.4	5549.8	*	5	0848	525	45.	6496.6	5549.2
2	0100	126	392.	7281.9	5551.8	*	3	1700	326	85.	6683.1	5549.8	*	5	0900	526	45.	6495.9	5549.2
2	0112	127	389.	7278.4	5551.8	*	3	1712	327	84.	6681.8	5549.8	*	5	0912	527	45.	6495.2	5549.2
2	0124	128	387.	7274.2	5551.8	*	3	1724	328	84.	6680.4	5549.8	*	5	0924	528	45.	6494.4	5549.2
2	0136	129	383.	7269.3	5551.7	*	3	1736	329	83.	6679.1	5549.8	*	5	0936	529	45.	6493.7	5549.2
2	0148	130	380.	7264.1	5551.7	*	3	1748	330	83.	6677.8	5549.8	*	5	0948	530	45.	6493.0	5549.1
2	0200	131	376.	7258.7	5551.7	*	3	1800	331	82.	6676.5	5549.8	*	5	1000	531	45.	6492.2	5549.1
2	0212	132	373.	7253.1	5551.7	*	3	1812	332	82.	6675.2	5549.8	*	5	1012	532	45.	6491.5	5549.1
2	0224	133	369.	7247.4	5551.7	*	3	1824	333	82.	6673.9	5549.8	*	5	1024	533	45.	6490.8	5549.1
2	0236	134	365.	7241.7	5551.6	*	3	1836	334	81.	6672.5	5549.7	*	5	1036	534	45.	6490.0	5549.1
2	0248	135	362.	7235.9	5551.6	*	3	1848	335	81.	6671.2	5549.7	*	5	1048	535	45.	6489.3	5549.1
2	0300	136	358.	7230.0	5551.6	*	3	1900	336	80.	6669.9	5549.7	*	5	1100	536	45.	6488.6	5549.1
2	0312	137	354.	7224.2	5551.6	*	3	1912	337	80.	6668.6	5549.7	*	5	1112	537	45.	6487.8	5549.1
2	0324	138	351.	7218.5	5551.6	*	3	1924	338	80.	6667.3	5549.7	*	5	1124	538	45.	6487.1	5549.1
2	0336	139	347.	7212.8	5551.6	*	3	1936	339	79.	6666.0	5549.7	*	5	1136	539	45.	6486.4	5549.1
2	0348	140	343.	7207.0	5551.5	*	3	1948	340	79.	6664.6	5549.7	*	5	1148	540	45.	6485.6	5549.1
2	0400	141	340.	7201.5	5551.5	*	3	2000	341	78.	6663.3	5549.7	*	5	1200	541	45.	6484.9	5549.1
2	0412	142	336.	7195.9	5551.5	*	3	2012	342	78.	6662.0	5549.7	*	5	1212	542	45.	6484.2	5549.1
2	0424	143	333.	7190.4	5551.5	*	3	2024	343	77.	6660.7	5549.7	*	5	1224	543	45.	6483.5	5549.1
2	0436	144	330.	7185.0	5551.5	*	3	2036	344	77.	6659.4	5549.7	*	5	1236	544	45.	6482.7	5549.1
2	0448	145	326.	7179.6	5551.4	*	3	2048	345	77.	6658.1	5549.7	*	5	1248	545	45.	6482.0	5549.1
2	0500	146	323.	7174.1	5551.4	*	3	2100	346	76.	6656.7	5549.7	*	5	1300	546	45.	6481.3	5549.1

```
   2     0512 147     320.   7168.9  5551.4 *  3     2112 347      76.   6655.6  5549.7 *  5     1312 547      45.   6480.5  5549.1
   2     0524 148     316.   7163.6  5551.4 *  3     2124 348      76.   6654.4  5549.7 *  5     1324 548      45.   6479.8  5549.1
   2     0536 149     313.   7158.5  5551.4 *  3     2136 349      75.   6653.2  5549.7 *  5     1336 549      45.   6479.1  5549.1
   2     0548 150     310.   7153.4  5551.4 *  3     2148 350      75.   6652.1  5549.7 *  5     1348 550      45.   6478.3  5549.1
   2     0600 151     307.   7148.3  5551.3 *  3     2200 351      75.   6650.9  5549.7 *  5     1400 551      45.   6477.6  5549.1
   2     0612 152     304.   7143.3  5551.3 *  3     2212 352      74.   6649.7  5549.7 *  5     1412 552      45.   6476.9  5549.1
   2     0624 153     301.   7138.3  5551.3 *  3     2224 353      74.   6648.6  5549.7 *  5     1424 553      45.   6476.1  5549.1
   2     0636 154     298.   7133.3  5551.3 *  3     2236 354      74.   6647.4  5549.7 *  5     1436 554      45.   6475.4  5549.1
   2     0648 155     295.   7128.5  5551.3 *  3     2248 355      73.   6646.2  5549.7 *  5     1448 555      45.   6474.7  5549.1
   2     0700 156     292.   7123.7  5551.3 *  3     2300 356      73.   6645.0  5549.7 *  5     1500 556      45.   6473.9  5549.1
   2     0712 157     290.   7118.9  5551.2 *  3     2312 357      72.   6643.9  5549.7 *  5     1512 557      45.   6473.2  5549.1
   2     0724 158     287.   7114.2  5551.2 *  3     2324 358      72.   6642.7  5549.6 *  5     1524 558      45.   6472.5  5549.1
   2     0736 159     284.   7109.5  5551.2 *  3     2336 359      72.   6641.5  5549.6 *  5     1536 559      45.   6471.8  5549.1
   2     0748 160     281.   7104.8  5551.2 *  3     2348 360      71.   6640.4  5549.6 *  5     1548 560      45.   6471.0  5549.1
   2     0800 161     279.   7100.1  5551.2 *  4     0000 361      71.   6639.2  5549.6 *  5     1600 561      45.   6470.3  5549.1
   2     0812 162     276.   7095.6  5551.2 *  4     0012 362      71.   6638.0  5549.6 *  5     1612 562      45.   6469.6  5549.1
   2     0824 163     273.   7091.1  5551.1 *  4     0024 363      70.   6636.9  5549.6 *  5     1624 563      45.   6468.8  5549.1
   2     0836 164     271.   7086.5  5551.1 *  4     0036 364      70.   6635.7  5549.6 *  5     1636 564      45.   6468.1  5549.1
   2     0848 165     268.   7082.2  5551.1 *  4     0048 365      70.   6634.5  5549.6 *  5     1648 565      45.   6467.4  5549.1
   2     0900 166     266.   7077.8  5551.1 *  4     0100 366      70.   6633.3  5549.6 *  5     1700 566      45.   6466.6  5549.1
   2     0912 167     263.   7073.4  5551.1 *  4     0112 367      69.   6632.2  5549.6 *  5     1712 567      45.   6465.9  5549.1
   2     0924 168     261.   7069.0  5551.1 *  4     0124 368      69.   6631.0  5549.6 *  5     1724 568      45.   6465.2  5549.1
   2     0936 169     258.   7064.8  5551.1 *  4     0136 369      69.   6629.8  5549.6 *  5     1736 569      45.   6464.4  5549.1
   2     0948 170     256.   7060.5  5551.0 *  4     0148 370      68.   6628.7  5549.6 *  5     1748 570      45.   6463.7  5549.1
   2     1000 171     254.   7056.3  5551.0 *  4     0200 371      68.   6627.5  5549.6 *  5     1800 571      44.   6463.0  5549.0
   2     1012 172     251.   7052.2  5551.0 *  4     0212 372      68.   6626.3  5549.6 *  5     1812 572      44.   6462.2  5549.0
   2     1024 173     249.   7048.1  5551.0 *  4     0224 373      67.   6625.2  5549.6 *  5     1824 573      44.   6461.5  5549.0
   2     1036 174     247.   7044.0  5551.0 *  4     0236 374      67.   6624.1  5549.6 *  5     1836 574      44.   6460.8  5549.0
   2     1048 175     245.   7039.9  5551.0 *  4     0248 375      67.   6623.1  5549.6 *  5     1848 575      44.   6460.1  5549.0
   2     1100 176     242.   7035.9  5551.0 *  4     0300 376      66.   6622.1  5549.6 *  5     1900 576      44.   6459.3  5549.0
   2     1112 177     240.   7032.0  5550.9 *  4     0312 377      66.   6621.1  5549.6 *  5     1912 577      44.   6458.6  5549.0
   2     1124 178     238.   7028.0  5550.9 *  4     0324 378      66.   6620.0  5549.6 *  5     1924 578      44.   6457.9  5549.0
   2     1136 179     236.   7024.1  5550.9 *  4     0336 379      66.   6619.0  5549.6 *  5     1936 579      44.   6457.1  5549.0
   2     1148 180     234.   7020.3  5550.9 *  4     0348 380      65.   6618.0  5549.6 *  5     1948 580      44.   6456.4  5549.0
   2     1200 181     232.   7016.5  5550.9 *  4     0400 381      65.   6617.0  5549.6 *  5     2000 581      44.   6455.7  5549.0
   2     1212 182     230.   7012.7  5550.9 *  4     0412 382      65.   6615.9  5549.6 *  5     2012 582      44.   6454.9  5549.0
   2     1224 183     228.   7008.9  5550.9 *  4     0424 383      65.   6614.9  5549.6 *  5     2024 583      44.   6454.2  5549.0
   2     1236 184     226.   7005.1  5550.9 *  4     0436 384      64.   6613.9  5549.6 *  5     2036 584      44.   6453.5  5549.0
   2     1248 185     224.   7001.4  5550.8 *  4     0448 385      64.   6612.9  5549.5 *  5     2048 585      44.   6452.7  5549.0
   2     1300 186     222.   6997.8  5550.8 *  4     0500 386      64.   6611.9  5549.5 *  5     2100 586      44.   6452.0  5549.0
   2     1312 187     220.   6994.1  5550.8 *  4     0512 387      63.   6610.8  5549.5 *  5     2112 587      44.   6451.3  5549.0
   2     1324 188     218.   6990.5  5550.8 *  4     0524 388      63.   6609.8  5549.5 *  5     2124 588      44.   6450.5  5549.0
   2     1336 189     216.   6987.0  5550.8 *  4     0536 389      63.   6608.8  5549.5 *  5     2136 589      44.   6449.8  5549.0
   2     1348 190     214.   6983.4  5550.8 *  4     0548 390      63.   6607.8  5549.5 *  5     2148 590      44.   6449.1  5549.0
   2     1400 191     212.   6979.9  5550.8 *  4     0600 391      62.   6606.7  5549.5 *  5     2200 591      44.   6448.4  5549.0
   2     1412 192     211.   6976.4  5550.8 *  4     0612 392      62.   6605.7  5549.5 *  5     2212 592      44.   6447.6  5549.0
   2     1424 193     209.   6972.9  5550.8 *  4     0624 393      62.   6604.7  5549.5 *  5     2224 593      44.   6446.9  5549.0
   2     1436 194     207.   6969.6  5550.7 *  4     0636 394      62.   6603.7  5549.5 *  5     2236 594      44.   6446.2  5549.0
   2     1448 195     205.   6966.2  5550.7 *  4     0648 395      61.   6602.6  5549.5 *  5     2248 595      44.   6445.4  5549.0
   2     1500 196     204.   6962.8  5550.7 *  4     0700 396      61.   6601.6  5549.5 *  5     2300 596      44.   6444.7  5549.0
   2     1512 197     202.   6959.5  5550.7 *  4     0712 397      61.   6600.6  5549.5 *  5     2312 597      44.   6444.0  5549.0
   2     1524 198     200.   6956.1  5550.7 *  4     0724 398      61.   6599.6  5549.5 *  5     2324 598      44.   6443.2  5549.0
   2     1536 199     199.   6952.9  5550.7 *  4     0736 399      60.   6598.5  5549.5 *  5     2336 599      44.   6442.5  5549.0
   2     1548 200     197.   6949.7  5550.7 *  4     0748 400      60.   6597.5  5549.5 *  5     2348 600      44.   6441.8  5549.0
                                        *                                                     *
 ********************************************************************************************************************************************************

 PEAK OUTFLOW IS      404. AT TIME  19.20 HOURS


  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                  6-HR        24-HR        72-HR     119.80-HR
+   (CFS)       (HR)
                      (CFS)
+     404.     19.20                401.         346.         191.          130.
                     (INCHES)       .000         .000         .000          .000
                      (AC-FT)       199.         687.        1135.         1291.

 PEAK STORAGE   TIME                       MAXIMUM AVERAGE STORAGE
                                  6-HR        24-HR        72-HR     119.80-HR
+  (AC-FT)      (HR)
     7300.     19.20               7296.        7209.        6902.         6696.

  PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                  6-HR        24-HR        72-HR     119.80-HR
+   (FEET)      (HR)
   5551.84     19.20              5551.83     5551.54     5550.52      5549.72

                       CUMULATIVE AREA =     .00 SQ MI

1

               PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
                           FLOWS IN CUBIC FEET PER SECOND,  AREA IN SQUARE MILES
                                        TIME TO PEAK IN HOURS


                                                          RATIOS APPLIED TO PRECIPITATION
 OPERATION       STATION     AREA    PLAN            RATIO 1
                                                       1.00

 HYDROGRAPH AT
```

```
+                 Cove        .00     1   FLOW        3524.
                                          TIME       12.00

 ROUTED TO
+                 Cove        .00     1   FLOW         404.
                                          TIME       19.20

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     5551.84
                                           TIME       19.20
1                                   SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    Cove
                                  (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


      PLAN  1 ..............                  INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                  ELEVATION        5545.50           5549.20          5552.00
                                  STORAGE             5845.             6508.            7347.
                                  OUTFLOW                0.               45.              435.


                     RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                       OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                      PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                     1.00      5551.84         .00       7300.       404.       .00        19.20         .00


 *** NORMAL END OF HEC-1 ***
```

Spillway Analysis

```
*******************************************************************************
SITES XEQ 08/20/2020   WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
     VER 2005.1.8              (USER MANUAL - DATED DECEMBER 2005)
     TIME 06:12:11

************************ 80-80 LIST OF INPUT Data **************************

SITES     01/01/2005COVRES    COV RES                       4.74      C3
SAVMOV    0    101
SAVMOV    101  1                                                      1
STRUCTURE STR1      Cove Res
                    5470                                    0.18
                    5480                                    62.26
                    5490                                    303.40
                    5500                                    738.03
                    5510                                    1400.09
                    5520                                    2323.02
                    5530                                    3541.97
                    5540                                    5073.81
                    5545.5                                  6055.03
                    5550                                    6934.92
                    5552                                    7347.18
                    5552.5                                  7450.25
ENDTABLE
HYD       1                 Principal Spillway
                    1
                    0         11        14        15        15
                    15        15        15        15        15
                    15        16        16        16        16
                    16        16        16        16        16
                    16        17        17        17        17
                    17        17        17        17        17
                    17        18        18        18        18
                    18        18        18        18        19
                    19        19        19        19        19
                    20        20        20        20        20
                    20        21        21        21        21
                    21        21        22        22        22
                    22        23        23        23        23
                    24        24        24        24        25
                    25        25        26        26        26
                    27        27        27        28        28
                    29        29        29        30        30
                    31        31        32        33        33
                    34        35        35        36        37
                    38        39        40        41        42
                    43        45        46        48        49
                    51        53        56        58        61
                    65        69        74        80        87
                    96        109       127       157       219
                    850       479       259       172       132
                    111       98        88        81        75
                    70        65        62        59        56
                    54        51        50        48        46
                    45        43        42        41        40
                    39        38        37        36        35
                    35        34        33        33        32
                    32        31        30        30        29
                    29        29        28        28        27
                    27        27        26        26        26
                    25        25        25        24        24
                    24        24        23        23        23
                    23        22        22        22        22
                    22        21        21        21        21
                    21        20        20        20        20
                    20        20        19        19        19
                    19        19        19        19        18
                    18        18        18        18        18
                    18        17        17        17        17
                    17        17        17        17        17
                    17        16        16        16        16
                    16        16        16        16        16
                    16        15        15        15        15
                    15        15        15        15        15
                    15        4         1
ENDTABLE
HYD       3                 Auxiliary Spillway (Local)
                    0.3
                    0         0         0         0         0
                    6         39        194       687       1365
                    2027      2180      1955      1683      1441
                    1248      1107      1001      924       874
                    833       748       589       423       283
                    180       112       73        47        28
                    16        9         5         3         1
                    1         0
ENDTABLE
HYD       5                 Freeboard (General)
                    1.2
                    0         0         4         35        84
                    195       425       1352      3365      3296
                    2008      1331      1060      912       792
```

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                  742       664       624       613       611
                  547       262       90        24        5
                  1         0
ENDTABLE
WSDATA    2C CR               4.74
PDIRECT                                 9.40      16.00
POOLDATA  ELEV                5545.5              5552      5435      SC
PSINLET             1         3.75
PSDATA    1         1000      30                  0.012     5450
ASSPRFL   41
          0         5530      75        5549.2    155       5549.2
          237       5517.6    600       5481.7    1049      5453.3
          1170      5435
ENDTABLE
ASSURFACE 41        1170      1
          0         1170      1         0         1
ENDTABLE
ASDATA    41                            2                             1
BTMWIDTH  FEET      30
ASMATERIAL
          1         50        1         75        115       .2
ENDTABLE
ASCOORD    1        W.Shale   N
          0         5530      75        5550      125       5565
          200       5552      250       5520      600       5485
          1050      5460      1150      5435      1300      5432.4
ENDTABLE
GRAPHICS  I
GO,DESIGN LP        TYPE2     24
SAVMOV    2    101  1                   STR1
ENDJOB

********************************************************************************

***** MESSAGE - DEFAULT TOPSOIL FILL MATERIAL PARAMETERS USED.

***** MESSAGE - AUXILIARY SPILLWAY CREST ELEVATION IS SET TO  5549.20
               FROM THE ASSPRFL RECORDS.

***** MESSAGE - ASSURFACE REACH  1: ZERO ROOTING DEPTH IS DEFAULTED TO 0.5 FT.


1SITES ----------------------------------------------------------------------
 XEQ 08/20/2020                    COV RES                       WSID= COVRES
 VER 2005.1.8                        Cove Res                      SUBW= CR
 TIME 06:12:11           SITE = STR1             PASS=    1     PART=   1



**********    MATERIAL PROPERTIES    **************************
                        DRY                  PERCENT       DETACH.      REP.
     MATERIAL       PI  DENSITY       Kh       CLAY         RATE      DIAMETER
                       lbs/CuFt                        (Ft/H)/(lb/SqFt)  inches
    W.Shale        50.      115.     0.20       75.0          --        1.00000
    TS_FILL         0.      100.     0.05        0.0          --        0.05000
    GEN_FILL       50.      115.     0.20       75.0          --        1.00000

**************************    BASIC Data    ********************************
HUMID- SUBHUMID CLIMATE AREA                    DESIGN CLASS  C

INFLOW HYDROGRAPH(S) ENTERED

PRECIP. - Q-PS,1-DAY    Q-PS,10-DAY       P-SD          P-FB
              0.00          0.00          9.40         16.00

WSDATA -       CN          DA-SM          TC/L           -/H          QRF
              0.00          4.74          0.00          0.00         0.00

SITEDATA- PERM POOL     CREST PS        FP SED       VALLEY FL        378?
              0.00       5545.50          0.00       5435.00           NO

          BASEFLOW      INITIAL EL     EXTRA VOL      SITE TYPE
              0.00          0.00          0.00         DESIGN

PSDATA -  NO. COND        COND L         DIA/W           -/H
              1.00       1000.00         30.00          0.00

               PS N            KE         WEIR L        TW EL
             0.012          1.00          3.75       5450.00

           2ND STG         ORF H          ORF L      START AUX.
              0.00          0.00          0.00          0.00

ASCRESTS -   AUX.1         AUX.2         AUX.3         AUX.4         AUX.5
            5549.20          0.00          0.00          0.00         0.00

AUX.Data -  REF.NO.    RETARD. Ci   TIE STATION    INLET LENGTH
                41          0.00       155.00             0

AUX.Data - INLET Ci    SIDE SLOPE       EXIT Ci     EXIT SLOPE     ACTUAL AUX?
             1.000          2.00         1.000          0.385           NO
```

```
 BTM WIDTH -    BW1           BW2           BW3           BW4           BW5
   ft         30.00          0.00          0.00          0.00          0.00

 AUXILIARY SPILLWAY RATING DEVELOPED USING WSPVRT.


1SITES ----------------------------------------------------------------------
 XEQ 08/20/2020                    COV RES                        WSID= COVRES
 VER 2005.1.8                        Cove Res                       SUBW= CR
 TIME 06:12:11            SITE = STR1              PASS=    1     PART=   2

MESSAGE ---- Climatic Index changed from 0.0 to 1.0 for this run.

 CREST PS       5545.50 FT    6055.0 ACFT      0.00 AC     126.3 CFS

 SED ACCUM      5545.50 FT    6055.0 ACFT      0.00 AC     126.3 CFS

 START ELEV     5545.50 FT    6055.0 ACFT      0.00 AC       0.0 CFS

 INFLOW HYDROGRAPH PROVIDED IN LOCATION  1,  PEAK=    850.00 CFS, AT 120.00 HRS.
 TITLE = Principal Spillway


 CREST PS       5545.50 FT    6055.0 ACFT      0.00 AC     126.3 CFS

 SED ACCUM      5545.50 FT    6055.0 ACFT      0.00 AC     126.3 CFS

 START ELEV     5545.50 FT    6055.0 ACFT      0.00 AC       0.0 CFS


 NRCS-PSH  RAINFALL   1-DAY =   0.00 IN    10-DAY =   0.00 IN    DA =   4.74 SM
           RUNOFF     1-DAY =   0.00 IN    10-DAY =   0.00 IN

      CLIMATIC INDEX = 1.00    CN 10-DAY =  0.    CN 1-DAY =   0.

      PEAK =       850.0 CFS, AT  120.0 HRS.


 ROUTED RESULT - HYD TYPE      EMAX         VOL-MAX        AMAX         QMAX
                 NRCS-PSH   5547.76 FT    6496.1 ACFT      0.00 AC     40.0 CFS

      PS STORAGE     441.0 ACFT,  BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

 DRAWDOWN (DDT) TEST       5545.84 FT    6121.2 ACFT      4.35 CFS
      CONTROL IS 0.150 DETENTION STORAGE

      TIME LIMIT REACHED = 10.00 DAYS. FLOW WAS     9.73 CFS,  ELEV =  5546.26
      (ELEVATION TO START ROUTING SDH AND/OR FBH HAS BEEN RAISED.)

      TIME TO DDT TEST DISCHARGE IS 15.79 DAYS - DRAWDOWN STOPPED.

 ***** NOTE - CREST OF AUX. RAISED TO HOLD   148.03 ACFT NOT EVACUATED IN
              DRAWDOWN TIME LIMIT.  TOTAL STORAGE REQUIRED =  6644.08 ACFT,
              NEW ELEVATION OF AUXILIARY SPILLWAY CREST    =  5548.51 FT.

 PLOT OF PRINCIPAL SPILLWAY HYDROGRAPH,  1 INCH=     200. CFS
                                                    0.      200.      400.      600.      800.     1000.     1200.     1400.
  Time    Qin  Qout   Elev    Vol   Area  ExtVel  I         I         I         I         I         I         I         I
  0.00   0.0   0.0 5545.5  6055.5   0.0          .
  1.00  11.0   0.0 5545.5  6055.5   0.0          .I
  2.00  14.0   0.1 5545.5  6056.5   0.0          .I
  3.00  15.0   0.2 5545.5  6057.7   0.0          .I
  4.00  15.0   0.3 5545.5  6058.9   0.0          .I
  5.00  15.0   0.3 5545.5  6060.1   0.0          .I
  6.00  15.0   0.4 5545.5  6061.3   0.0          .I
  7.00  15.0   0.5 5545.5  6062.5   0.0          .I
  8.00  15.0   0.6 5545.5  6063.7   0.0          .I
  9.00  15.0   0.7 5545.6  6064.9   0.0          .I
 10.00  15.0   0.7 5545.6  6066.1   0.0          .I
 11.00  16.0   0.8 5545.6  6067.3   0.0          .I
 12.00  16.0   0.9 5545.6  6068.6   0.0          .I
 13.00  16.0   1.0 5545.6  6069.8   0.0          .I
 14.00  16.0   1.1 5545.6  6071.1   0.0          .I
 15.00  16.0   1.1 5545.6  6072.3   0.0          .I
 16.00  16.0   1.2 5545.6  6073.5   0.0          .I
 17.00  16.0   1.3 5545.6  6074.7   0.0          .I
 18.00  16.0   1.4 5545.6  6076.0   0.0          .I
 19.00  16.0   1.5 5545.6  6077.2   0.0          .I
 20.00  16.0   1.5 5545.6  6078.4   0.0          .I
 21.00  17.0   1.6 5545.6  6079.6   0.0          .I
 22.00  17.0   1.7 5545.6  6080.9   0.0          .I
 23.00  17.0   1.8 5545.6  6082.1   0.0          .I
 24.00  17.0   1.9 5545.6  6083.4   0.0          .I
 25.00  17.0   1.9 5545.7  6084.6   0.0          .I
 26.00  17.0   2.0 5545.7  6085.9   0.0          .I
 27.00  17.0   2.1 5545.7  6087.1   0.0          .I
 28.00  17.0   2.2 5545.7  6088.3   0.0          .I
 29.00  17.0   2.3 5545.7  6089.5   0.0          .I
 30.00  17.0   2.3 5545.7  6090.8   0.0          .I
 31.00  18.0   2.4 5545.7  6092.0   0.0          .I
 32.00  18.0   2.5 5545.7  6093.3   0.0          .I
 33.00  18.0   2.6 5545.7  6094.6   0.0          .I
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 34.00  18.0   2.7 5545.7  6095.8   0.0         .I
 35.00  18.0   2.8 5545.7  6097.1   0.0         .I
 36.00  18.0   2.8 5545.7  6098.4   0.0         .I
 37.00  18.0   2.9 5545.7  6099.6   0.0         .I
 38.00  18.0   3.0 5545.7  6100.8   0.0         .I
 39.00  19.0   3.1 5545.7  6102.1   0.0         .I
 40.00  19.0   3.2 5545.7  6103.4   0.0         .I
 41.00  19.0   3.3 5545.8  6104.7   0.0         .I
 42.00  19.0   3.4 5545.8  6106.0   0.0         .I
 43.00  19.0   3.4 5545.8  6107.3   0.0         .I
 44.00  19.0   3.5 5545.8  6108.6   0.0         .I
 45.00  20.0   3.6 5545.8  6109.9   0.0         .I
 46.00  20.0   3.7 5545.8  6111.3   0.0         .I
 47.00  20.0   3.8 5545.8  6112.6   0.0         .I
 48.00  20.0   3.9 5545.8  6114.0   0.0         .I
 49.00  20.0   4.0 5545.8  6115.3   0.0         .I
 50.00  20.0   4.0 5545.8  6116.6   0.0         .I
 51.00  21.0   4.1 5545.8  6118.0   0.0         .I
 52.00  21.0   4.2 5545.8  6119.4   0.0         .I
 53.00  21.0   4.3 5545.8  6120.7   0.0         .I
 54.00  21.0   4.4 5545.8  6122.1   0.0         .I
 55.00  21.0   4.5 5545.9  6123.5   0.0         .I
 56.00  21.0   4.6 5545.9  6124.8   0.0         .I
 57.00  22.0   4.7 5545.9  6126.2   0.0         .I
 58.00  22.0   4.8 5545.9  6127.7   0.0         .I
 59.00  22.0   4.9 5545.9  6129.1   0.0         .I
 60.00  22.0   5.0 5545.9  6130.5   0.0         .I
 61.00  23.0   5.1 5545.9  6131.9   0.0         .I
 62.00  23.0   5.2 5545.9  6133.4   0.0         .I
 63.00  23.0   5.2 5545.9  6134.9   0.0         .I
 64.00  23.0   5.3 5545.9  6136.4   0.0         .I
 65.00  24.0   5.4 5545.9  6137.8   0.0         .I
 66.00  24.0   5.5 5545.9  6139.4   0.0         .I
 67.00  24.0   5.6 5545.9  6140.9   0.0         .I
 68.00  24.0   5.7 5545.9  6142.4   0.0         .I
 69.00  25.0   5.8 5546.0  6144.0   0.0         .I
 70.00  25.0   5.9 5546.0  6145.5   0.0         .I
 71.00  25.0   6.1 5546.0  6147.1   0.0         .I
 72.00  26.0   6.2 5546.0  6148.7   0.0         .I
 73.00  26.0   6.3 5546.0  6150.3   0.0         .I
 74.00  26.0   6.4 5546.0  6152.0   0.0         .I
 75.00  27.0   6.5 5546.0  6153.6   0.0         .I
 76.00  27.0   6.6 5546.0  6155.3   0.0         .I
 77.00  27.0   6.7 5546.0  6157.0   0.0         .I
 78.00  28.0   6.8 5546.0  6158.7   0.0         .I
 79.00  28.0   6.9 5546.0  6160.5   0.0         .I
 80.00  29.0   7.0 5546.0  6162.2   0.0         .I
 81.00  29.0   7.2 5546.1  6164.1   0.0         .I
 82.00  29.0   7.3 5546.1  6165.9   0.0         .I
 83.00  30.0   7.4 5546.1  6167.7   0.0         . I
 84.00  30.0   7.5 5546.1  6169.5   0.0         . I
 85.00  31.0   7.7 5546.1  6171.4   0.0         . I
 86.00  31.0   7.8 5546.1  6173.4   0.0         . I
 87.00  32.0   7.9 5546.1  6175.3   0.0         . I
 88.00  33.0   8.0 5546.1  6177.3   0.0         . I
 89.00  33.0   8.2 5546.1  6179.4   0.0         . I
 90.00  34.0   8.3 5546.1  6181.5   0.0         . I
 91.00  35.0   8.5 5546.2  6183.6   0.0         . I
 92.00  35.0   8.6 5546.2  6185.8   0.0         . I
 93.00  36.0   8.7 5546.2  6188.1   0.0         . I
 94.00  37.0   8.9 5546.2  6190.3   0.0         . I
 95.00  38.0   9.0 5546.2  6192.7   0.0         . I
 96.00  39.0   9.2 5546.2  6195.1   0.0         . I
 97.00  40.0   9.4 5546.2  6197.6   0.0         . I
 98.00  41.0   9.5 5546.2  6200.2   0.0         . I
 99.00  42.0   9.7 5546.3  6202.8   0.0         . I
100.00  43.0   9.9 5546.3  6205.5   0.0         . I
101.00  45.0  10.1 5546.3  6208.3   0.0         .PI
102.00  46.0  10.3 5546.3  6211.3   0.0         .PI
103.00  48.0  10.5 5546.3  6214.3   0.0         .PI
104.00  49.0  10.7 5546.3  6217.4   0.0         .PI
105.00  51.0  10.9 5546.3  6220.7   0.0         .P I
106.00  53.0  11.1 5546.4  6224.0   0.0         .P I
107.00  56.0  11.3 5546.4  6227.6   0.0         .P I
108.00  58.0  11.6 5546.4  6231.4   0.0         .P I
109.00  61.0  11.9 5546.4  6235.3   0.0         .P I
110.00  65.0  12.1 5546.4  6239.5   0.0         .P I
111.00  69.0  12.4 5546.5  6244.1   0.0         .P I
112.00  74.0  12.7 5546.5  6248.9   0.0         .P  I
113.00  80.0  13.1 5546.5  6254.2   0.0         .P  I
114.00  87.0  13.5 5546.5  6260.0   0.0         .P  I
115.00  96.0  13.9 5546.6  6266.5   0.0         .P   I
116.00 109.0  14.4 5546.6  6273.8   0.0         .P   I
117.00 127.0  14.9 5546.7  6282.3   0.0         .P    I
118.00 157.0  15.6 5546.7  6292.8   0.0         .P      I
119.00 219.0  17.3 5546.8  6307.0   0.0         .P         I
120.00 850.0  22.4 5547.0  6349.5   0.0         .P                                      X
121.00 479.0  28.7 5547.3  6402.3   0.0         .P                    I
122.00 259.0  32.1 5547.4  6430.3   0.0         . P         I
123.00 172.0  33.9 5547.5  6445.4   0.0         . P      I
124.00 132.0  35.1 5547.5  6455.1   0.0         . P    I
125.00 111.0  35.9 5547.6  6462.2   0.0         . P   I
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126.00	98.0	36.6	5547.6	6467.8	0.0	. P I
127.00	88.0	37.2	5547.6	6472.5	0.0	. P I
128.00	81.0	37.6	5547.7	6476.4	0.0	. P I
129.00	75.0	38.0	5547.7	6479.7	0.0	. P I
130.00	70.0	38.4	5547.7	6482.5	0.0	. P I
131.00	65.0	38.7	5547.7	6484.9	0.0	. PI
132.00	62.0	38.9	5547.7	6487.0	0.0	. PI
133.00	59.0	39.1	5547.7	6488.7	0.0	. PI
134.00	56.0	39.3	5547.7	6490.2	0.0	. PI
135.00	54.0	39.4	5547.7	6491.5	0.0	. PI
136.00	51.0	39.6	5547.7	6492.6	0.0	. PI
137.00	50.0	39.7	5547.7	6493.5	0.0	. PI
138.00	48.0	39.8	5547.7	6494.3	0.0	. P
139.00	46.0	39.8	5547.7	6494.9	0.0	. P
140.00	45.0	39.9	5547.8	6495.3	0.0	. P
141.00	43.0	39.9	5547.8	6495.7	0.0	. P
142.00	42.0	40.0	5547.8	6495.9	0.0	. P
143.00	41.0	40.0	5547.8	6496.0	0.0	. P
144.00	40.0	40.0	5547.8	6496.1	0.0	. X
145.00	39.0	40.0	5547.8	6496.0	0.0	. P
146.00	38.0	40.0	5547.8	6495.9	0.0	. P
147.00	37.0	39.9	5547.8	6495.7	0.0	. P
148.00	36.0	39.9	5547.8	6495.4	0.0	. P
149.00	35.0	39.9	5547.8	6495.0	0.0	. P
150.00	35.0	39.8	5547.7	6494.6	0.0	. P
151.00	34.0	39.8	5547.7	6494.2	0.0	. P
152.00	33.0	39.7	5547.7	6493.7	0.0	. P
153.00	33.0	39.6	5547.7	6493.1	0.0	. P
154.00	32.0	39.6	5547.7	6492.6	0.0	. P
155.00	32.0	39.5	5547.7	6491.9	0.0	. P
156.00	31.0	39.4	5547.7	6491.3	0.0	. P
157.00	30.0	39.3	5547.7	6490.5	0.0	. P
158.00	30.0	39.2	5547.7	6489.8	0.0	. P
159.00	29.0	39.1	5547.7	6489.0	0.0	.IP
160.00	29.0	39.0	5547.7	6488.1	0.0	.IP
161.00	29.0	38.9	5547.7	6487.3	0.0	.IP
162.00	28.0	38.8	5547.7	6486.5	0.0	.IP
163.00	28.0	38.7	5547.7	6485.6	0.0	.IP
164.00	27.0	38.6	5547.7	6484.6	0.0	.IP
165.00	27.0	38.5	5547.7	6483.7	0.0	.IP
166.00	27.0	38.4	5547.7	6482.7	0.0	.IP
167.00	26.0	38.3	5547.7	6481.8	0.0	.IP
168.00	26.0	38.1	5547.7	6480.8	0.0	.IP
169.00	26.0	38.0	5547.7	6479.8	0.0	.IP
170.00	25.0	37.9	5547.7	6478.7	0.0	.IP
171.00	25.0	37.8	5547.7	6477.7	0.0	.IP
172.00	25.0	37.7	5547.7	6476.6	0.0	.IP
173.00	24.0	37.5	5547.7	6475.5	0.0	.IP
174.00	24.0	37.4	5547.6	6474.4	0.0	.IP
175.00	24.0	37.3	5547.6	6473.3	0.0	.IP
176.00	24.0	37.1	5547.6	6472.2	0.0	.IP
177.00	23.0	37.0	5547.6	6471.1	0.0	.IP
178.00	23.0	36.9	5547.6	6470.0	0.0	.IP
179.00	23.0	36.7	5547.6	6468.8	0.0	.IP
180.00	23.0	36.6	5547.6	6467.7	0.0	.IP
181.00	22.0	36.4	5547.6	6466.5	0.0	.IP
182.00	22.0	36.3	5547.6	6465.3	0.0	.IP
183.00	22.0	36.2	5547.6	6464.2	0.0	.IP
184.00	22.0	36.0	5547.6	6463.0	0.0	.IP
185.00	22.0	35.9	5547.6	6461.8	0.0	.IP
186.00	21.0	35.7	5547.6	6460.7	0.0	.IP
187.00	21.0	35.6	5547.6	6459.5	0.0	.IP
188.00	21.0	35.4	5547.6	6458.3	0.0	.IP
189.00	21.0	35.3	5547.6	6457.1	0.0	.IP
190.00	21.0	35.2	5547.6	6455.9	0.0	.IP
191.00	20.0	35.0	5547.5	6454.7	0.0	.IP
192.00	20.0	34.9	5547.5	6453.4	0.0	.IP
193.00	20.0	34.7	5547.5	6452.2	0.0	.IP
194.00	20.0	34.6	5547.5	6451.0	0.0	.IP
195.00	20.0	34.4	5547.5	6449.8	0.0	.IP
196.00	20.0	34.3	5547.5	6448.6	0.0	.IP
197.00	19.0	34.1	5547.5	6447.4	0.0	.IP
198.00	19.0	34.0	5547.5	6446.2	0.0	.IP
199.00	19.0	33.8	5547.5	6444.9	0.0	.IP
200.00	19.0	33.7	5547.5	6443.7	0.0	.IP
201.00	19.0	33.6	5547.5	6442.5	0.0	.IP
202.00	19.0	33.4	5547.5	6441.3	0.0	.IP
203.00	19.0	33.3	5547.5	6440.1	0.0	.IP
204.00	18.0	33.1	5547.5	6438.9	0.0	.IP
205.00	18.0	33.0	5547.5	6437.7	0.0	.IP
206.00	18.0	32.8	5547.5	6436.4	0.0	.IP
207.00	18.0	32.7	5547.4	6435.2	0.0	.IP
208.00	18.0	32.5	5547.4	6434.0	0.0	.IP
209.00	18.0	32.4	5547.4	6432.8	0.0	.IP
210.00	18.0	32.2	5547.4	6431.6	0.0	.IP
211.00	17.0	32.1	5547.4	6430.4	0.0	.IP
212.00	17.0	32.0	5547.4	6429.2	0.0	.IP
213.00	17.0	31.8	5547.4	6427.9	0.0	.IP
214.00	17.0	31.7	5547.4	6426.7	0.0	.IP
215.00	17.0	31.5	5547.4	6425.5	0.0	.IP
216.00	17.0	31.4	5547.4	6424.3	0.0	.IP
217.00	17.0	31.2	5547.4	6423.1	0.0	.IP

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218.00  17.0  31.1 5547.4  6422.0   0.0          .IP
219.00  17.0  30.9 5547.4  6420.8   0.0          .IP
220.00  17.0  30.8 5547.4  6419.7   0.0          .IP
221.00  16.0  30.7 5547.4  6418.5   0.0          .IP
222.00  16.0  30.5 5547.4  6417.3   0.0          .IP
223.00  16.0  30.4 5547.3  6416.1   0.0          .IP
224.00  16.0  30.2 5547.3  6414.9   0.0          .IP
225.00  16.0  30.1 5547.3  6413.7   0.0          .IP
226.00  16.0  30.0 5547.3  6412.6   0.0          .P
227.00  16.0  29.8 5547.3  6411.4   0.0          .P
228.00  16.0  29.7 5547.3  6410.3   0.0          .P
229.00  16.0  29.5 5547.3  6409.2   0.0          .P
230.00  16.0  29.4 5547.3  6408.1   0.0          .P
231.00  15.0  29.3 5547.3  6406.9   0.0          .P
232.00  15.0  29.1 5547.3  6405.7   0.0          .P
233.00  15.0  29.0 5547.3  6404.6   0.0          .P
234.00  15.0  28.9 5547.3  6403.4   0.0          .P
235.00  15.0  28.7 5547.3  6402.3   0.0          .P
236.00  15.0  28.6 5547.3  6401.2   0.0          .P
237.00  15.0  28.5 5547.3  6400.0   0.0          .P
238.00  15.0  28.3 5547.3  6398.9   0.0          .P
239.00  15.0  28.2 5547.3  6397.8   0.0          .P
 Time    Qin  Qout   Elev    Vol   Area  ExtVel  I         I         I         I         I         I         I         I
                                                 0.      200.      400.      600.      800.     1000.     1200.     1400.
        END NRCS-PSH   PLOT


**********************************************************************
RATING TABLE DEVELOPED, SITE = STR1 :
 BY PROGRAM FOR PS AND AUX. SPILLWAYS
 AUX. RATING USED WSPVRT METHOD.


RATING TABLE NUMBER  1
       ELEV.    Q-TOTAL    Q-PS     Q-AUX.    VOLUME     AREA
       FEET       CFS       CFS       CFS      AC-FT     ACRE
  1  5545.50      0.00      0.00      0.00   6055.03      0.00
  2  5546.72     15.71     15.71      0.00   6294.00      0.00
  3  5547.94     44.43     44.43      0.00   6532.97      0.00
  4  5549.17     81.62     81.62      0.00   6771.95      0.00
                                          FULL CONDUIT FLOW, ELEV = 5550.39 FT
  5  5550.39    125.65    125.65      0.00   7015.04      0.00
  6  5550.65    125.84    125.84      0.00   7069.39      0.00
  7  5550.92    126.01    126.01      0.00   7123.74      0.00
  8  5551.18    126.17    126.17      0.00   7178.09      0.00
  9  5551.44    126.34    126.34      0.00   7232.44      0.00
 10  5551.71    126.50    126.50      0.00   7286.79      0.00
 11  5551.97    126.67    126.67      0.00   7341.14      0.00
 12  5552.23    126.83    126.83      0.00   7395.49      0.00
 13  5552.50    126.99    126.99      0.00   7449.85      0.00

INFLOW HYDROGRAPH PROVIDED IN LOCATION  3,  PEAK=   2180.00 CFS, AT   3.30 HRS.
TITLE = Auxiliary Spillway (Local)


INFLOW HYDROGRAPH PROVIDED IN LOCATION  5,  PEAK=   3365.00 CFS, AT   9.60 HRS.
TITLE = Freeboard (General)



1SITES ---------------------------------------------------------------------
 XEQ 08/20/2020                    COV RES                       WSID= COVRES
 VER 2005.1.8                        Cove Res                      SUBW= CR
 TIME 06:12:11            SITE = STR1              PASS=    1     PART=   3


 AUX. CREST     5548.51 FT    6644.1 ACFT      0.00 AC      61.7 CFS

      PS STORAGE    589.1 ACFT,  BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

 START ELEV     5546.26 FT    6203.0 ACFT      0.00 AC       9.7 CFS

 ***** WARNING - AUXILIARY CREST LOWER THAN LOW POINT IN SITE.

 NRCS-SDH   INFLOW HYDROGRAPH INPUT, DA =    4.74 SQUARE MILES

      PEAK =      2180.0 CFS, AT    3.3 HRS.

 NRCS-FBH   INFLOW HYDROGRAPH INPUT, DA =    4.74 SQUARE MILES

      PEAK =      3365.0 CFS, AT    9.6 HRS.

 ***** WARNING - MAXIMUM AUX. SURFACE PROFILE ELEVATION ( 5549.20) AND AUXILIARY
                 CREST ( 5548.51) ELEVATION Do NOT MATCH.  MAXIMUM AUX. SURFACE
                 PROFILE ELEVATION USED IN WSPVRT PROCEDURE.


 ***** MESSAGE - INPUT(5549.14) TO INTERPOLATION ROUTINE IS BELOW
                 ARRAY LIMIT(5549.20).


 **********************************************************************
```

RATING TABLE DEVELOPED, SITE = STR1 :
 BY PROGRAM FOR PS AND AUX. SPILLWAYS
 AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 2

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	5545.50	0.00	0.00	0.00	6055.03	0.00
2	5545.83	2.25	2.25	0.00	6120.52	0.00
3	5546.17	6.37	6.37	0.00	6186.02	0.00
4	5546.50	11.71	11.71	0.00	6251.52	0.00
5	5546.84	18.03	18.03	0.00	6317.01	0.00
6	5547.17	25.20	25.20	0.00	6382.51	0.00
7	5547.51	33.12	33.12	0.00	6448.00	0.00
8	5547.84	41.74	41.74	0.00	6513.50	0.00
9	5548.18	50.99	50.99	0.00	6578.99	0.00
10	5548.51	60.85	60.85	0.00	6644.49	0.00
11	5549.14	80.67	80.67	0.00	6766.41	0.00
12	5549.76	126.50	102.35	24.15	6888.71	0.00
				FULL CONDUIT FLOW, ELEV = 5550.39 FT		
13	5550.39	223.05	125.67	97.38	7015.14	0.00
14	5550.49	237.89	125.75	112.14	7036.88	0.00
15	5550.60	255.98	125.81	130.16	7058.62	0.00
16	5550.79	290.40	125.93	164.47	7097.77	0.00
17	5551.02	332.53	126.08	206.45	7145.68	0.00
18	5551.44	422.70	126.34	296.36	7232.64	0.00
19	5551.97	551.57	126.67	424.90	7341.44	0.00
20	5552.50	697.75	126.99	570.75	7450.25	0.00

 ****

SUMMARY OF AUXILIARY SPILLWAY SURFACE CONDITIONS USED IN COMPUTATIONS BY REACH

REACH	FROM STA (ft)	TO STA (ft)	SLOPE (%)	RETARDANCE CURVE INDEX	VEGETAL COVER FACTOR	MAINT. CODE +	ROOTING DEPTH (ft)	REACH LOCATION *
1	0.	75.	-25.6	1.000	**	**	**	INLET
2	75.	155.	0.0	1.000	**	**	**	CREST
3	155.	237.	38.5	1.000	0.00	1		EXIT !
4	237.	600.	9.9	1.000	0.00	1		EXIT
5	600.	1049.	6.3	1.000	0.00	1		EXIT
6	1049.	1170.	15.1	1.000	0.00	1		EXIT

 + The minimum maintenance code value of 2 is used in INTEGRITY computations
     (the program changes values of 1 to 2 during computation).
 * Upper case indicates a reach of constructed spillway channel.
** The program does not use vegetal cover factor, maintenance code, and
     rooting depth for inlet and crest reaches in computations.
 ! Reach   3 used in computing exit channel velocities.
 ****

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-SDH	30.0	5548.67	6675.5	0.0	0.16	31.0

	PEAK - CFS	Q-PS	Q-AUX.	Q-TOT.
	DISCHARGE =	65.7	0.2	65.9

	CRITICAL DEPTH	CRITICAL VELOCITY	CRITICAL SLOPE-Sc	25% OF Q Sc
AUXILIARY SPILLWAY ---	FT 0.01	FT/SEC 0.57	FT/FT 0.148	FT/FT 0.308

AUXILIARY SPILLWAY DURATION FLOW = 8.7 HOURS

PLOT NRCS-SDH 1 IN = 500. CFS EXIT SLOPE = 0.385

Time	Qin	Qout	Elev	Vol	Area	ExtVel	0. 500. 1000. 1500. 2000. 2500. 3000. 3500.
1.50	0	8	5546.3	6203.0	0.0	0.00	.
1.80	6	8	5546.3	6203.0	0.0	0.00	.
2.10	39	8	5546.3	6203.4	0.0	0.00	.I
2.40	194	8	5546.3	6206.1	0.0	0.00	. I
2.70	687	9	5546.3	6216.8	0.0	0.00	. I
3.00	1365	11	5546.5	6242.0	0.0	0.00	. I
3.30	2027	15	5546.7	6283.7	0.0	0.00	. I
3.60	2180	20	5546.9	6335.4	0.0	0.00	. X
3.90	1955	26	5547.2	6386.1	0.0	0.00	.P I
4.20	1683	31	5547.4	6430.5	0.0	0.00	.P I
4.50	1441	36	5547.6	6468.4	0.0	0.00	.P I
4.80	1248	40	5547.8	6500.8	0.0	0.00	.P I
5.10	1107	44	5547.9	6528.9	0.0	0.00	.P I
5.40	1001	47	5548.1	6553.9	0.0	0.00	.P I
5.70	924	51	5548.2	6576.6	0.0	0.00	.P I
6.00	874	54	5548.3	6597.6	0.0	0.00	.P I
6.30	833	57	5548.4	6617.4	0.0	0.00	.P I
6.60	748	60	5548.5	6635.5	0.0	0.00	.P I
6.90	589	62	5548.5	6650.6	0.0	0.00	.A I
7.20	423	64	5548.6	6661.6	0.0	0.00	.A I
7.50	283	65	5548.6	6668.8	0.0	0.00	.A I
7.80	180	65	5548.7	6672.9	0.0	0.00	.A I
8.10	112	66	5548.7	6674.9	0.0	0.00	.AI

8.40	73	66	5548.7	6675.5	0.0	0.00	.X
8.70	47	66	5548.7	6675.4	0.0	0.00	.A
9.00	28	66	5548.7	6674.7	0.0	0.00	.A
9.30	16	66	5548.7	6673.6	0.0	0.00	.A
9.60	9	65	5548.7	6672.3	0.0	0.00	.A
9.90	5	65	5548.6	6670.8	0.0	0.00	.A
10.20	3	65	5548.6	6669.3	0.0	0.00	.A
10.50	1	65	5548.6	6667.8	0.0	0.00	.A
10.80	1	64	5548.6	6666.2	0.0	0.00	.A
11.10	0	64	5548.6	6664.6	0.0	0.00	.A
11.40	0	64	5548.6	6663.1	0.0	0.00	.A
11.70	0	64	5548.6	6661.5	0.0	0.00	.A
12.00	0	63	5548.6	6660.0	0.0	0.00	.A
12.30	0	63	5548.6	6658.4	0.0	0.00	.A
12.60	0	63	5548.6	6656.9	0.0	0.00	.A
12.90	0	63	5548.6	6655.4	0.0	0.00	.A
13.20	0	62	5548.6	6653.8	0.0	0.00	.A
13.50	0	62	5548.6	6652.3	0.0	0.00	.A
13.80	0	62	5548.5	6650.8	0.0	0.00	.A
14.10	0	62	5548.5	6649.3	0.0	0.00	.A
14.40	0	61	5548.5	6647.8	0.0	0.00	.A
14.70	0	61	5548.5	6646.3	0.0	0.00	.A
15.00	0	61	5548.5	6644.8	0.0	0.00	.A
15.30	0	61	5548.5	6643.3	0.0	0.00	.P
15.60	0	60	5548.5	6641.9	0.0	0.00	.P
15.90	0	60	5548.5	6640.4	0.0	0.00	.P
16.20	0	60	5548.5	6638.9	0.0	0.00	.P
16.50	0	60	5548.5	6637.5	0.0	0.00	.P
16.80	0	60	5548.5	6636.0	0.0	0.00	.P
17.10	0	59	5548.5	6634.5	0.0	0.00	.P
17.40	0	59	5548.5	6633.1	0.0	0.00	.P
17.70	0	59	5548.4	6631.7	0.0	0.00	.P
18.00	0	59	5548.4	6630.2	0.0	0.00	.P
18.30	0	58	5548.4	6628.8	0.0	0.00	.P
18.60	0	58	5548.4	6627.4	0.0	0.00	.P
18.90	0	58	5548.4	6626.0	0.0	0.00	.P
19.20	0	58	5548.4	6624.6	0.0	0.00	.P
19.50	0	58	5548.4	6623.1	0.0	0.00	.P
19.80	0	57	5548.4	6621.7	0.0	0.00	.P
20.10	0	57	5548.4	6620.3	0.0	0.00	.P
20.40	0	57	5548.4	6619.0	0.0	0.00	.P
20.70	0	57	5548.4	6617.6	0.0	0.00	.P
21.00	0	57	5548.4	6616.2	0.0	0.00	.P
21.30	0	56	5548.4	6614.8	0.0	0.00	.P
21.60	0	56	5548.4	6613.4	0.0	0.00	.P
21.90	0	56	5548.3	6612.1	0.0	0.00	.P
22.20	0	56	5548.3	6610.7	0.0	0.00	.P
22.50	0	56	5548.3	6609.4	0.0	0.00	.P
22.80	0	55	5548.3	6608.0	0.0	0.00	.P
23.10	0	55	5548.3	6606.7	0.0	0.00	.P
23.40	0	55	5548.3	6605.3	0.0	0.00	.P
23.70	0	55	5548.3	6604.0	0.0	0.00	.P
24.00	0	55	5548.3	6602.7	0.0	0.00	.P
24.30	0	54	5548.3	6601.3	0.0	0.00	.P
24.60	0	54	5548.3	6600.0	0.0	0.00	.P
24.90	0	54	5548.3	6598.7	0.0	0.00	.P
25.20	0	54	5548.3	6597.4	0.0	0.00	.P
25.50	0	54	5548.3	6596.1	0.0	0.00	.P
25.80	0	53	5548.3	6594.8	0.0	0.00	.P
26.10	0	53	5548.3	6593.5	0.0	0.00	.P
26.40	0	53	5548.2	6592.2	0.0	0.00	.P
26.70	0	53	5548.2	6590.9	0.0	0.00	.P
27.00	0	53	5548.2	6589.6	0.0	0.00	.P
27.30	0	52	5548.2	6588.4	0.0	0.00	.P
27.60	0	52	5548.2	6587.1	0.0	0.00	.P
27.90	0	52	5548.2	6585.8	0.0	0.00	.P
28.20	0	52	5548.2	6584.5	0.0	0.00	.P
28.50	0	52	5548.2	6583.3	0.0	0.00	.P
28.80	0	51	5548.2	6582.0	0.0	0.00	.P
29.10	0	51	5548.2	6580.8	0.0	0.00	.P
29.40	0	51	5548.2	6579.5	0.0	0.00	.P
29.70	0	51	5548.2	6578.3	0.0	0.00	.P
30.00	0	51	5548.2	6577.1	0.0	0.00	.P
30.30	0	51	5548.2	6575.8	0.0	0.00	.P
30.60	0	50	5548.2	6574.6	0.0	0.00	.P
30.90	0	50	5548.2	6573.4	0.0	0.00	.P
31.20	0	50	5548.1	6572.2	0.0	0.00	.P
31.50	0	50	5548.1	6571.0	0.0	0.00	.P
31.80	0	50	5548.1	6569.8	0.0	0.00	.P
32.10	0	50	5548.1	6568.5	0.0	0.00	.P
32.40	0	49	5548.1	6567.3	0.0	0.00	.P
32.70	0	49	5548.1	6566.1	0.0	0.00	.P
33.00	0	49	5548.1	6565.0	0.0	0.00	.P
33.30	0	49	5548.1	6563.8	0.0	0.00	.P
33.60	0	49	5548.1	6562.6	0.0	0.00	.P
33.90	0	49	5548.1	6561.4	0.0	0.00	.P
34.20	0	48	5548.1	6560.2	0.0	0.00	.P
34.50	0	48	5548.1	6559.1	0.0	0.00	.P
34.80	0	48	5548.1	6557.9	0.0	0.00	.P
35.10	0	48	5548.1	6556.7	0.0	0.00	.P
35.40	0	48	5548.1	6555.6	0.0	0.00	.P
35.70	0	48	5548.1	6554.4	0.0	0.00	.P

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36.00     0    47 5548.0  6553.3   0.0   0.00   .P
36.30     0    47 5548.0  6552.1   0.0   0.00   .P
36.60     0    47 5548.0  6551.0   0.0   0.00   .P
36.90     0    47 5548.0  6549.8   0.0   0.00   .P
37.20     0    47 5548.0  6548.7   0.0   0.00   .P
37.50     0    47 5548.0  6547.6   0.0   0.00   .P
37.80     0    46 5548.0  6546.4   0.0   0.00   .P
38.10     0    46 5548.0  6545.3   0.0   0.00   .P
38.40     0    46 5548.0  6544.2   0.0   0.00   .P
38.70     0    46 5548.0  6543.1   0.0   0.00   .P
39.00     0    46 5548.0  6542.0   0.0   0.00   .P
39.30     0    46 5548.0  6540.9   0.0   0.00   .P
39.60     0    45 5548.0  6539.8   0.0   0.00   .P
39.90     0    45 5548.0  6538.7   0.0   0.00   .P
40.20     0    45 5548.0  6537.6   0.0   0.00   .P
40.50     0    45 5548.0  6536.5   0.0   0.00   .P
40.80     0    45 5548.0  6535.4   0.0   0.00   .P
41.10     0    45 5548.0  6534.3   0.0   0.00   .P
41.40     0    45 5547.9  6533.2   0.0   0.00   .P
41.70     0    44 5547.9  6532.1   0.0   0.00   .P
42.00     0    44 5547.9  6531.1   0.0   0.00   .P
42.30     0    44 5547.9  6530.0   0.0   0.00   .P
42.60     0    44 5547.9  6528.9   0.0   0.00   .P
42.90     0    44 5547.9  6527.9   0.0   0.00   .P
43.20     0    44 5547.9  6526.8   0.0   0.00   .P
43.50     0    43 5547.9  6525.7   0.0   0.00   .P
43.80     0    43 5547.9  6524.7   0.0   0.00   .P
44.10     0    43 5547.9  6523.6   0.0   0.00   .P
44.40     0    43 5547.9  6522.6   0.0   0.00   .P
44.70     0    43 5547.9  6521.6   0.0   0.00   .P
45.00     0    43 5547.9  6520.5   0.0   0.00   .P
45.30     0    43 5547.9  6519.5   0.0   0.00   .P
45.60     0    42 5547.9  6518.5   0.0   0.00   .P
45.90     0    42 5547.9  6517.4   0.0   0.00   .P
46.20     0    42 5547.9  6516.4   0.0   0.00   .P
46.50     0    42 5547.9  6515.4   0.0   0.00   .P
46.80     0    42 5547.8  6514.4   0.0   0.00   .P
47.10     0    42 5547.8  6513.4   0.0   0.00   .P
47.40     0    42 5547.8  6512.4   0.0   0.00   .P
47.70     0    41 5547.8  6511.4   0.0   0.00   .P
48.00     0    41 5547.8  6510.4   0.0   0.00   .P
48.30     0    41 5547.8  6509.4   0.0   0.00   .P
48.60     0    41 5547.8  6508.4   0.0   0.00   .P
48.90     0    41 5547.8  6507.4   0.0   0.00   .P
49.20     0    41 5547.8  6506.4   0.0   0.00   .P
49.50     0    41 5547.8  6505.4   0.0   0.00   .P
49.80     0    41 5547.8  6504.4   0.0   0.00   .P
50.10     0    40 5547.8  6503.4   0.0   0.00   .P
50.40     0    40 5547.8  6502.5   0.0   0.00   .P
50.70     0    40 5547.8  6501.5   0.0   0.00   .P
51.00     0    40 5547.8  6500.5   0.0   0.00   .P
51.30     0    40 5547.8  6499.6   0.0   0.00   .P
51.60     0    40 5547.8  6498.6   0.0   0.00   .P
51.90     0    40 5547.8  6497.6   0.0   0.00   .P
52.20     0    40 5547.8  6496.7   0.0   0.00   .P
52.50     0    39 5547.8  6495.7   0.0   0.00   .P
52.80     0    39 5547.7  6494.8   0.0   0.00   .P
53.10     0    39 5547.7  6493.8   0.0   0.00   .P
53.40     0    39 5547.7  6492.9   0.0   0.00   .P
53.70     0    39 5547.7  6491.9   0.0   0.00   .P
54.00     0    39 5547.7  6491.0   0.0   0.00   .P
54.30     0    39 5547.7  6490.1   0.0   0.00   .P
54.60     0    39 5547.7  6489.1   0.0   0.00   .P
54.90     0    38 5547.7  6488.2   0.0   0.00   .P
55.20     0    38 5547.7  6487.3   0.0   0.00   .P
55.50     0    38 5547.7  6486.4   0.0   0.00   .P
55.80     0    38 5547.7  6485.4   0.0   0.00   .P
56.10     0    38 5547.7  6484.5   0.0   0.00   .P
56.40     0    38 5547.7  6483.6   0.0   0.00   .P
56.70     0    38 5547.7  6482.7   0.0   0.00   .P
57.00     0    38 5547.7  6481.8   0.0   0.00   .P
57.30     0    37 5547.7  6480.9   0.0   0.00   .P
57.60     0    37 5547.7  6480.0   0.0   0.00   .P
57.90     0    37 5547.7  6479.1   0.0   0.00   .P
58.20     0    37 5547.7  6478.2   0.0   0.00   .P
58.50     0    37 5547.7  6477.3   0.0   0.00   .P
58.80     0    37 5547.7  6476.4   0.0   0.00   .P
59.10     0    37 5547.7  6475.5   0.0   0.00   .P
59.40     0    37 5547.6  6474.6   0.0   0.00   .P
59.70     0    37 5547.6  6473.7   0.0   0.00   .P
60.00     0    36 5547.6  6472.9   0.0   0.00   .P
60.30     0    36 5547.6  6472.0   0.0   0.00   .P
60.60     0    36 5547.6  6471.1   0.0   0.00   .P
60.90     0    36 5547.6  6470.2   0.0   0.00   .P
61.20     0    36 5547.6  6469.4   0.0   0.00   .P
61.50     0    36 5547.6  6468.5   0.0   0.00   .P
61.80     0    36 5547.6  6467.7   0.0   0.00   .P
62.10     0    36 5547.6  6466.8   0.0   0.00   .P
62.40     0    35 5547.6  6465.9   0.0   0.00   .P
62.70     0    35 5547.6  6465.1   0.0   0.00   .P
63.00     0    35 5547.6  6464.2   0.0   0.00   .P
63.30     0    35 5547.6  6463.4   0.0   0.00   .P
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63.60     0    35 5547.6  6462.5   0.0   0.00   .P
63.90     0    35 5547.6  6461.7   0.0   0.00   .P
64.20     0    35 5547.6  6460.9   0.0   0.00   .P
64.50     0    35 5547.6  6460.0   0.0   0.00   .P
64.80     0    35 5547.6  6459.2   0.0   0.00   .P
65.10     0    34 5547.6  6458.4   0.0   0.00   .P
65.40     0    34 5547.6  6457.5   0.0   0.00   .P
65.70     0    34 5547.6  6456.7   0.0   0.00   .P
66.00     0    34 5547.5  6455.9   0.0   0.00   .P
66.30     0    34 5547.5  6455.1   0.0   0.00   .P
66.60     0    34 5547.5  6454.2   0.0   0.00   .P
66.90     0    34 5547.5  6453.4   0.0   0.00   .P
67.20     0    34 5547.5  6452.6   0.0   0.00   .P
67.50     0    34 5547.5  6451.8   0.0   0.00   .P
67.80     0    34 5547.5  6451.0   0.0   0.00   .P
68.10     0    33 5547.5  6450.2   0.0   0.00   .P
68.40     0    33 5547.5  6449.4   0.0   0.00   .P
68.70     0    33 5547.5  6448.6   0.0   0.00   .P
69.00     0    33 5547.5  6447.8   0.0   0.00   .P
69.30     0    33 5547.5  6447.0   0.0   0.00   .P
69.60     0    33 5547.5  6446.2   0.0   0.00   .P
69.90     0    33 5547.5  6445.4   0.0   0.00   .P
70.20     0    33 5547.5  6444.6   0.0   0.00   .P
70.50     0    33 5547.5  6443.8   0.0   0.00   .P
70.80     0    33 5547.5  6443.1   0.0   0.00   .P
71.10     0    32 5547.5  6442.3   0.0   0.00   .P
71.40     0    32 5547.5  6441.5   0.0   0.00   .P
71.70     0    32 5547.5  6440.7   0.0   0.00   .P
72.00     0    32 5547.5  6439.9   0.0   0.00   .P
72.30     0    32 5547.5  6439.2   0.0   0.00   .P
72.60     0    32 5547.5  6438.4   0.0   0.00   .P
72.90     0    32 5547.5  6437.6   0.0   0.00   .P
73.20     0    32 5547.5  6436.9   0.0   0.00   .P
73.50     0    32 5547.4  6436.1   0.0   0.00   .P
73.80     0    32 5547.4  6435.4   0.0   0.00   .P
74.10     0    31 5547.4  6434.6   0.0   0.00   .P
74.40     0    31 5547.4  6433.8   0.0   0.00   .P
74.70     0    31 5547.4  6433.1   0.0   0.00   .P
75.00     0    31 5547.4  6432.3   0.0   0.00   .P
75.30     0    31 5547.4  6431.6   0.0   0.00   .P
75.60     0    31 5547.4  6430.8   0.0   0.00   .P
75.90     0    31 5547.4  6430.1   0.0   0.00   .P
76.20     0    31 5547.4  6429.4   0.0   0.00   .P
76.50     0    31 5547.4  6428.6   0.0   0.00   .P
76.80     0    31 5547.4  6427.9   0.0   0.00   .P
77.10     0    31 5547.4  6427.1   0.0   0.00   .P
77.40     0    31 5547.4  6426.4   0.0   0.00   .P
77.70     0    30 5547.4  6425.7   0.0   0.00   .P
78.00     0    30 5547.4  6425.0   0.0   0.00   .P
78.30     0    30 5547.4  6424.2   0.0   0.00   .P
78.60     0    30 5547.4  6423.5   0.0   0.00   .P
78.90     0    30 5547.4  6422.8   0.0   0.00   .P
79.20     0    30 5547.4  6422.1   0.0   0.00   .P
79.50     0    30 5547.4  6421.3   0.0   0.00   .P
79.80     0    30 5547.4  6420.6   0.0   0.00   .P
80.10     0    30 5547.4  6419.9   0.0   0.00   .P
80.40     0    30 5547.4  6419.2   0.0   0.00   .P
80.70     0    30 5547.4  6418.5   0.0   0.00   .P
81.00     0    29 5547.4  6417.8   0.0   0.00   .P
81.30     0    29 5547.4  6417.1   0.0   0.00   .P
81.60     0    29 5547.3  6416.4   0.0   0.00   .P
81.90     0    29 5547.3  6415.7   0.0   0.00   .P
82.20     0    29 5547.3  6415.0   0.0   0.00   .P
82.50     0    29 5547.3  6414.3   0.0   0.00   .P
82.80     0    29 5547.3  6413.6   0.0   0.00   .P
83.10     0    29 5547.3  6412.9   0.0   0.00   .P
83.40     0    29 5547.3  6412.2   0.0   0.00   .P
83.70     0    29 5547.3  6411.5   0.0   0.00   .P
84.00     0    29 5547.3  6410.8   0.0   0.00   .P
84.30     0    29 5547.3  6410.2   0.0   0.00   .P
84.60     0    28 5547.3  6409.5   0.0   0.00   .P
84.90     0    28 5547.3  6408.8   0.0   0.00   .P
85.20     0    28 5547.3  6408.1   0.0   0.00   .P
85.50     0    28 5547.3  6407.4   0.0   0.00   .P
85.80     0    28 5547.3  6406.8   0.0   0.00   .P
86.10     0    28 5547.3  6406.1   0.0   0.00   .P
86.40     0    28 5547.3  6405.4   0.0   0.00   .P
86.70     0    28 5547.3  6404.8   0.0   0.00   .P
87.00     0    28 5547.3  6404.1   0.0   0.00   .P
87.30     0    28 5547.3  6403.4   0.0   0.00   .P
87.60     0    28 5547.3  6402.8   0.0   0.00   .P
87.90     0    28 5547.3  6402.1   0.0   0.00   .P
88.20     0    27 5547.3  6401.4   0.0   0.00   .P
88.50     0    27 5547.3  6400.8   0.0   0.00   .P
88.80     0    27 5547.3  6400.1   0.0   0.00   .P
89.10     0    27 5547.3  6399.5   0.0   0.00   .P
89.40     0    27 5547.3  6398.8   0.0   0.00   .P
89.70     0    27 5547.3  6398.2   0.0   0.00   .P
90.00     0    27 5547.3  6397.5   0.0   0.00   .P
90.30     0    27 5547.2  6396.9   0.0   0.00   .P
90.60     0    27 5547.2  6396.3   0.0   0.00   .P
90.90     0    27 5547.2  6395.6   0.0   0.00   .P
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 91.20     0    27 5547.2  6395.0   0.0   0.00   .P
 91.50     0    27 5547.2  6394.3   0.0   0.00   .P
 91.80     0    27 5547.2  6393.7   0.0   0.00   .P
 92.10     0    26 5547.2  6393.1   0.0   0.00   .P
 92.40     0    26 5547.2  6392.4   0.0   0.00   .P
 92.70     0    26 5547.2  6391.8   0.0   0.00   .P
 93.00     0    26 5547.2  6391.2   0.0   0.00   .P
 93.30     0    26 5547.2  6390.6   0.0   0.00   .P
 93.60     0    26 5547.2  6389.9   0.0   0.00   .P
 93.90     0    26 5547.2  6389.3   0.0   0.00   .P
 94.20     0    26 5547.2  6388.7   0.0   0.00   .P
 94.50     0    26 5547.2  6388.1   0.0   0.00   .P
 94.80     0    26 5547.2  6387.5   0.0   0.00   .P
 95.10     0    26 5547.2  6386.9   0.0   0.00   .P
 95.40     0    26 5547.2  6386.2   0.0   0.00   .P
 95.70     0    26 5547.2  6385.6   0.0   0.00   .P
 96.00     0    26 5547.2  6385.0   0.0   0.00   .P
 96.30     0    25 5547.2  6384.4   0.0   0.00   .P
 96.60     0    25 5547.2  6383.8   0.0   0.00   .P
 96.90     0    25 5547.2  6383.2   0.0   0.00   .P
 97.20     0    25 5547.2  6382.6   0.0   0.00   .P
 Time    Qin  Qout   Elev    Vol   Area  ExtVel  I         I         I         I         I         I         I         I
                                                 0.      500.     1000.     1500.     2000.     2500.     3000.     3500.
        END NRCS-SDH   PLOT

ROUTED       BTM WIDTH  MAX ELEV   VOL-MAX  AREA-MAX   AUX.-HP   VOL-AUX.
RESULTS          FT        FT        ACFT      AC         FT       ACFT
NRCS-FBH          30.0   5552.32    7413.5       0.0      3.81     769.0

          PEAK - CFS        Q-PS     Q-AUX.    Q-TOT.
          DISCHARGE  =     126.9     521.5     648.3

                        CRITICAL  CRITICAL   CRITICAL  25% OF Q
                          DEPTH   VELOCITY   SLOPE-Sc     Sc
          AUXILIARY         FT      FT/SEC     FT/FT     FT/FT
          SPILLWAY ---     2.01      7.61     0.008     0.011

          INTEGRITY ANALYSIS - REACH SURFACE PERFORMANCE SUMMARY
           (The auxiliary spillway began flow at time =    9.6 hours
            and peaked at time =   20.4 hours.)


            REACH   3: FROM STATION    155. TO    237. ON   38.5% SLOPE.
               Non-vegetated conditions implied: flow concentration
                assumed with minimal flow: Time =   12.0 hours.


            REACH   4: FROM STATION    237. TO    600. ON    9.9% SLOPE.
               Non-vegetated conditions implied: flow concentration
                assumed with minimal flow: Time =   12.0 hours.


            REACH   5: FROM STATION    600. TO   1049. ON    6.3% SLOPE.
               Non-vegetated conditions implied: flow concentration
                assumed with minimal flow: Time =   12.0 hours.


            REACH   6: FROM STATION   1049. TO   1170. ON   15.1% SLOPE.
               Non-vegetated conditions implied: flow concentration
                assumed with minimal flow: Time =   12.0 hours.


          INTEGRITY ANALYSIS - HEADCUT EROSION DAMAGE SUMMARY

            The headcut BREACHED the spillway crest at
            time equal approximately    27.6 hours.
            Computations terminated at that point!

            The most upstream headcut began at station    237.
            and progressed upstream to station     75.
            The final height of the headcut was   36.2 ft.

            The deepest headcut is also the furthest upstream.

          THE HYDROGRAPH WAS NOT ADJUSTED FOR THE EFFECTS OF EROSION.

                          DURATION    ATTACK   DIST. FROM MOST U/S
                            FLOW       OE/B    HEADCUT TO U/S EDGE
          AUXILIARY          HRS     ACFT/FT     AUX. CREST, FT
          SPILLWAY----      74.4      27.8         >>>BREACH<<<
                                                Depth =   36.2 ft

          EXIT CHANNEL FLOW SUPERCRITICAL: MAX VELOCITY=  25.9 FT/SEC
                                           EXIT SLOPE  = 0.385 FT/FT
                                           FLOW DEPTH  =   0.6 FT

          PLOT NRCS-FBH                 1 IN =    500. CFS                                    EXIT SLOPE = 0.385
                                                 0.      500.     1000.     1500.     2000.     2500.     3000.     3500.
 Time    Qin  Qout   Elev    Vol   Area  ExtVel  I         I         I         I         I         I         I         I
  2.40     0     8 5546.3  6203.0   0.0   0.00   .
  3.60     4     8 5546.3  6203.0   0.0   0.00   .
  4.80    35     8 5546.3  6204.0   0.0   0.00   .I
```

```
  6.00    84     8 5546.3  6209.1   0.0   0.00   . I
  7.20   195     9 5546.4  6222.1   0.0   0.00   .   I
  8.40   425    12 5546.5  6251.8   0.0   0.00   .       I
  9.60  1352    20 5546.9  6338.3   0.0   0.00   .                        I
 10.80  3365    50 5548.1  6568.7   0.0   0.00   .P                                                    X
 12.00  3296   128 5549.8  6890.2   0.0   7.93   .  A                                                  I
 13.20  2008   320 5551.0  7131.1   0.0  17.72   .     A                                  I
 14.40  1331   453 5551.6  7258.3   0.0  21.69   .        A               I
 15.60  1060   535 5551.9  7327.8   0.0  23.63   .          A         I
 16.80   912   590 5552.1  7369.8   0.0  24.78   .           A     I
 18.00   792   622 5552.2  7394.2   0.0  25.43   .           A   I
 19.20   742   641 5552.3  7407.7   0.0  25.78   .            A I
 20.40   664   648 5552.3  7413.5   0.0  25.92   .            X
 21.60   624   648 5552.3  7413.1   0.0  25.91   .           IA
 22.80   613   644 5552.3  7410.3   0.0  25.85   .           IA
 24.00   611   640 5552.3  7407.4   0.0  25.77   .           IA
 25.20   547   632 5552.3  7401.7   0.0  25.62   .          I A
 26.40   262   604 5552.2  7380.5   0.0  25.07   .    I      A
 27.60    90   551 5552.0  7340.7   0.0  23.96   . I       A
 28.80    24   496 5551.7  7294.4   0.0  22.73   .        A
 30.00     5   442 5551.5  7249.3   0.0  21.41   .       A
 31.20     1   397 5551.3  7208.0   0.0  20.18   .      A
 32.40     0   358 5551.1  7170.6   0.0  19.01   .     A
 33.60     0   325 5551.0  7136.9   0.0  17.90   .     A
 34.80     0   298 5550.8  7106.1   0.0  16.91   .     A
 36.00     0   273 5550.7  7077.9   0.0  15.92   .    A
 37.20     0   251 5550.6  7052.0   0.0  14.93   .    A
 38.40     0   232 5550.5  7028.2   0.0  14.02   .    A
 39.60     0   216 5550.3  7006.1   0.0  13.26   .   A
 40.80     0   200 5550.2  6985.5   0.0  12.56   .   A
 42.00     0   186 5550.2  6966.5   0.0  11.85   .   A
 43.20     0   172 5550.1  6948.8   0.0  11.12   .  A
 44.40     0   160 5550.0  6932.4   0.0  10.38   .  A
 45.60     0   148 5549.9  6917.2   0.0   9.61   .  A
 46.80     0   138 5549.8  6903.2   0.0   8.80   .  A
 48.00     0   128 5549.8  6890.1   0.0   7.92   .  A
 49.20     0   122 5549.7  6877.8   0.0   7.54   . A
 50.40     0   118 5549.6  6866.0   0.0   7.23   . A
 51.60     0   114 5549.6  6854.6   0.0   6.89   . A
 52.80     0   110 5549.5  6843.6   0.0   6.55   . A
 54.00     0   106 5549.5  6833.1   0.0   6.18   . A
 55.20     0   102 5549.4  6822.9   0.0   5.80   . A
 56.40     0    98 5549.4  6813.1   0.0   5.38   . A
 57.60     0    95 5549.3  6803.6   0.0   4.92   . A
 58.80     0    91 5549.3  6794.5   0.0   4.40   . A
 60.00     0    88 5549.2  6785.7   0.0   3.68   . A
 61.20     0    85 5549.2  6777.2   0.0   2.77   . A
 62.40     0    82 5549.2  6769.1   0.0   1.37   . A
 63.60     0    80 5549.1  6761.2   0.0   0.00   . A
 64.80     0    79 5549.1  6753.4   0.0   0.00   . A
 66.00     0    77 5549.0  6745.8   0.0   0.00   . A
 67.20     0    76 5549.0  6738.3   0.0   0.00   . A
 68.40     0    75 5549.0  6730.9   0.0   0.00   .A
 69.60     0    74 5548.9  6723.6   0.0   0.00   .A
 70.80     0    73 5548.9  6716.5   0.0   0.00   .A
 72.00     0    71 5548.8  6709.4   0.0   0.00   .A
 73.20     0    70 5548.8  6702.5   0.0   0.00   .A
 74.40     0    69 5548.8  6695.7   0.0   0.00   .A
 75.60     0    68 5548.7  6689.0   0.0   0.00   .A
 76.80     0    67 5548.7  6682.4   0.0   0.00   .A
 78.00     0    66 5548.7  6675.9   0.0   0.00   .A
 79.20     0    65 5548.6  6669.5   0.0   0.00   .A
 80.40     0    64 5548.6  6663.2   0.0   0.00   .A
 Time    Qin  Qout   Elev    Vol   Area  ExtVel  I         I         I         I         I         I         I         I
                                                 0.      500.     1000.     1500.     2000.     2500.     3000.     3500.
        END NRCS-FBH   PLOT
 ------------------------------------------------------------------------------

 Inflow Hyd 1 PSH-Peak =         39.99 CFS  at  143.00 hrs.,  Location Point

 Inflow Hyd 1 SDH-Peak =         65.90 CFS  at    8.10 hrs.,  Location Point

 Inflow Hyd 1 FBH-Peak =        648.34 CFS  at   19.20 hrs.,  Location Point
HYDOUT   1     STR1

1SITES....JOB NO.  1 COMPLETE.
 ------------------------------------------------------------------------------

 COVRES        COV RES

       0 SUBWATERSHED(S) ANALYZED.

       1 STRUCTURE(S) ANALYZED.

       3 HYDROGRAPHS ROUTED AT LOWEST SITE.

       0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

 ******************************************************************************
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 SITES.....COMPUTATIONS COMPLETE


                              SUMMARY TABLE  1          SITES VERSION 2005.1.8
                             ----------------                 DATED 01/01/2005


 WATERSHED ID                       RUN DATE                           RUN TIME
 ------------                       --------                           --------
 COVRES                            08/20/2020                          06:12:11

 >>>   SITE    SUBWS    SUBWS DA   CURVE     TC   TOTAL DA   TYPE     STRUC    <<<
         ID      ID      (SQ MI)    NO.     (HRS)  (SQ MI)  DESIGN   CLASS
       -----   ----   ---------   -----   ----   --------   -----   -----
       STR1     CR         4.74      0.   0.00       4.74    TR60     C

 PASS  DIA./  AUX.CREST  BTM.  MAX.     MAX.     EMB.  INTEGR.*  EXIT*     TYPE
  NO.  WIDTH     ELEV    WIDTH   HP      ELEV     VOL.   DIST.     VEL.      HYD
      (IN/FT)   (FT)     (FT)  (FT)     (FT)     (CY)   (FT)   (FT/SEC)
 ----  -----  --------  ------  ----  --------  --------  -----  ------  ----------
    1   30.0   5548.5    30.0   3.8   5552.3       0.<BREACH>   25.9  NRCS-FBH


 *  INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED
    HYDROGRAPH SHOWN UNDER TYPE HYD.



 SITES.......SUMMARY TABLE 1 COMPLETED.


                    NRCS  SITES    VERSION 2005.1.8  ,01/01/2005
                             COVRES   FILES

INPUT  = c:\USDA\SITES\080620-PSH-ASHL-FBHG.d2c
OUTPUT = c:\USDA\SITES\080620-PSH-ASHL-FBHG.OUT
         DATED 08/20/2020 06:12:11

                          GRAPHICS FILES GENERATED

OPTION "L"  = c:\USDA\SITES\080620-PSH-ASHL-FBHG.DRG DATED 08/20/2020 06:12:11

OPTION "P"  = c:\USDA\SITES\080620-PSH-ASHL-FBHG.DHY DATED 08/20/2020 06:12:11

OPTION "E"  = c:\USDA\SITES\080620-PSH-ASHL-FBHG.DEM DATED 08/20/2020 06:12:11

AUX.GRAPHICS = c:\USDA\SITES\080620-PSH-ASHL-FBHG.DG* DATED 08/20/2020 06:12:11
```

```
********************************************************************************
SITES XEQ 08/20/2020   WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
     VER 2005.1.8              (USER MANUAL - DATED DECEMBER 2005)
     TIME 06:12:11

************************ 80-80 LIST OF INPUT Data **************************

SITES     01/01/2005COVRES    COV RES                       4.74      C3
SAVMOV    0    101
SAVMOV    101  1                                                      1
STRUCTURE STR1      Cove Res
                    5470                                    0.18
                    5480                                    62.26
                    5490                                    303.40
                    5500                                    738.03
                    5510                                    1400.09
                    5520                                    2323.02
                    5530                                    3541.97
                    5540                                    5073.81
                    5545.5                                  6055.03
                    5550                                    6934.92
                    5552                                    7347.18
                    5552.5                                  7450.25
ENDTABLE
HYD       1                 Principal Spillway
                    1
                    0         11        14        15        15
                    15        15        15        15        15
                    15        16        16        16        16
                    16        16        16        16        16
                    16        17        17        17        17
                    17        17        17        17        17
                    17        18        18        18        18
                    18        18        18        18        19
                    19        19        19        19        19
                    20        20        20        20        20
                    20        21        21        21        21
                    21        21        22        22        22
                    22        23        23        23        23
                    24        24        24        24        25
                    25        25        26        26        26
                    27        27        27        28        28
                    29        29        29        30        30
                    31        31        32        33        33
                    34        35        35        36        37
                    38        39        40        41        42
                    43        45        46        48        49
                    51        53        56        58        61
                    65        69        74        80        87
                    96        109       127       157       219
                    850       479       259       172       132
                    111       98        88        81        75
                    70        65        62        59        56
                    54        51        50        48        46
                    45        43        42        41        40
                    39        38        37        36        35
                    35        34        33        33        32
                    32        31        30        30        29
                    29        29        28        28        27
                    27        27        26        26        26
                    25        25        25        24        24
                    24        24        23        23        23
                    23        22        22        22        22
                    22        21        21        21        21
                    21        20        20        20        20
                    20        20        19        19        19
                    19        19        19        19        18
                    18        18        18        18        18
                    18        17        17        17        17
                    17        17        17        17        17
                    17        16        16        16        16
                    16        16        16        16        16
                    16        15        15        15        15
                    15        15        15        15        15
                    15        4         1
ENDTABLE
HYD       3                 Auxiliary Spillway (Local)
                    0.3
                    0         0         0         0         0
                    6         39        194       687       1365
                    2027      2180      1955      1683      1441
                    1248      1107      1001      924       874
                    833       748       589       423       283
                    180       112       73        47        28
                    16        9         5         3         1
                    1         0
ENDTABLE
HYD       5                 Freeboard (Local)
                    0.3
                    0         0         0         8         43
                    129       306       824       2325      4867
                    6395      6123      5053      4063      3364
```

```
                    2855      2500      2228      2039      1913
                    1819      1614      1240      851       540
                    332       201       113       62        34
                    18        9         5         2         1
                    0
 ENDTABLE
 WSDATA    2C CR               4.74
 PDIRECT                                 9.40      16.00
 POOLDATA  ELEV                5545.5              5552      5435      SC
 PSINLET             1         3.75
 PSDATA    1         1000      30                  0.012     5450
 ASSPRFL   41
           0         5530      75        5549.2    155       5549.2
           237       5517.6    600       5481.7    1049      5453.3
           1170      5435
 ENDTABLE
 ASSURFACE 41        1170      1
           0         1170      1         0         1
 ENDTABLE
 ASDATA    41                            2                               1
 BTMWIDTH  FEET      30
 ASMATERIAL
           1         50        1         75        115       .2
 ENDTABLE
 ASCOORD    1        W.Shale   N
           0         5530      75        5550      125       5565
           200       5552      250       5520      600       5485
           1050      5460      1150      5435      1300      5432.4
 ENDTABLE
 GRAPHICS  I
 GO,DESIGN LCP       TYPE2     24
 SAVMOV    2    101  1                   STR1
 ENDJOB

 ********************************************************************************

 ***** MESSAGE - DEFAULT TOPSOIL FILL MATERIAL PARAMETERS USED.

 ***** MESSAGE - AUXILIARY SPILLWAY CREST ELEVATION IS SET TO  5549.20
                FROM THE ASSPRFL RECORDS.

 ***** MESSAGE - ASSURFACE REACH  1: ZERO ROOTING DEPTH IS DEFAULTED TO 0.5 FT.


1SITES ----------------------------------------------------------------------
 XEQ 08/20/2020                    COV RES                       WSID= COVRES
 VER 2005.1.8                        Cove Res                      SUBW= CR
 TIME 06:12:11            SITE = STR1              PASS=    1     PART=   1


 **********************    MATERIAL PROPERTIES    ***************************
                            DRY                  PERCENT       DETACH.      REP.
      MATERIAL       PI   DENSITY        Kh        CLAY         RATE      DIAMETER
                          lbs/CuFt                          (Ft/H)/(lb/SqFt)  inches
     W.Shale        50.      115.      0.20        75.0          --        1.00000
     TS_FILL         0.      100.      0.05         0.0          --        0.05000
     GEN_FILL       50.      115.      0.20        75.0          --        1.00000

 ***************************    BASIC Data    ********************************
 HUMID- SUBHUMID CLIMATE AREA                    DESIGN CLASS  C

 INFLOW HYDROGRAPH(S) ENTERED

 PRECIP. - Q-PS,1-DAY    Q-PS,10-DAY       P-SD          P-FB
               0.00          0.00          9.40         16.00

 WSDATA -       CN          DA-SM          TC/L           -/H          QRF
               0.00          4.74          0.00          0.00         0.00

 SITEDATA- PERM POOL     CREST PS        FP SED        VALLEY FL         378?
               0.00       5545.50          0.00        5435.00           NO

           BASEFLOW      INITIAL EL     EXTRA VOL      SITE TYPE
               0.00          0.00          0.00         DESIGN

 PSDATA -  NO. COND        COND L         DIA/W           -/H
               1.00       1000.00         30.00          0.00

              PS N            KE         WEIR L         TW EL
             0.012          1.00          3.75        5450.00

            2ND STG         ORF H          ORF L      START AUX.
               0.00          0.00          0.00          0.00

 ASCRESTS -   AUX.1         AUX.2         AUX.3         AUX.4         AUX.5
             5549.20          0.00          0.00          0.00         0.00

 AUX.Data -  REF.NO.    RETARD. Ci   TIE STATION    INLET LENGTH
                41          0.00        155.00             0

 AUX.Data - INLET Ci    SIDE SLOPE       EXIT Ci     EXIT SLOPE     ACTUAL AUX?
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```
             1.000          2.00         1.000          0.385            NO

 BTM WIDTH -    BW1           BW2           BW3           BW4           BW5
   ft         30.00          0.00          0.00          0.00          0.00

 AUXILIARY SPILLWAY RATING DEVELOPED USING WSPVRT.

1*********************     DETAILED LIST OF BASIC Data     **********************
 WEIR COEF. FOR ORIFICES.......... 3.10    RATIO OF Ia TO S (CH.10,NEH4). 0.20
 WEIR COEF. FOR DROP INLET........ 3.10    TIME INCS TO PEAK OF UNIT HYD.  10.
 DISCHARGE COEF. FOR ORIFICES..... 0.60    NO. POINTS FOR DESIGN HYD. ... 5000

 HOOD, WEIR INLET COEF. .......... 0.60    DRAWDOWN TIME LIMIT - DAYS.... 10.0
 HOOD, PIPE ENTRANCE COEF. ....... 0.60    DRAWDOWN RATIO STORAGE LIMIT.. 0.15
 HOOD, SLUG FLOW COEF. ........... 0.00    OTHER DRAWDOWN RATIOS APPLY ?.   NO

 PS ACCURACY OF FULL FLOW CALC.,FT 0.01    WSP ALLOWABLE FSS VEL. CHANGE. 0.05
 FILLET SIZE FOR BOX CONDUITS..... 6.00    WSP FSS CALC. PRECISION, FT.. 0.005

 GRAVITATIONAL CONSTANT.......... 32.16    AUX. SPILLWAY MIN. CAP. COEF. 237.0
 MIN. NHCP378 PS PIPE AREA SQFT.. 0.545    AUX. SPILLWAY MIN. CAP. EXP.  0.493

 MIN. TR60 DEPTH AUX. TO TOP DAM.. 3.00    MIN. AUX. BW IN BW SOLUTION,FT 20.0
 MIN. NHCP378 DEPTH AUX.TO TOP DAM 2.00    PRECISION OF BW SOLUTION......  1.0
 MIN. NHCP378 DEPTH PS - AUX.CREST 1.00    OLD TR60 CRITERIA USED .......   NO
 MIN. NHCP378 DEPTH DESIGN Q - TOD 1.00    OLD NHCP378 CRITERIA USED ....   NO

 EMBANKMENT TEMPLATE:  TOP WIDTH = (calc.),  MAX. CROWN = 0.667 ft,
 SIDE SLOPE   WAVE BERM   MULTIPLE STABILITY BERMS    SEPARATE STABILITY BERMS
    RATIOS      WIDTH      U&D/S WIDTHS   DELTA H     WIDTHS, ft   HEIGHTS, ft
   U/S  D/S       ft             ft          ft       U/S   D/S    U/S   D/S
  2.50 2.50      10.0            0.0        0.00       0.00  0.00   0.00  0.00


 DIMENSIONLESS UNIT HYDROGRAPH
 STANDARD DIMENSIONLESS UNIT HYDROGRAPH
 PEAK FACTOR = 484.0 | TIME INC. =0.020 | NO. INC. TO PEAK =  10.
 VOLUME FACTOR =  48.3429

      0.0000     0.0300     0.1000     0.1900     0.3100
      0.4700     0.6600     0.8200     0.9300     0.9900
      1.0000     0.9900     0.9300     0.8600     0.7800
      0.6800     0.5600     0.4600     0.3900     0.3300
      0.2800     0.2410     0.2070     0.1740     0.1470
      0.1260     0.1070     0.0910     0.0770     0.0660
      0.0550     0.0470     0.0400     0.0340     0.0290
      0.0250     0.0210     0.0180     0.0150     0.0130
      0.0110     0.0090     0.0080     0.0070     0.0060
      0.0050     0.0040     0.0030     0.0020     0.0010
      0.0000

 EXISTING NATURAL SURFACE AT AUXILIARY SPILLWAY SITE - X,Y COORDINATES:

               0.     5530.00
              75.     5550.00
             125.     5565.00
             200.     5552.00
             250.     5520.00
             600.     5485.00
            1050.     5460.00
            1150.     5435.00


1NRCS DESIGN STORM RAINFALL DISTRIBUTION  (CHAPTER 21, NEH4 & TR-60).

       0.000      0.008      0.016      0.025      0.033
       0.043      0.052      0.063      0.074      0.086
       0.099      0.112      0.126      0.142      0.160
       0.180      0.205      0.255      0.345      0.437
       0.530      0.603      0.633      0.660      0.684
       0.705      0.724      0.742      0.759      0.775
       0.790      0.804      0.818      0.831      0.844
       0.856      0.868      0.879      0.890      0.900
       0.910      0.920      0.930      0.939      0.948
       0.957      0.966      0.975      0.983      0.992
       1.000


 24 HOUR TYPE II RAINFALL DISTRIBUTION
 IDENTIFICATION NAME IS TYPE2  GIVEN DURATION =  24.0 HRS

       0.000      0.001      0.002      0.003      0.004
       0.005      0.006      0.007      0.008      0.009
       0.010      0.012      0.013      0.014      0.015
       0.016      0.017      0.018      0.020      0.021
       0.022      0.023      0.024      0.026      0.027
       0.028      0.029      0.031      0.032      0.033
       0.034      0.036      0.037      0.038      0.040
       0.041      0.042      0.044      0.045      0.047
       0.048      0.049      0.051      0.052      0.054
       0.055      0.057      0.058      0.060      0.061
       0.063      0.065      0.066      0.068      0.070
```

```
      0.071     0.073     0.075     0.076     0.078
      0.080     0.082     0.084     0.085     0.087
      0.089     0.091     0.093     0.095     0.097
      0.099     0.101     0.103     0.105     0.107
      0.109     0.111     0.113     0.116     0.118
      0.120     0.122     0.125     0.127     0.130
      0.132     0.135     0.138     0.141     0.144
      0.147     0.150     0.153     0.157     0.160
      0.163     0.166     0.170     0.173     0.177
      0.181     0.185     0.189     0.194     0.199
      0.204     0.209     0.215     0.221     0.228
      0.235     0.243     0.251     0.261     0.271
      0.283     0.307     0.354     0.431     0.568
      0.663     0.682     0.699     0.713     0.725
      0.735     0.743     0.751     0.759     0.766
      0.772     0.778     0.784     0.789     0.794
      0.799     0.804     0.808     0.812     0.816
      0.820     0.824     0.827     0.831     0.834
      0.838     0.841     0.844     0.847     0.850
      0.854     0.856     0.859     0.862     0.865
      0.868     0.870     0.873     0.875     0.878
      0.880     0.882     0.885     0.887     0.889
      0.891     0.893     0.895     0.898     0.900
      0.902     0.904     0.906     0.908     0.910
      0.912     0.914     0.915     0.917     0.919
      0.921     0.923     0.925     0.926     0.928
      0.930     0.931     0.933     0.935     0.936
      0.938     0.939     0.941     0.942     0.944
      0.945     0.947     0.948     0.949     0.951
      0.952     0.953     0.955     0.956     0.957
      0.958     0.960     0.961     0.962     0.964
      0.965     0.966     0.967     0.968     0.970
      0.971     0.972     0.973     0.975     0.976
      0.977     0.978     0.979     0.981     0.982
      0.983     0.984     0.985     0.986     0.988
      0.989     0.990     0.991     0.992     0.993
      0.994     0.996     0.997     0.998     0.999
      1.000


1SITES ------------------------------------------------------------------------
 XEQ 08/20/2020                    COV RES                       WSID= COVRES
 VER 2005.1.8                        Cove Res                      SUBW= CR
 TIME 06:12:11           SITE = STR1             PASS=    1     PART=   2

MESSAGE ---- Climatic Index changed from 0.0 to 1.0 for this run.

 CREST PS       5545.50 FT    6055.0 ACFT      0.00 AC     126.3 CFS

 SED ACCUM      5545.50 FT    6055.0 ACFT      0.00 AC     126.3 CFS

 START ELEV     5545.50 FT    6055.0 ACFT      0.00 AC       0.0 CFS

 INFLOW HYDROGRAPH PROVIDED IN LOCATION  1,  PEAK=    850.00 CFS, AT 120.00 HRS.
 TITLE = Principal Spillway


 CREST PS       5545.50 FT    6055.0 ACFT      0.00 AC     126.3 CFS

 SED ACCUM      5545.50 FT    6055.0 ACFT      0.00 AC     126.3 CFS

 START ELEV     5545.50 FT    6055.0 ACFT      0.00 AC       0.0 CFS


 NRCS-PSH  RAINFALL   1-DAY =   0.00 IN    10-DAY =   0.00 IN    DA =   4.74 SM
           RUNOFF     1-DAY =   0.00 IN    10-DAY =   0.00 IN

      CLIMATIC INDEX = 1.00    CN 10-DAY =  0.    CN 1-DAY =   0.

      PEAK =       850.0 CFS, AT  120.0 HRS.


 ROUTED RESULT - HYD TYPE      EMAX         VOL-MAX        AMAX         QMAX
                 NRCS-PSH   5547.76 FT    6496.1 ACFT      0.00 AC     40.0 CFS

      PS STORAGE     441.0 ACFT,  BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

 DRAWDOWN (DDT) TEST       5545.84 FT    6121.2 ACFT      4.35 CFS
      CONTROL IS 0.150 DETENTION STORAGE

      TIME LIMIT REACHED = 10.00 DAYS. FLOW WAS     9.73 CFS,  ELEV =  5546.26
      (ELEVATION TO START ROUTING SDH AND/OR FBH HAS BEEN RAISED.)

      TIME TO DDT TEST DISCHARGE IS 15.79 DAYS - DRAWDOWN STOPPED.

 ***** NOTE - CREST OF AUX. RAISED TO HOLD   148.03 ACFT NOT EVACUATED IN
             DRAWDOWN TIME LIMIT.  TOTAL STORAGE REQUIRED =  6644.08 ACFT,
             NEW ELEVATION OF AUXILIARY SPILLWAY CREST    =  5548.51 FT.

 PLOT OF PRINCIPAL SPILLWAY HYDROGRAPH,  1 INCH=     200. CFS
                                              0.      200.      400.      600.      800.     1000.     1200.     1400.
  Time    Qin  Qout   Elev    Vol   Area  ExtVel  I         I         I         I         I         I         I         I
```

0.00	0.0	0.0	5545.5	6055.5	0.0	.
1.00	11.0	0.0	5545.5	6055.5	0.0	.I
2.00	14.0	0.1	5545.5	6056.5	0.0	.I
3.00	15.0	0.2	5545.5	6057.7	0.0	.I
4.00	15.0	0.3	5545.5	6058.9	0.0	.I
5.00	15.0	0.3	5545.5	6060.1	0.0	.I
6.00	15.0	0.4	5545.5	6061.3	0.0	.I
7.00	15.0	0.5	5545.5	6062.5	0.0	.I
8.00	15.0	0.6	5545.5	6063.7	0.0	.I
9.00	15.0	0.7	5545.6	6064.9	0.0	.I
10.00	15.0	0.7	5545.6	6066.1	0.0	.I
11.00	16.0	0.8	5545.6	6067.3	0.0	.I
12.00	16.0	0.9	5545.6	6068.6	0.0	.I
13.00	16.0	1.0	5545.6	6069.8	0.0	.I
14.00	16.0	1.1	5545.6	6071.1	0.0	.I
15.00	16.0	1.1	5545.6	6072.3	0.0	.I
16.00	16.0	1.2	5545.6	6073.5	0.0	.I
17.00	16.0	1.3	5545.6	6074.7	0.0	.I
18.00	16.0	1.4	5545.6	6076.0	0.0	.I
19.00	16.0	1.5	5545.6	6077.2	0.0	.I
20.00	16.0	1.5	5545.6	6078.4	0.0	.I
21.00	17.0	1.6	5545.6	6079.6	0.0	.I
22.00	17.0	1.7	5545.6	6080.9	0.0	.I
23.00	17.0	1.8	5545.6	6082.1	0.0	.I
24.00	17.0	1.9	5545.6	6083.4	0.0	.I
25.00	17.0	1.9	5545.7	6084.6	0.0	.I
26.00	17.0	2.0	5545.7	6085.9	0.0	.I
27.00	17.0	2.1	5545.7	6087.1	0.0	.I
28.00	17.0	2.2	5545.7	6088.3	0.0	.I
29.00	17.0	2.3	5545.7	6089.5	0.0	.I
30.00	17.0	2.3	5545.7	6090.8	0.0	.I
31.00	18.0	2.4	5545.7	6092.0	0.0	.I
32.00	18.0	2.5	5545.7	6093.3	0.0	.I
33.00	18.0	2.6	5545.7	6094.6	0.0	.I
34.00	18.0	2.7	5545.7	6095.8	0.0	.I
35.00	18.0	2.8	5545.7	6097.1	0.0	.I
36.00	18.0	2.8	5545.7	6098.4	0.0	.I
37.00	18.0	2.9	5545.7	6099.6	0.0	.I
38.00	18.0	3.0	5545.7	6100.8	0.0	.I
39.00	19.0	3.1	5545.7	6102.1	0.0	.I
40.00	19.0	3.2	5545.7	6103.4	0.0	.I
41.00	19.0	3.3	5545.8	6104.7	0.0	.I
42.00	19.0	3.4	5545.8	6106.0	0.0	.I
43.00	19.0	3.4	5545.8	6107.3	0.0	.I
44.00	19.0	3.5	5545.8	6108.6	0.0	.I
45.00	20.0	3.6	5545.8	6109.9	0.0	.I
46.00	20.0	3.7	5545.8	6111.3	0.0	.I
47.00	20.0	3.8	5545.8	6112.6	0.0	.I
48.00	20.0	3.9	5545.8	6114.0	0.0	.I
49.00	20.0	4.0	5545.8	6115.3	0.0	.I
50.00	20.0	4.0	5545.8	6116.6	0.0	.I
51.00	21.0	4.1	5545.8	6118.0	0.0	.I
52.00	21.0	4.2	5545.8	6119.4	0.0	.I
53.00	21.0	4.3	5545.8	6120.7	0.0	.I
54.00	21.0	4.4	5545.8	6122.1	0.0	.I
55.00	21.0	4.5	5545.9	6123.5	0.0	.I
56.00	21.0	4.6	5545.9	6124.8	0.0	.I
57.00	22.0	4.7	5545.9	6126.2	0.0	.I
58.00	22.0	4.8	5545.9	6127.7	0.0	.I
59.00	22.0	4.9	5545.9	6129.1	0.0	.I
60.00	22.0	5.0	5545.9	6130.5	0.0	.I
61.00	23.0	5.1	5545.9	6131.9	0.0	.I
62.00	23.0	5.2	5545.9	6133.4	0.0	.I
63.00	23.0	5.2	5545.9	6134.9	0.0	.I
64.00	23.0	5.3	5545.9	6136.4	0.0	.I
65.00	24.0	5.4	5545.9	6137.8	0.0	.I
66.00	24.0	5.5	5545.9	6139.4	0.0	.I
67.00	24.0	5.6	5545.9	6140.9	0.0	.I
68.00	24.0	5.7	5545.9	6142.4	0.0	.I
69.00	25.0	5.8	5546.0	6144.0	0.0	.I
70.00	25.0	5.9	5546.0	6145.5	0.0	.I
71.00	25.0	6.1	5546.0	6147.1	0.0	.I
72.00	26.0	6.2	5546.0	6148.7	0.0	.I
73.00	26.0	6.3	5546.0	6150.3	0.0	.I
74.00	26.0	6.4	5546.0	6152.0	0.0	.I
75.00	27.0	6.5	5546.0	6153.6	0.0	.I
76.00	27.0	6.6	5546.0	6155.3	0.0	.I
77.00	27.0	6.7	5546.0	6157.0	0.0	.I
78.00	28.0	6.8	5546.0	6158.7	0.0	.I
79.00	28.0	6.9	5546.0	6160.5	0.0	.I
80.00	29.0	7.0	5546.0	6162.2	0.0	.I
81.00	29.0	7.2	5546.1	6164.1	0.0	.I
82.00	29.0	7.3	5546.1	6165.9	0.0	.I
83.00	30.0	7.4	5546.1	6167.7	0.0	. I
84.00	30.0	7.5	5546.1	6169.5	0.0	. I
85.00	31.0	7.7	5546.1	6171.4	0.0	. I
86.00	31.0	7.8	5546.1	6173.4	0.0	. I
87.00	32.0	7.9	5546.1	6175.3	0.0	. I
88.00	33.0	8.0	5546.1	6177.3	0.0	. I
89.00	33.0	8.2	5546.1	6179.4	0.0	. I
90.00	34.0	8.3	5546.1	6181.5	0.0	. I
91.00	35.0	8.5	5546.2	6183.6	0.0	. I

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 92.00  35.0   8.6 5546.2  6185.8   0.0         . I
 93.00  36.0   8.7 5546.2  6188.1   0.0         . I
 94.00  37.0   8.9 5546.2  6190.3   0.0         . I
 95.00  38.0   9.0 5546.2  6192.7   0.0         . I
 96.00  39.0   9.2 5546.2  6195.1   0.0         . I
 97.00  40.0   9.4 5546.2  6197.6   0.0         . I
 98.00  41.0   9.5 5546.2  6200.2   0.0         . I
 99.00  42.0   9.7 5546.3  6202.8   0.0         . I
100.00  43.0   9.9 5546.3  6205.5   0.0         . I
101.00  45.0  10.1 5546.3  6208.3   0.0         .PI
102.00  46.0  10.3 5546.3  6211.3   0.0         .PI
103.00  48.0  10.5 5546.3  6214.3   0.0         .PI
104.00  49.0  10.7 5546.3  6217.4   0.0         .PI
105.00  51.0  10.9 5546.3  6220.7   0.0         .P I
106.00  53.0  11.1 5546.4  6224.0   0.0         .P I
107.00  56.0  11.3 5546.4  6227.6   0.0         .P I
108.00  58.0  11.6 5546.4  6231.4   0.0         .P I
109.00  61.0  11.9 5546.4  6235.3   0.0         .P I
110.00  65.0  12.1 5546.4  6239.5   0.0         .P I
111.00  69.0  12.4 5546.5  6244.1   0.0         .P I
112.00  74.0  12.7 5546.5  6248.9   0.0         .P  I
113.00  80.0  13.1 5546.5  6254.2   0.0         .P  I
114.00  87.0  13.5 5546.5  6260.0   0.0         .P  I
115.00  96.0  13.9 5546.6  6266.5   0.0         .P   I
116.00 109.0  14.4 5546.6  6273.8   0.0         .P   I
117.00 127.0  14.9 5546.7  6282.3   0.0         .P    I
118.00 157.0  15.6 5546.7  6292.8   0.0         .P      I
119.00 219.0  17.3 5546.8  6307.0   0.0         .P        I
120.00 850.0  22.4 5547.0  6349.5   0.0         .P                                      X
121.00 479.0  28.7 5547.3  6402.3   0.0         .P                    I
122.00 259.0  32.1 5547.4  6430.3   0.0         . P         I
123.00 172.0  33.9 5547.5  6445.4   0.0         . P      I
124.00 132.0  35.1 5547.5  6455.1   0.0         . P    I
125.00 111.0  35.9 5547.6  6462.2   0.0         . P   I
126.00  98.0  36.6 5547.6  6467.8   0.0         . P  I
127.00  88.0  37.2 5547.6  6472.5   0.0         . P I
128.00  81.0  37.6 5547.7  6476.4   0.0         . P I
129.00  75.0  38.0 5547.7  6479.7   0.0         . P I
130.00  70.0  38.4 5547.7  6482.5   0.0         . P I
131.00  65.0  38.7 5547.7  6484.9   0.0         . PI
132.00  62.0  38.9 5547.7  6487.0   0.0         . PI
133.00  59.0  39.1 5547.7  6488.7   0.0         . PI
134.00  56.0  39.3 5547.7  6490.2   0.0         . PI
135.00  54.0  39.4 5547.7  6491.5   0.0         . PI
136.00  51.0  39.6 5547.7  6492.6   0.0         . PI
137.00  50.0  39.7 5547.7  6493.5   0.0         . PI
138.00  48.0  39.8 5547.7  6494.3   0.0         . P
139.00  46.0  39.8 5547.7  6494.9   0.0         . P
140.00  45.0  39.9 5547.8  6495.3   0.0         . P
141.00  43.0  39.9 5547.8  6495.7   0.0         . P
142.00  42.0  40.0 5547.8  6495.9   0.0         . P
143.00  41.0  40.0 5547.8  6496.0   0.0         . P
144.00  40.0  40.0 5547.8  6496.1   0.0         . X
145.00  39.0  40.0 5547.8  6496.0   0.0         . P
146.00  38.0  40.0 5547.8  6495.9   0.0         . P
147.00  37.0  39.9 5547.8  6495.7   0.0         . P
148.00  36.0  39.9 5547.8  6495.4   0.0         . P
149.00  35.0  39.9 5547.8  6495.0   0.0         . P
150.00  35.0  39.8 5547.7  6494.6   0.0         . P
151.00  34.0  39.8 5547.7  6494.2   0.0         . P
152.00  33.0  39.7 5547.7  6493.7   0.0         . P
153.00  33.0  39.6 5547.7  6493.1   0.0         . P
154.00  32.0  39.6 5547.7  6492.6   0.0         . P
155.00  32.0  39.5 5547.7  6491.9   0.0         . P
156.00  31.0  39.4 5547.7  6491.3   0.0         . P
157.00  30.0  39.3 5547.7  6490.5   0.0         . P
158.00  30.0  39.2 5547.7  6489.8   0.0         . P
159.00  29.0  39.1 5547.7  6489.0   0.0         .IP
160.00  29.0  39.0 5547.7  6488.1   0.0         .IP
161.00  29.0  38.9 5547.7  6487.3   0.0         .IP
162.00  28.0  38.8 5547.7  6486.5   0.0         .IP
163.00  28.0  38.7 5547.7  6485.6   0.0         .IP
164.00  27.0  38.6 5547.7  6484.6   0.0         .IP
165.00  27.0  38.5 5547.7  6483.7   0.0         .IP
166.00  27.0  38.4 5547.7  6482.7   0.0         .IP
167.00  26.0  38.3 5547.7  6481.8   0.0         .IP
168.00  26.0  38.1 5547.7  6480.8   0.0         .IP
169.00  26.0  38.0 5547.7  6479.8   0.0         .IP
170.00  25.0  37.9 5547.7  6478.7   0.0         .IP
171.00  25.0  37.8 5547.7  6477.7   0.0         .IP
172.00  25.0  37.7 5547.7  6476.6   0.0         .IP
173.00  24.0  37.5 5547.7  6475.5   0.0         .IP
174.00  24.0  37.4 5547.6  6474.4   0.0         .IP
175.00  24.0  37.3 5547.6  6473.3   0.0         .IP
176.00  24.0  37.1 5547.6  6472.2   0.0         .IP
177.00  23.0  37.0 5547.6  6471.1   0.0         .IP
178.00  23.0  36.9 5547.6  6470.0   0.0         .IP
179.00  23.0  36.7 5547.6  6468.8   0.0         .IP
180.00  23.0  36.6 5547.6  6467.7   0.0         .IP
181.00  22.0  36.4 5547.6  6466.5   0.0         .IP
182.00  22.0  36.3 5547.6  6465.3   0.0         .IP
183.00  22.0  36.2 5547.6  6464.2   0.0         .IP
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184.00  22.0  36.0 5547.6  6463.0   0.0          .IP
185.00  22.0  35.9 5547.6  6461.8   0.0          .IP
186.00  21.0  35.7 5547.6  6460.7   0.0          .IP
187.00  21.0  35.6 5547.6  6459.5   0.0          .IP
188.00  21.0  35.4 5547.6  6458.3   0.0          .IP
189.00  21.0  35.3 5547.6  6457.1   0.0          .IP
190.00  21.0  35.2 5547.6  6455.9   0.0          .IP
191.00  20.0  35.0 5547.5  6454.7   0.0          .IP
192.00  20.0  34.9 5547.5  6453.4   0.0          .IP
193.00  20.0  34.7 5547.5  6452.2   0.0          .IP
194.00  20.0  34.6 5547.5  6451.0   0.0          .IP
195.00  20.0  34.4 5547.5  6449.8   0.0          .IP
196.00  20.0  34.3 5547.5  6448.6   0.0          .IP
197.00  19.0  34.1 5547.5  6447.4   0.0          .IP
198.00  19.0  34.0 5547.5  6446.2   0.0          .IP
199.00  19.0  33.8 5547.5  6444.9   0.0          .IP
200.00  19.0  33.7 5547.5  6443.7   0.0          .IP
201.00  19.0  33.6 5547.5  6442.5   0.0          .IP
202.00  19.0  33.4 5547.5  6441.3   0.0          .IP
203.00  19.0  33.3 5547.5  6440.1   0.0          .IP
204.00  18.0  33.1 5547.5  6438.9   0.0          .IP
205.00  18.0  33.0 5547.5  6437.7   0.0          .IP
206.00  18.0  32.8 5547.5  6436.4   0.0          .IP
207.00  18.0  32.7 5547.4  6435.2   0.0          .IP
208.00  18.0  32.5 5547.4  6434.0   0.0          .IP
209.00  18.0  32.4 5547.4  6432.8   0.0          .IP
210.00  18.0  32.2 5547.4  6431.6   0.0          .IP
211.00  17.0  32.1 5547.4  6430.4   0.0          .IP
212.00  17.0  32.0 5547.4  6429.2   0.0          .IP
213.00  17.0  31.8 5547.4  6427.9   0.0          .IP
214.00  17.0  31.7 5547.4  6426.7   0.0          .IP
215.00  17.0  31.5 5547.4  6425.5   0.0          .IP
216.00  17.0  31.4 5547.4  6424.3   0.0          .IP
217.00  17.0  31.2 5547.4  6423.1   0.0          .IP
218.00  17.0  31.1 5547.4  6422.0   0.0          .IP
219.00  17.0  30.9 5547.4  6420.8   0.0          .IP
220.00  17.0  30.8 5547.4  6419.7   0.0          .IP
221.00  16.0  30.7 5547.4  6418.5   0.0          .IP
222.00  16.0  30.5 5547.4  6417.3   0.0          .IP
223.00  16.0  30.4 5547.3  6416.1   0.0          .IP
224.00  16.0  30.2 5547.3  6414.9   0.0          .IP
225.00  16.0  30.1 5547.3  6413.7   0.0          .IP
226.00  16.0  30.0 5547.3  6412.6   0.0          .P
227.00  16.0  29.8 5547.3  6411.4   0.0          .P
228.00  16.0  29.7 5547.3  6410.3   0.0          .P
229.00  16.0  29.5 5547.3  6409.2   0.0          .P
230.00  16.0  29.4 5547.3  6408.1   0.0          .P
231.00  15.0  29.3 5547.3  6406.9   0.0          .P
232.00  15.0  29.1 5547.3  6405.7   0.0          .P
233.00  15.0  29.0 5547.3  6404.6   0.0          .P
234.00  15.0  28.9 5547.3  6403.4   0.0          .P
235.00  15.0  28.7 5547.3  6402.3   0.0          .P
236.00  15.0  28.6 5547.3  6401.2   0.0          .P
237.00  15.0  28.5 5547.3  6400.0   0.0          .P
238.00  15.0  28.3 5547.3  6398.9   0.0          .P
239.00  15.0  28.2 5547.3  6397.8   0.0          .P
 Time    Qin  Qout   Elev    Vol   Area  ExtVel  I         I         I         I         I         I         I         I
                                                 0.      200.      400.      600.      800.     1000.     1200.     1400.
       END NRCS-PSH   PLOT


*********************************************************************************
RATING TABLE DEVELOPED, SITE = STR1 :
 BY PROGRAM FOR PS AND AUX. SPILLWAYS
 AUX. RATING USED WSPVRT METHOD.


RATING TABLE NUMBER  1
       ELEV.    Q-TOTAL    Q-PS     Q-AUX.    VOLUME     AREA
       FEET       CFS       CFS       CFS      AC-FT     ACRE
  1  5545.50      0.00      0.00      0.00   6055.03      0.00
  2  5546.72     15.71     15.71      0.00   6294.00      0.00
  3  5547.94     44.43     44.43      0.00   6532.97      0.00
  4  5549.17     81.62     81.62      0.00   6771.95      0.00
                                         FULL CONDUIT FLOW, ELEV = 5550.39 FT
  5  5550.39    125.65    125.65      0.00   7015.04      0.00
  6  5550.65    125.84    125.84      0.00   7069.39      0.00
  7  5550.92    126.01    126.01      0.00   7123.74      0.00
  8  5551.18    126.17    126.17      0.00   7178.09      0.00
  9  5551.44    126.34    126.34      0.00   7232.44      0.00
 10  5551.71    126.50    126.50      0.00   7286.79      0.00
 11  5551.97    126.67    126.67      0.00   7341.14      0.00
 12  5552.23    126.83    126.83      0.00   7395.49      0.00
 13  5552.50    126.99    126.99      0.00   7449.85      0.00

INFLOW HYDROGRAPH PROVIDED IN LOCATION  3,  PEAK=   2180.00 CFS, AT   3.30 HRS.
TITLE = Auxiliary Spillway (Local)


INFLOW HYDROGRAPH PROVIDED IN LOCATION  5,  PEAK=   6395.00 CFS, AT   3.00 HRS.
TITLE = Freeboard (Local)
```

```
1SITES ------------------------------------------------------------------------
 XEQ 08/20/2020                    COV RES                        WSID= COVRES
 VER 2005.1.8                        Cove Res                       SUBW= CR
 TIME 06:12:11            SITE = STR1              PASS=    1     PART=   3


 AUX. CREST     5548.51 FT    6644.1 ACFT      0.00 AC      61.7 CFS

      PS STORAGE    589.1 ACFT,  BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

 START ELEV     5546.26 FT    6203.0 ACFT      0.00 AC       9.7 CFS

 ***** WARNING - AUXILIARY CREST LOWER THAN LOW POINT IN SITE.

 NRCS-SDH   INFLOW HYDROGRAPH INPUT, DA =    4.74 SQUARE MILES

      PEAK =      2180.0 CFS, AT    3.3 HRS.

 NRCS-FBH   INFLOW HYDROGRAPH INPUT, DA =    4.74 SQUARE MILES

      PEAK =      6395.0 CFS, AT    3.0 HRS.

 ***** WARNING - MAXIMUM AUX. SURFACE PROFILE ELEVATION ( 5549.20) AND AUXILIARY
                 CREST ( 5548.51) ELEVATION Do NOT MATCH.  MAXIMUM AUX. SURFACE
                 PROFILE ELEVATION USED IN WSPVRT PROCEDURE.


 ***** MESSAGE - INPUT(5549.14) TO INTERPOLATION ROUTINE IS BELOW
                 ARRAY LIMIT(5549.20).


 ******************************************************************************
 RATING TABLE DEVELOPED, SITE = STR1 :
  BY PROGRAM FOR PS AND AUX. SPILLWAYS
  AUX. RATING USED WSPVRT METHOD.


 RATING TABLE NUMBER  2
        ELEV.    Q-TOTAL    Q-PS     Q-AUX.    VOLUME     AREA
        FEET       CFS       CFS       CFS      AC-FT     ACRE
   1  5545.50      0.00      0.00      0.00   6055.03      0.00
   2  5545.83      2.25      2.25      0.00   6120.52      0.00
   3  5546.17      6.37      6.37      0.00   6186.02      0.00
   4  5546.50     11.71     11.71      0.00   6251.52      0.00
   5  5546.84     18.03     18.03      0.00   6317.01      0.00
   6  5547.17     25.20     25.20      0.00   6382.51      0.00
   7  5547.51     33.12     33.12      0.00   6448.00      0.00
   8  5547.84     41.74     41.74      0.00   6513.50      0.00
   9  5548.18     50.99     50.99      0.00   6578.99      0.00
  10  5548.51     60.85     60.85      0.00   6644.49      0.00
  11  5549.14     80.67     80.67      0.00   6766.41      0.00
  12  5549.76    126.50    102.35     24.15   6888.71      0.00
                                           FULL CONDUIT FLOW, ELEV = 5550.39 FT
  13  5550.39    223.05    125.67     97.38   7015.14      0.00
  14  5550.49    237.89    125.75    112.14   7036.88      0.00
  15  5550.60    255.98    125.81    130.16   7058.62      0.00
  16  5550.79    290.40    125.93    164.47   7097.77      0.00
  17  5551.02    332.53    126.08    206.45   7145.68      0.00
  18  5551.44    422.70    126.34    296.36   7232.64      0.00
  19  5551.97    551.57    126.67    424.90   7341.44      0.00
  20  5552.50    697.75    126.99    570.75   7450.25      0.00
  ******************************************************************************

 SUMMARY OF AUXILIARY SPILLWAY SURFACE CONDITIONS USED IN COMPUTATIONS BY REACH

 REACH  FROM     TO   SLOPE  RETARDANCE  VEGETAL  MAINT. ROOTING  REACH
        STA     STA           CURVE      COVER    CODE   DEPTH  LOCATION
        (ft)    (ft)   (%)    INDEX      FACTOR     +    (ft)     *
 -----  ----    ----  ------ ----------  -------  -----  ------- --------
   1      0.     75.  -25.6     1.000       **       **     **    INLET
   2     75.    155.    0.0     1.000       **       **     **    CREST
   3    155.    237.   38.5     1.000     0.00       1            EXIT !
   4    237.    600.    9.9     1.000     0.00       1            EXIT
   5    600.   1049.    6.3     1.000     0.00       1            EXIT
   6   1049.   1170.   15.1     1.000     0.00       1            EXIT

  + The minimum maintenance code value of 2 is used in INTEGRITY computations
      (the program changes values of 1 to 2 during computation).
  * Upper case indicates a reach of constructed spillway channel.
 ** The program does not use vegetal cover factor, maintenance code, and
      rooting depth for inlet and crest reaches in computations.
  ! Reach   3 used in computing exit channel velocities.
  ******************************************************************************

 ROUTED       BTM WIDTH  MAX ELEV   VOL-MAX  AREA-MAX   AUX.-HP   VOL-AUX.
 RESULTS          FT        FT       ACFT      AC         FT       ACFT
 NRCS-SDH          30.0   5548.67    6675.5       0.0      0.16      31.0

           PEAK - CFS        Q-PS     Q-AUX.    Q-TOT.
           DISCHARGE  =      65.7       0.2      65.9
```

	CRITICAL DEPTH	CRITICAL VELOCITY	CRITICAL SLOPE-Sc	25% OF Q Sc
	FT	FT/SEC	FT/FT	FT/FT
AUXILIARY SPILLWAY ---	0.01	0.57	0.148	0.308

AUXILIARY SPILLWAY DURATION FLOW = 8.7 HOURS

PLOT NRCS-SDH 1 IN = 500. CFS EXIT SLOPE = 0.385

Time	Qin	Qout	Elev	Vol	Area	ExtVel	0. I	500. I	1000. I	1500. I	2000. I	2500. I	3000. I	3500. I
1.50	0	8	5546.3	6203.0	0.0	0.00	.							
1.80	6	8	5546.3	6203.0	0.0	0.00	.							
2.10	39	8	5546.3	6203.4	0.0	0.00	.I							
2.40	194	8	5546.3	6206.1	0.0	0.00	. I							
2.70	687	9	5546.3	6216.8	0.0	0.00	. I							
3.00	1365	11	5546.5	6242.0	0.0	0.00	. I							
3.30	2027	15	5546.7	6283.7	0.0	0.00	. I							
3.60	2180	20	5546.9	6335.4	0.0	0.00	. X							
3.90	1955	26	5547.2	6386.1	0.0	0.00	.P I							
4.20	1683	31	5547.4	6430.5	0.0	0.00	.P I							
4.50	1441	36	5547.6	6468.4	0.0	0.00	.P I							
4.80	1248	40	5547.8	6500.8	0.0	0.00	.P I							
5.10	1107	44	5547.9	6528.9	0.0	0.00	.P I							
5.40	1001	47	5548.1	6553.9	0.0	0.00	.P I							
5.70	924	51	5548.2	6576.6	0.0	0.00	.P I							
6.00	874	54	5548.3	6597.6	0.0	0.00	.P I							
6.30	833	57	5548.4	6617.4	0.0	0.00	.P I							
6.60	748	60	5548.5	6635.5	0.0	0.00	.P I							
6.90	589	62	5548.5	6650.6	0.0	0.00	.A I							
7.20	423	64	5548.6	6661.6	0.0	0.00	.A I							
7.50	283	65	5548.6	6668.8	0.0	0.00	.A I							
7.80	180	65	5548.7	6672.9	0.0	0.00	.A I							
8.10	112	66	5548.7	6674.9	0.0	0.00	.AI							
8.40	73	66	5548.7	6675.5	0.0	0.00	.X							
8.70	47	66	5548.7	6675.4	0.0	0.00	.A							
9.00	28	66	5548.7	6674.7	0.0	0.00	.A							
9.30	16	66	5548.7	6673.6	0.0	0.00	.A							
9.60	9	65	5548.7	6672.3	0.0	0.00	.A							
9.90	5	65	5548.6	6670.8	0.0	0.00	.A							
10.20	3	65	5548.6	6669.3	0.0	0.00	.A							
10.50	1	65	5548.6	6667.8	0.0	0.00	.A							
10.80	1	64	5548.6	6666.2	0.0	0.00	.A							
11.10	0	64	5548.6	6664.6	0.0	0.00	.A							
11.40	0	64	5548.6	6663.1	0.0	0.00	.A							
11.70	0	64	5548.6	6661.5	0.0	0.00	.A							
12.00	0	63	5548.6	6660.0	0.0	0.00	.A							
12.30	0	63	5548.6	6658.4	0.0	0.00	.A							
12.60	0	63	5548.6	6656.9	0.0	0.00	.A							
12.90	0	63	5548.6	6655.4	0.0	0.00	.A							
13.20	0	62	5548.6	6653.8	0.0	0.00	.A							
13.50	0	62	5548.6	6652.3	0.0	0.00	.A							
13.80	0	62	5548.5	6650.8	0.0	0.00	.A							
14.10	0	62	5548.5	6649.3	0.0	0.00	.A							
14.40	0	61	5548.5	6647.8	0.0	0.00	.A							
14.70	0	61	5548.5	6646.3	0.0	0.00	.A							
15.00	0	61	5548.5	6644.8	0.0	0.00	.A							
15.30	0	61	5548.5	6643.3	0.0	0.00	.P							
15.60	0	60	5548.5	6641.9	0.0	0.00	.P							
15.90	0	60	5548.5	6640.4	0.0	0.00	.P							
16.20	0	60	5548.5	6638.9	0.0	0.00	.P							
16.50	0	60	5548.5	6637.5	0.0	0.00	.P							
16.80	0	60	5548.5	6636.0	0.0	0.00	.P							
17.10	0	59	5548.5	6634.5	0.0	0.00	.P							
17.40	0	59	5548.5	6633.1	0.0	0.00	.P							
17.70	0	59	5548.4	6631.7	0.0	0.00	.P							
18.00	0	59	5548.4	6630.2	0.0	0.00	.P							
18.30	0	58	5548.4	6628.8	0.0	0.00	.P							
18.60	0	58	5548.4	6627.4	0.0	0.00	.P							
18.90	0	58	5548.4	6626.0	0.0	0.00	.P							
19.20	0	58	5548.4	6624.6	0.0	0.00	.P							
19.50	0	58	5548.4	6623.1	0.0	0.00	.P							
19.80	0	57	5548.4	6621.7	0.0	0.00	.P							
20.10	0	57	5548.4	6620.3	0.0	0.00	.P							
20.40	0	57	5548.4	6619.0	0.0	0.00	.P							
20.70	0	57	5548.4	6617.6	0.0	0.00	.P							
21.00	0	57	5548.4	6616.2	0.0	0.00	.P							
21.30	0	56	5548.4	6614.8	0.0	0.00	.P							
21.60	0	56	5548.4	6613.4	0.0	0.00	.P							
21.90	0	56	5548.3	6612.1	0.0	0.00	.P							
22.20	0	56	5548.3	6610.7	0.0	0.00	.P							
22.50	0	56	5548.3	6609.4	0.0	0.00	.P							
22.80	0	55	5548.3	6608.0	0.0	0.00	.P							
23.10	0	55	5548.3	6606.7	0.0	0.00	.P							
23.40	0	55	5548.3	6605.3	0.0	0.00	.P							
23.70	0	55	5548.3	6604.0	0.0	0.00	.P							
24.00	0	55	5548.3	6602.7	0.0	0.00	.P							
24.30	0	54	5548.3	6601.3	0.0	0.00	.P							
24.60	0	54	5548.3	6600.0	0.0	0.00	.P							
24.90	0	54	5548.3	6598.7	0.0	0.00	.P							
25.20	0	54	5548.3	6597.4	0.0	0.00	.P							
25.50	0	54	5548.3	6596.1	0.0	0.00	.P							

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25.80     0    53 5548.3  6594.8   0.0   0.00   .P
26.10     0    53 5548.3  6593.5   0.0   0.00   .P
26.40     0    53 5548.2  6592.2   0.0   0.00   .P
26.70     0    53 5548.2  6590.9   0.0   0.00   .P
27.00     0    53 5548.2  6589.6   0.0   0.00   .P
27.30     0    52 5548.2  6588.4   0.0   0.00   .P
27.60     0    52 5548.2  6587.1   0.0   0.00   .P
27.90     0    52 5548.2  6585.8   0.0   0.00   .P
28.20     0    52 5548.2  6584.5   0.0   0.00   .P
28.50     0    52 5548.2  6583.3   0.0   0.00   .P
28.80     0    51 5548.2  6582.0   0.0   0.00   .P
29.10     0    51 5548.2  6580.8   0.0   0.00   .P
29.40     0    51 5548.2  6579.5   0.0   0.00   .P
29.70     0    51 5548.2  6578.3   0.0   0.00   .P
30.00     0    51 5548.2  6577.1   0.0   0.00   .P
30.30     0    51 5548.2  6575.8   0.0   0.00   .P
30.60     0    50 5548.2  6574.6   0.0   0.00   .P
30.90     0    50 5548.2  6573.4   0.0   0.00   .P
31.20     0    50 5548.1  6572.2   0.0   0.00   .P
31.50     0    50 5548.1  6571.0   0.0   0.00   .P
31.80     0    50 5548.1  6569.8   0.0   0.00   .P
32.10     0    50 5548.1  6568.5   0.0   0.00   .P
32.40     0    49 5548.1  6567.3   0.0   0.00   .P
32.70     0    49 5548.1  6566.1   0.0   0.00   .P
33.00     0    49 5548.1  6565.0   0.0   0.00   .P
33.30     0    49 5548.1  6563.8   0.0   0.00   .P
33.60     0    49 5548.1  6562.6   0.0   0.00   .P
33.90     0    49 5548.1  6561.4   0.0   0.00   .P
34.20     0    48 5548.1  6560.2   0.0   0.00   .P
34.50     0    48 5548.1  6559.1   0.0   0.00   .P
34.80     0    48 5548.1  6557.9   0.0   0.00   .P
35.10     0    48 5548.1  6556.7   0.0   0.00   .P
35.40     0    48 5548.1  6555.6   0.0   0.00   .P
35.70     0    48 5548.1  6554.4   0.0   0.00   .P
36.00     0    47 5548.0  6553.3   0.0   0.00   .P
36.30     0    47 5548.0  6552.1   0.0   0.00   .P
36.60     0    47 5548.0  6551.0   0.0   0.00   .P
36.90     0    47 5548.0  6549.8   0.0   0.00   .P
37.20     0    47 5548.0  6548.7   0.0   0.00   .P
37.50     0    47 5548.0  6547.6   0.0   0.00   .P
37.80     0    46 5548.0  6546.4   0.0   0.00   .P
38.10     0    46 5548.0  6545.3   0.0   0.00   .P
38.40     0    46 5548.0  6544.2   0.0   0.00   .P
38.70     0    46 5548.0  6543.1   0.0   0.00   .P
39.00     0    46 5548.0  6542.0   0.0   0.00   .P
39.30     0    46 5548.0  6540.9   0.0   0.00   .P
39.60     0    45 5548.0  6539.8   0.0   0.00   .P
39.90     0    45 5548.0  6538.7   0.0   0.00   .P
40.20     0    45 5548.0  6537.6   0.0   0.00   .P
40.50     0    45 5548.0  6536.5   0.0   0.00   .P
40.80     0    45 5548.0  6535.4   0.0   0.00   .P
41.10     0    45 5548.0  6534.3   0.0   0.00   .P
41.40     0    45 5547.9  6533.2   0.0   0.00   .P
41.70     0    44 5547.9  6532.1   0.0   0.00   .P
42.00     0    44 5547.9  6531.1   0.0   0.00   .P
42.30     0    44 5547.9  6530.0   0.0   0.00   .P
42.60     0    44 5547.9  6528.9   0.0   0.00   .P
42.90     0    44 5547.9  6527.9   0.0   0.00   .P
43.20     0    44 5547.9  6526.8   0.0   0.00   .P
43.50     0    43 5547.9  6525.7   0.0   0.00   .P
43.80     0    43 5547.9  6524.7   0.0   0.00   .P
44.10     0    43 5547.9  6523.6   0.0   0.00   .P
44.40     0    43 5547.9  6522.6   0.0   0.00   .P
44.70     0    43 5547.9  6521.6   0.0   0.00   .P
45.00     0    43 5547.9  6520.5   0.0   0.00   .P
45.30     0    43 5547.9  6519.5   0.0   0.00   .P
45.60     0    42 5547.9  6518.5   0.0   0.00   .P
45.90     0    42 5547.9  6517.4   0.0   0.00   .P
46.20     0    42 5547.9  6516.4   0.0   0.00   .P
46.50     0    42 5547.9  6515.4   0.0   0.00   .P
46.80     0    42 5547.8  6514.4   0.0   0.00   .P
47.10     0    42 5547.8  6513.4   0.0   0.00   .P
47.40     0    42 5547.8  6512.4   0.0   0.00   .P
47.70     0    41 5547.8  6511.4   0.0   0.00   .P
48.00     0    41 5547.8  6510.4   0.0   0.00   .P
48.30     0    41 5547.8  6509.4   0.0   0.00   .P
48.60     0    41 5547.8  6508.4   0.0   0.00   .P
48.90     0    41 5547.8  6507.4   0.0   0.00   .P
49.20     0    41 5547.8  6506.4   0.0   0.00   .P
49.50     0    41 5547.8  6505.4   0.0   0.00   .P
49.80     0    41 5547.8  6504.4   0.0   0.00   .P
50.10     0    40 5547.8  6503.4   0.0   0.00   .P
50.40     0    40 5547.8  6502.5   0.0   0.00   .P
50.70     0    40 5547.8  6501.5   0.0   0.00   .P
51.00     0    40 5547.8  6500.5   0.0   0.00   .P
51.30     0    40 5547.8  6499.6   0.0   0.00   .P
51.60     0    40 5547.8  6498.6   0.0   0.00   .P
51.90     0    40 5547.8  6497.6   0.0   0.00   .P
52.20     0    40 5547.8  6496.7   0.0   0.00   .P
52.50     0    39 5547.8  6495.7   0.0   0.00   .P
52.80     0    39 5547.7  6494.8   0.0   0.00   .P
53.10     0    39 5547.7  6493.8   0.0   0.00   .P
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53.40     0    39 5547.7  6492.9   0.0   0.00   .P
53.70     0    39 5547.7  6491.9   0.0   0.00   .P
54.00     0    39 5547.7  6491.0   0.0   0.00   .P
54.30     0    39 5547.7  6490.1   0.0   0.00   .P
54.60     0    39 5547.7  6489.1   0.0   0.00   .P
54.90     0    38 5547.7  6488.2   0.0   0.00   .P
55.20     0    38 5547.7  6487.3   0.0   0.00   .P
55.50     0    38 5547.7  6486.4   0.0   0.00   .P
55.80     0    38 5547.7  6485.4   0.0   0.00   .P
56.10     0    38 5547.7  6484.5   0.0   0.00   .P
56.40     0    38 5547.7  6483.6   0.0   0.00   .P
56.70     0    38 5547.7  6482.7   0.0   0.00   .P
57.00     0    38 5547.7  6481.8   0.0   0.00   .P
57.30     0    37 5547.7  6480.9   0.0   0.00   .P
57.60     0    37 5547.7  6480.0   0.0   0.00   .P
57.90     0    37 5547.7  6479.1   0.0   0.00   .P
58.20     0    37 5547.7  6478.2   0.0   0.00   .P
58.50     0    37 5547.7  6477.3   0.0   0.00   .P
58.80     0    37 5547.7  6476.4   0.0   0.00   .P
59.10     0    37 5547.7  6475.5   0.0   0.00   .P
59.40     0    37 5547.6  6474.6   0.0   0.00   .P
59.70     0    37 5547.6  6473.7   0.0   0.00   .P
60.00     0    36 5547.6  6472.9   0.0   0.00   .P
60.30     0    36 5547.6  6472.0   0.0   0.00   .P
60.60     0    36 5547.6  6471.1   0.0   0.00   .P
60.90     0    36 5547.6  6470.2   0.0   0.00   .P
61.20     0    36 5547.6  6469.4   0.0   0.00   .P
61.50     0    36 5547.6  6468.5   0.0   0.00   .P
61.80     0    36 5547.6  6467.7   0.0   0.00   .P
62.10     0    36 5547.6  6466.8   0.0   0.00   .P
62.40     0    35 5547.6  6465.9   0.0   0.00   .P
62.70     0    35 5547.6  6465.1   0.0   0.00   .P
63.00     0    35 5547.6  6464.2   0.0   0.00   .P
63.30     0    35 5547.6  6463.4   0.0   0.00   .P
63.60     0    35 5547.6  6462.5   0.0   0.00   .P
63.90     0    35 5547.6  6461.7   0.0   0.00   .P
64.20     0    35 5547.6  6460.9   0.0   0.00   .P
64.50     0    35 5547.6  6460.0   0.0   0.00   .P
64.80     0    35 5547.6  6459.2   0.0   0.00   .P
65.10     0    34 5547.6  6458.4   0.0   0.00   .P
65.40     0    34 5547.6  6457.5   0.0   0.00   .P
65.70     0    34 5547.6  6456.7   0.0   0.00   .P
66.00     0    34 5547.5  6455.9   0.0   0.00   .P
66.30     0    34 5547.5  6455.1   0.0   0.00   .P
66.60     0    34 5547.5  6454.2   0.0   0.00   .P
66.90     0    34 5547.5  6453.4   0.0   0.00   .P
67.20     0    34 5547.5  6452.6   0.0   0.00   .P
67.50     0    34 5547.5  6451.8   0.0   0.00   .P
67.80     0    34 5547.5  6451.0   0.0   0.00   .P
68.10     0    33 5547.5  6450.2   0.0   0.00   .P
68.40     0    33 5547.5  6449.4   0.0   0.00   .P
68.70     0    33 5547.5  6448.6   0.0   0.00   .P
69.00     0    33 5547.5  6447.8   0.0   0.00   .P
69.30     0    33 5547.5  6447.0   0.0   0.00   .P
69.60     0    33 5547.5  6446.2   0.0   0.00   .P
69.90     0    33 5547.5  6445.4   0.0   0.00   .P
70.20     0    33 5547.5  6444.6   0.0   0.00   .P
70.50     0    33 5547.5  6443.8   0.0   0.00   .P
70.80     0    33 5547.5  6443.1   0.0   0.00   .P
71.10     0    32 5547.5  6442.3   0.0   0.00   .P
71.40     0    32 5547.5  6441.5   0.0   0.00   .P
71.70     0    32 5547.5  6440.7   0.0   0.00   .P
72.00     0    32 5547.5  6439.9   0.0   0.00   .P
72.30     0    32 5547.5  6439.2   0.0   0.00   .P
72.60     0    32 5547.5  6438.4   0.0   0.00   .P
72.90     0    32 5547.5  6437.6   0.0   0.00   .P
73.20     0    32 5547.5  6436.9   0.0   0.00   .P
73.50     0    32 5547.4  6436.1   0.0   0.00   .P
73.80     0    32 5547.4  6435.4   0.0   0.00   .P
74.10     0    31 5547.4  6434.6   0.0   0.00   .P
74.40     0    31 5547.4  6433.8   0.0   0.00   .P
74.70     0    31 5547.4  6433.1   0.0   0.00   .P
75.00     0    31 5547.4  6432.3   0.0   0.00   .P
75.30     0    31 5547.4  6431.6   0.0   0.00   .P
75.60     0    31 5547.4  6430.8   0.0   0.00   .P
75.90     0    31 5547.4  6430.1   0.0   0.00   .P
76.20     0    31 5547.4  6429.4   0.0   0.00   .P
76.50     0    31 5547.4  6428.6   0.0   0.00   .P
76.80     0    31 5547.4  6427.9   0.0   0.00   .P
77.10     0    31 5547.4  6427.1   0.0   0.00   .P
77.40     0    31 5547.4  6426.4   0.0   0.00   .P
77.70     0    30 5547.4  6425.7   0.0   0.00   .P
78.00     0    30 5547.4  6425.0   0.0   0.00   .P
78.30     0    30 5547.4  6424.2   0.0   0.00   .P
78.60     0    30 5547.4  6423.5   0.0   0.00   .P
78.90     0    30 5547.4  6422.8   0.0   0.00   .P
79.20     0    30 5547.4  6422.1   0.0   0.00   .P
79.50     0    30 5547.4  6421.3   0.0   0.00   .P
79.80     0    30 5547.4  6420.6   0.0   0.00   .P
80.10     0    30 5547.4  6419.9   0.0   0.00   .P
80.40     0    30 5547.4  6419.2   0.0   0.00   .P
80.70     0    30 5547.4  6418.5   0.0   0.00   .P
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 81.00     0    29 5547.4  6417.8   0.0   0.00   .P
 81.30     0    29 5547.4  6417.1   0.0   0.00   .P
 81.60     0    29 5547.3  6416.4   0.0   0.00   .P
 81.90     0    29 5547.3  6415.7   0.0   0.00   .P
 82.20     0    29 5547.3  6415.0   0.0   0.00   .P
 82.50     0    29 5547.3  6414.3   0.0   0.00   .P
 82.80     0    29 5547.3  6413.6   0.0   0.00   .P
 83.10     0    29 5547.3  6412.9   0.0   0.00   .P
 83.40     0    29 5547.3  6412.2   0.0   0.00   .P
 83.70     0    29 5547.3  6411.5   0.0   0.00   .P
 84.00     0    29 5547.3  6410.8   0.0   0.00   .P
 84.30     0    29 5547.3  6410.2   0.0   0.00   .P
 84.60     0    28 5547.3  6409.5   0.0   0.00   .P
 84.90     0    28 5547.3  6408.8   0.0   0.00   .P
 85.20     0    28 5547.3  6408.1   0.0   0.00   .P
 85.50     0    28 5547.3  6407.4   0.0   0.00   .P
 85.80     0    28 5547.3  6406.8   0.0   0.00   .P
 86.10     0    28 5547.3  6406.1   0.0   0.00   .P
 86.40     0    28 5547.3  6405.4   0.0   0.00   .P
 86.70     0    28 5547.3  6404.8   0.0   0.00   .P
 87.00     0    28 5547.3  6404.1   0.0   0.00   .P
 87.30     0    28 5547.3  6403.4   0.0   0.00   .P
 87.60     0    28 5547.3  6402.8   0.0   0.00   .P
 87.90     0    28 5547.3  6402.1   0.0   0.00   .P
 88.20     0    27 5547.3  6401.4   0.0   0.00   .P
 88.50     0    27 5547.3  6400.8   0.0   0.00   .P
 88.80     0    27 5547.3  6400.1   0.0   0.00   .P
 89.10     0    27 5547.3  6399.5   0.0   0.00   .P
 89.40     0    27 5547.3  6398.8   0.0   0.00   .P
 89.70     0    27 5547.3  6398.2   0.0   0.00   .P
 90.00     0    27 5547.3  6397.5   0.0   0.00   .P
 90.30     0    27 5547.2  6396.9   0.0   0.00   .P
 90.60     0    27 5547.2  6396.3   0.0   0.00   .P
 90.90     0    27 5547.2  6395.6   0.0   0.00   .P
 91.20     0    27 5547.2  6395.0   0.0   0.00   .P
 91.50     0    27 5547.2  6394.3   0.0   0.00   .P
 91.80     0    27 5547.2  6393.7   0.0   0.00   .P
 92.10     0    26 5547.2  6393.1   0.0   0.00   .P
 92.40     0    26 5547.2  6392.4   0.0   0.00   .P
 92.70     0    26 5547.2  6391.8   0.0   0.00   .P
 93.00     0    26 5547.2  6391.2   0.0   0.00   .P
 93.30     0    26 5547.2  6390.6   0.0   0.00   .P
 93.60     0    26 5547.2  6389.9   0.0   0.00   .P
 93.90     0    26 5547.2  6389.3   0.0   0.00   .P
 94.20     0    26 5547.2  6388.7   0.0   0.00   .P
 94.50     0    26 5547.2  6388.1   0.0   0.00   .P
 94.80     0    26 5547.2  6387.5   0.0   0.00   .P
 95.10     0    26 5547.2  6386.9   0.0   0.00   .P
 95.40     0    26 5547.2  6386.2   0.0   0.00   .P
 95.70     0    26 5547.2  6385.6   0.0   0.00   .P
 96.00     0    26 5547.2  6385.0   0.0   0.00   .P
 96.30     0    25 5547.2  6384.4   0.0   0.00   .P
 96.60     0    25 5547.2  6383.8   0.0   0.00   .P
 96.90     0    25 5547.2  6383.2   0.0   0.00   .P
 97.20     0    25 5547.2  6382.6   0.0   0.00   .P
 Time    Qin  Qout   Elev    Vol   Area  ExtVel  I         I         I         I         I         I         I         I
                                                 0.      500.     1000.     1500.     2000.     2500.     3000.     3500.
        END NRCS-SDH   PLOT

ROUTED       BTM WIDTH  MAX ELEV   VOL-MAX  AREA-MAX   AUX.-HP   VOL-AUX.
RESULTS          FT        FT        ACFT      AC         FT       ACFT
NRCS-FBH          30.0   5552.00    7347.2       0.0      3.49     702.7

          PEAK - CFS        Q-PS     Q-AUX.    Q-TOT.
          DISCHARGE  =     126.7     432.6     559.2

                        CRITICAL  CRITICAL   CRITICAL  25% OF Q
                          DEPTH   VELOCITY   SLOPE-Sc     Sc
          AUXILIARY         FT      FT/SEC     FT/FT     FT/FT
          SPILLWAY ---     1.79      7.21     0.008     0.011

          INTEGRITY ANALYSIS - REACH SURFACE PERFORMANCE SUMMARY
           (The auxiliary spillway began flow at time =    3.3 hours
            and peaked at time =    7.5 hours.)


            REACH   3: FROM STATION    155. TO    237. ON   38.5% SLOPE.
               Non-vegetated conditions implied: flow concentration
                assumed with minimal flow: Time =    4.2 hours.


            REACH   4: FROM STATION    237. TO    600. ON    9.9% SLOPE.
               Non-vegetated conditions implied: flow concentration
                assumed with minimal flow: Time =    4.2 hours.


            REACH   5: FROM STATION    600. TO   1049. ON    6.3% SLOPE.
               Non-vegetated conditions implied: flow concentration
                assumed with minimal flow: Time =    4.2 hours.


            REACH   6: FROM STATION   1049. TO   1170. ON   15.1% SLOPE.
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Non-vegetated conditions implied: flow concentration
assumed with minimal flow: Time = 4.2 hours.

INTEGRITY ANALYSIS - HEADCUT EROSION DAMAGE SUMMARY

The most upstream headcut began at station 155.
and progressed upstream to station 153.
The final height of the headcut was 6.9 ft.

The deepest headcut is also the furthest upstream.

THE HYDROGRAPH WAS NOT ADJUSTED FOR THE EFFECTS OF EROSION.

	DURATION FLOW HRS	ATTACK OE/B ACFT/FT	DIST. FROM MOST U/S HEADCUT TO U/S EDGE AUX. CREST, FT
AUXILIARY SPILLWAY ---	61.5	12.1	78.

EXIT CHANNEL FLOW SUPERCRITICAL: MAX VELOCITY= 24.1 FT/SEC
EXIT SLOPE = 0.385 FT/FT
FLOW DEPTH = 0.6 FT

>>>>> MINIMUM FLOW IN AUXILIARY SPILLWAY FROM TR60 (510. CFS).

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
MIN. AUX.	30.0	5552.28	7405.2	0.0	3.77	760.7

	Q-PS	Q-AUX.	Q-TOT.
PEAK - CFS DISCHARGE =	126.9	510.4	637.3

	CRITICAL DEPTH FT	CRITICAL VELOCITY FT/SEC	CRITICAL SLOPE-Sc FT/FT	25% OF Q Sc FT/FT
AUXILIARY SPILLWAY ---	1.99	7.57	0.008	0.011

PLOT NRCS-FBH 1 IN = 1000. CFS EXIT SLOPE = 0.385

0. 1000. 2000. 3000. 4000. 5000. 6000. 7000.

Time	Qin	Qout	Elev	Vol	Area	ExtVel	Plot
0.90	0	8	5546.3	6203.0	0.0	0.00	.
1.20	8	8	5546.3	6203.0	0.0	0.00	.
1.50	43	8	5546.3	6203.5	0.0	0.00	.
1.80	129	8	5546.3	6205.4	0.0	0.00	.I
2.10	306	8	5546.3	6210.6	0.0	0.00	. I
2.40	824	9	5546.4	6224.4	0.0	0.00	. I
2.70	2325	13	5546.6	6263.1	0.0	0.00	. I
3.00	4867	22	5547.0	6351.9	0.0	0.00	. I
3.30	6395	39	5547.7	6490.7	0.0	0.00	. X
3.60	6123	61	5548.5	6644.7	0.0	0.00	.A I
3.90	5053	86	5549.2	6781.4	0.0	3.25	.A I
4.20	4063	129	5549.8	6891.7	0.0	8.04	.A I
4.50	3364	196	5550.2	6979.8	0.0	12.35	. A I
4.80	2855	250	5550.6	7051.3	0.0	14.90	. A I
5.10	2500	302	5550.9	7110.9	0.0	17.07	. A I
5.40	2228	349	5551.1	7161.4	0.0	18.71	. A I
5.70	2039	394	5551.3	7205.1	0.0	20.09	. A I
6.00	1913	436	5551.5	7243.8	0.0	21.24	. A I
6.30	1819	477	5551.7	7278.8	0.0	22.29	. A I
6.60	1614	513	5551.8	7309.0	0.0	23.13	. A I
6.90	1240	540	5551.9	7331.4	0.0	23.72	. A I
7.20	851	555	5552.0	7343.7	0.0	24.05	. A I
7.50	540	559	5552.0	7347.2	0.0	24.15	. IX
7.80	332	555	5552.0	7344.1	0.0	24.06	. I A
8.10	201	546	5552.0	7337.1	0.0	23.87	. I A
8.40	113	535	5551.9	7327.6	0.0	23.62	.I A
8.70	62	522	5551.9	7316.6	0.0	23.34	.I A
9.00	34	508	5551.8	7305.1	0.0	23.02	. A
9.30	18	495	5551.7	7293.3	0.0	22.70	. A
9.60	9	481	5551.7	7281.5	0.0	22.37	. A
9.90	5	467	5551.6	7269.9	0.0	22.03	. A
10.20	2	453	5551.6	7258.6	0.0	21.70	. A
10.50	1	440	5551.5	7247.6	0.0	21.36	. A
10.80	0	428	5551.5	7236.8	0.0	21.02	. A
11.10	0	416	5551.4	7226.4	0.0	20.71	. A
11.40	0	406	5551.4	7216.2	0.0	20.42	. A
11.70	0	395	5551.3	7206.3	0.0	20.13	. A
12.00	0	385	5551.3	7196.7	0.0	19.84	. A
12.30	0	376	5551.2	7187.3	0.0	19.55	. A
12.60	0	366	5551.2	7178.1	0.0	19.26	. A
12.90	0	357	5551.1	7169.2	0.0	18.97	. A
13.20	0	348	5551.1	7160.4	0.0	18.68	. A
13.50	0	339	5551.1	7152.0	0.0	18.39	. A
13.80	0	331	5551.0	7143.7	0.0	18.11	. A
14.10	0	324	5551.0	7135.6	0.0	17.86	. A
14.40	0	317	5550.9	7127.7	0.0	17.62	. A
14.70	0	310	5550.9	7119.9	0.0	17.37	. A
15.00	0	303	5550.9	7112.4	0.0	17.12	. A
15.30	0	297	5550.8	7104.9	0.0	16.88	. A
15.60	0	290	5550.8	7097.7	0.0	16.63	. A
15.90	0	284	5550.8	7090.6	0.0	16.38	. A

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16.20     0   278 5550.7  7083.7   0.0  16.13   .  A
16.50     0   272 5550.7  7076.9   0.0  15.88   .  A
16.80     0   266 5550.7  7070.2   0.0  15.63   .  A
17.10     0   260 5550.6  7063.7   0.0  15.38   .  A
17.40     0   255 5550.6  7057.3   0.0  15.13   .  A
17.70     0   250 5550.6  7051.1   0.0  14.89   . A
18.00     0   245 5550.5  7045.0   0.0  14.65   . A
18.30     0   240 5550.5  7039.0   0.0  14.41   . A
18.60     0   235 5550.5  7033.2   0.0  14.20   . A
18.90     0   231 5550.4  7027.4   0.0  14.00   . A
19.20     0   228 5550.4  7021.7   0.0  13.79   . A
19.50     0   224 5550.4  7016.2   0.0  13.59   . A
19.80     0   220 5550.4  7010.7   0.0  13.41   . A
20.10     0   216 5550.3  7005.3   0.0  13.24   . A
20.40     0   212 5550.3  7000.1   0.0  13.06   . A
20.70     0   208 5550.3  6994.9   0.0  12.89   . A
21.00     0   204 5550.3  6989.8   0.0  12.71   . A
21.30     0   200 5550.2  6984.8   0.0  12.54   . A
21.60     0   196 5550.2  6979.9   0.0  12.36   . A
21.90     0   193 5550.2  6975.2   0.0  12.18   . A
22.20     0   189 5550.2  6970.5   0.0  12.01   . A
22.50     0   185 5550.1  6965.8   0.0  11.83   . A
22.80     0   182 5550.1  6961.3   0.0  11.65   . A
23.10     0   179 5550.1  6956.9   0.0  11.46   . A
23.40     0   175 5550.1  6952.5   0.0  11.28   . A
23.70     0   172 5550.1  6948.2   0.0  11.10   . A
24.00     0   169 5550.0  6944.0   0.0  10.91   . A
24.30     0   166 5550.0  6939.9   0.0  10.73   . A
24.60     0   163 5550.0  6935.9   0.0  10.54   . A
24.90     0   159 5550.0  6931.9   0.0  10.35   . A
25.20     0   157 5550.0  6928.0   0.0  10.16   . A
25.50     0   154 5549.9  6924.2   0.0   9.97   . A
25.80     0   151 5549.9  6920.4   0.0   9.78   . A
26.10     0   148 5549.9  6916.8   0.0   9.58   .A
26.40     0   145 5549.9  6913.1   0.0   9.38   .A
26.70     0   142 5549.9  6909.6   0.0   9.18   .A
27.00     0   140 5549.9  6906.1   0.0   8.98   .A
27.30     0   137 5549.8  6902.7   0.0   8.77   .A
27.60     0   135 5549.8  6899.4   0.0   8.56   .A
27.90     0   132 5549.8  6896.1   0.0   8.34   .A
28.20     0   130 5549.8  6892.9   0.0   8.12   .A
28.50     0   127 5549.8  6889.7   0.0   7.89   .A
28.80     0   126 5549.8  6886.6   0.0   7.77   .A
29.10     0   125 5549.7  6883.5   0.0   7.69   .A
29.40     0   123 5549.7  6880.5   0.0   7.61   .A
29.70     0   122 5549.7  6877.5   0.0   7.53   .A
30.00     0   121 5549.7  6874.5   0.0   7.46   .A
30.30     0   120 5549.7  6871.5   0.0   7.38   .A
30.60     0   119 5549.7  6868.6   0.0   7.30   .A
30.90     0   118 5549.6  6865.7   0.0   7.22   .A
31.20     0   117 5549.6  6862.8   0.0   7.13   .A
31.50     0   116 5549.6  6859.9   0.0   7.05   .A
31.80     0   115 5549.6  6857.1   0.0   6.97   .A
32.10     0   114 5549.6  6854.3   0.0   6.88   .A
32.40     0   113 5549.6  6851.5   0.0   6.80   .A
32.70     0   112 5549.6  6848.7   0.0   6.71   .A
33.00     0   110 5549.5  6846.0   0.0   6.62   .A
33.30     0   109 5549.5  6843.3   0.0   6.54   .A
33.60     0   108 5549.5  6840.6   0.0   6.45   .A
33.90     0   107 5549.5  6838.0   0.0   6.36   .A
34.20     0   107 5549.5  6835.4   0.0   6.27   .A
34.50     0   106 5549.5  6832.8   0.0   6.17   .A
34.80     0   105 5549.5  6830.2   0.0   6.08   .A
35.10     0   104 5549.5  6827.6   0.0   5.98   .A
35.40     0   103 5549.4  6825.1   0.0   5.88   .A
35.70     0   102 5549.4  6822.6   0.0   5.78   .A
36.00     0   101 5549.4  6820.1   0.0   5.68   .A
36.30     0   100 5549.4  6817.6   0.0   5.58   .A
36.60     0    99 5549.4  6815.2   0.0   5.47   .A
36.90     0    98 5549.4  6812.8   0.0   5.36   .A
37.20     0    97 5549.4  6810.4   0.0   5.25   .A
37.50     0    96 5549.4  6808.0   0.0   5.14   .A
37.80     0    95 5549.3  6805.7   0.0   5.02   .A
38.10     0    95 5549.3  6803.3   0.0   4.90   .A
38.40     0    94 5549.3  6801.0   0.0   4.78   .A
38.70     0    93 5549.3  6798.7   0.0   4.65   .A
39.00     0    92 5549.3  6796.5   0.0   4.52   .A
39.30     0    91 5549.3  6794.2   0.0   4.39   .A
39.60     0    90 5549.3  6792.0   0.0   4.22   .A
39.90     0    89 5549.3  6789.8   0.0   4.04   .A
40.20     0    89 5549.2  6787.6   0.0   3.85   .A
40.50     0    88 5549.2  6785.4   0.0   3.66   .A
40.80     0    87 5549.2  6783.3   0.0   3.45   .A
41.10     0    86 5549.2  6781.2   0.0   3.23   .A
41.40     0    85 5549.2  6779.1   0.0   2.99   .A
41.70     0    85 5549.2  6777.0   0.0   2.74   .A
42.00     0    84 5549.2  6774.9   0.0   2.46   .A
42.30     0    83 5549.2  6772.9   0.0   2.14   .A
42.60     0    82 5549.2  6770.9   0.0   1.77   .A
42.90     0    82 5549.2  6768.9   0.0   1.29   .A
43.20     0    81 5549.1  6766.9   0.0   0.00   .A
43.50     0    80 5549.1  6764.9   0.0   0.00   .A
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43.80	0	80	5549.1	6762.9	0.0	0.00	.A
44.10	0	80	5549.1	6761.0	0.0	0.00	.A
44.40	0	79	5549.1	6759.0	0.0	0.00	.A
44.70	0	79	5549.1	6757.1	0.0	0.00	.A
45.00	0	79	5549.1	6755.1	0.0	0.00	.A
45.30	0	79	5549.1	6753.2	0.0	0.00	.A
45.60	0	78	5549.1	6751.3	0.0	0.00	.A
45.90	0	78	5549.1	6749.4	0.0	0.00	.A
46.20	0	78	5549.0	6747.5	0.0	0.00	.A
46.50	0	77	5549.0	6745.6	0.0	0.00	.A
46.80	0	77	5549.0	6743.7	0.0	0.00	.A
47.10	0	77	5549.0	6741.8	0.0	0.00	.A
47.40	0	76	5549.0	6740.0	0.0	0.00	.A
47.70	0	76	5549.0	6738.1	0.0	0.00	.A
48.00	0	76	5549.0	6736.2	0.0	0.00	.A
48.30	0	75	5549.0	6734.4	0.0	0.00	.A
48.60	0	75	5549.0	6732.5	0.0	0.00	.A
48.90	0	75	5549.0	6730.7	0.0	0.00	.A
49.20	0	75	5548.9	6728.9	0.0	0.00	.A
49.50	0	74	5548.9	6727.1	0.0	0.00	.A
49.80	0	74	5548.9	6725.2	0.0	0.00	.A
50.10	0	74	5548.9	6723.4	0.0	0.00	.A
50.40	0	73	5548.9	6721.6	0.0	0.00	.A
50.70	0	73	5548.9	6719.8	0.0	0.00	.A
51.00	0	73	5548.9	6718.1	0.0	0.00	.A
51.30	0	73	5548.9	6716.3	0.0	0.00	.A
51.60	0	72	5548.9	6714.5	0.0	0.00	.A
51.90	0	72	5548.9	6712.8	0.0	0.00	.A
52.20	0	72	5548.9	6711.0	0.0	0.00	.A
52.50	0	71	5548.8	6709.2	0.0	0.00	.A
52.80	0	71	5548.8	6707.5	0.0	0.00	.A
53.10	0	71	5548.8	6705.8	0.0	0.00	.A
53.40	0	71	5548.8	6704.0	0.0	0.00	.A
53.70	0	70	5548.8	6702.3	0.0	0.00	.A
54.00	0	70	5548.8	6700.6	0.0	0.00	.A
54.30	0	70	5548.8	6698.9	0.0	0.00	.A
54.60	0	69	5548.8	6697.2	0.0	0.00	.A
54.90	0	69	5548.8	6695.5	0.0	0.00	.A
55.20	0	69	5548.8	6693.8	0.0	0.00	.A
55.50	0	69	5548.8	6692.1	0.0	0.00	.A
55.80	0	68	5548.8	6690.5	0.0	0.00	.A
56.10	0	68	5548.7	6688.8	0.0	0.00	.A
56.40	0	68	5548.7	6687.1	0.0	0.00	.A
56.70	0	68	5548.7	6685.5	0.0	0.00	.A
57.00	0	67	5548.7	6683.9	0.0	0.00	.A
57.30	0	67	5548.7	6682.2	0.0	0.00	.A
57.60	0	67	5548.7	6680.6	0.0	0.00	.A
57.90	0	66	5548.7	6679.0	0.0	0.00	.A
58.20	0	66	5548.7	6677.3	0.0	0.00	.A
58.50	0	66	5548.7	6675.7	0.0	0.00	.A
58.80	0	66	5548.7	6674.1	0.0	0.00	.A
59.10	0	65	5548.7	6672.5	0.0	0.00	.A
59.40	0	65	5548.6	6670.9	0.0	0.00	.A
59.70	0	65	5548.6	6669.3	0.0	0.00	.A
60.00	0	65	5548.6	6667.8	0.0	0.00	.A
60.30	0	64	5548.6	6666.2	0.0	0.00	.A
60.60	0	64	5548.6	6664.6	0.0	0.00	.A
60.90	0	64	5548.6	6663.0	0.0	0.00	.A
61.20	0	64	5548.6	6661.5	0.0	0.00	.A
61.50	0	63	5548.6	6659.9	0.0	0.00	.A
61.80	0	63	5548.6	6658.4	0.0	0.00	.A
62.10	0	63	5548.6	6656.9	0.0	0.00	.A
62.40	0	63	5548.6	6655.3	0.0	0.00	.A
62.70	0	62	5548.6	6653.8	0.0	0.00	.A
63.00	0	62	5548.6	6652.3	0.0	0.00	.A
63.30	0	62	5548.5	6650.8	0.0	0.00	.A
63.60	0	62	5548.5	6649.3	0.0	0.00	.A
63.90	0	61	5548.5	6647.8	0.0	0.00	.A
64.20	0	61	5548.5	6646.3	0.0	0.00	.A
64.50	0	61	5548.5	6644.8	0.0	0.00	.A
64.80	0	61	5548.5	6643.3	0.0	0.00	.P
65.10	0	60	5548.5	6641.8	0.0	0.00	.P
65.40	0	60	5548.5	6640.4	0.0	0.00	.P
65.70	0	60	5548.5	6638.9	0.0	0.00	.P
66.00	0	60	5548.5	6637.4	0.0	0.00	.P
66.30	0	60	5548.5	6636.0	0.0	0.00	.P
66.60	0	59	5548.5	6634.5	0.0	0.00	.P
66.90	0	59	5548.5	6633.1	0.0	0.00	.P
67.20	0	59	5548.4	6631.6	0.0	0.00	.P
67.50	0	59	5548.4	6630.2	0.0	0.00	.P
67.80	0	58	5548.4	6628.8	0.0	0.00	.P
68.10	0	58	5548.4	6627.4	0.0	0.00	.P
68.40	0	58	5548.4	6625.9	0.0	0.00	.P
68.70	0	58	5548.4	6624.5	0.0	0.00	.P
69.00	0	58	5548.4	6623.1	0.0	0.00	.P
69.30	0	57	5548.4	6621.7	0.0	0.00	.P
69.60	0	57	5548.4	6620.3	0.0	0.00	.P
69.90	0	57	5548.4	6618.9	0.0	0.00	.P
70.20	0	57	5548.4	6617.6	0.0	0.00	.P
70.50	0	57	5548.4	6616.2	0.0	0.00	.P
70.80	0	56	5548.4	6614.8	0.0	0.00	.P
71.10	0	56	5548.4	6613.4	0.0	0.00	.P

```
 71.40     0    56 5548.3  6612.1   0.0   0.00   .P
 71.70     0    56 5548.3  6610.7   0.0   0.00   .P
 Time    Qin  Qout   Elev    Vol   Area  ExtVel  I         I         I         I         I         I         I         I
                                                 0.     1000.     2000.     3000.     4000.     5000.     6000.     7000.
        END NRCS-FBH   PLOT
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 Inflow Hyd 1 PSH-Peak =         39.99 CFS  at  143.00 hrs.,  Location Point

 Inflow Hyd 1 SDH-Peak =         65.90 CFS  at    8.10 hrs.,  Location Point

 Inflow Hyd 1 FBH-Peak =        559.24 CFS  at    7.20 hrs.,  Location Point
HYDOUT   1     STR1

1SITES....JOB NO.  1 COMPLETE.
 ------------------------------------------------------------------------------

 COVRES        COV RES

       0 SUBWATERSHED(S) ANALYZED.

       1 STRUCTURE(S) ANALYZED.

       3 HYDROGRAPHS ROUTED AT LOWEST SITE.

       0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

 ******************************************************************************



 SITES.....COMPUTATIONS COMPLETE


                              SUMMARY TABLE  1          SITES VERSION 2005.1.8
                             ----------------               DATED 01/01/2005


 WATERSHED ID                        RUN DATE                          RUN TIME
 ------------                        --------                          --------
 COVRES                             08/20/2020                         06:12:11

 >>>   SITE   SUBWS   SUBWS DA   CURVE    TC   TOTAL DA   TYPE    STRUC    <<<
         ID      ID     (SQ MI)    NO.    (HRS)  (SQ MI)  DESIGN   CLASS
        -----   ----   --------   -----   ----   -------   -----   -----
        STR1     CR        4.74      0.   0.00      4.74    TR60     C

 PASS  DIA./  AUX.CREST  BTM.  MAX.    MAX.    EMB.  INTEGR.*  EXIT*    TYPE
  NO.  WIDTH    ELEV    WIDTH   HP     ELEV    VOL.   DIST.     VEL.     HYD
      (IN/FT)   (FT)     (FT)  (FT)    (FT)    (CY)   (FT)   (FT/SEC)
 ----  -----  -------  ------  ----  -------  -------  -----  ------  ---------
    1   30.0   5548.5    30.0   3.8   5552.3       0.    78.    24.1  MIN. AUX.


 *  INTEGRITY DIST. AND EXIT VEL. ARE BASED ON THE ROUTED HYDROGRAPH
    AND WILL NOT RELATE TO THE MAX. ELEV. (TOP OF DAM),
    WHICH IS SET BY MINIMUM DESIGN CRITERIA.



 SITES.......SUMMARY TABLE 1 COMPLETED.


                   NRCS  SITES    VERSION 2005.1.8  ,01/01/2005
                           COVRES   FILES

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                         GRAPHICS FILES GENERATED

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Breach Analysis

Sunny Day

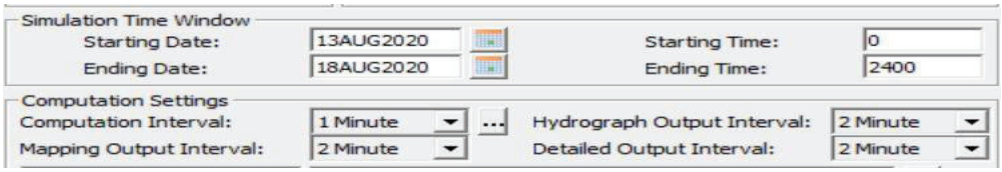
Unsteady Flow Data

	Storage/2D Flow Areas		Boundary Condition
1	CoveReservoir		Flow Hydrograph
2	Downstream2D	BCLine: Downstream	
3	Downstream2D	BCLine: Upstream	
4	Downstream2D	BCLine: DownStream	Normal Depth

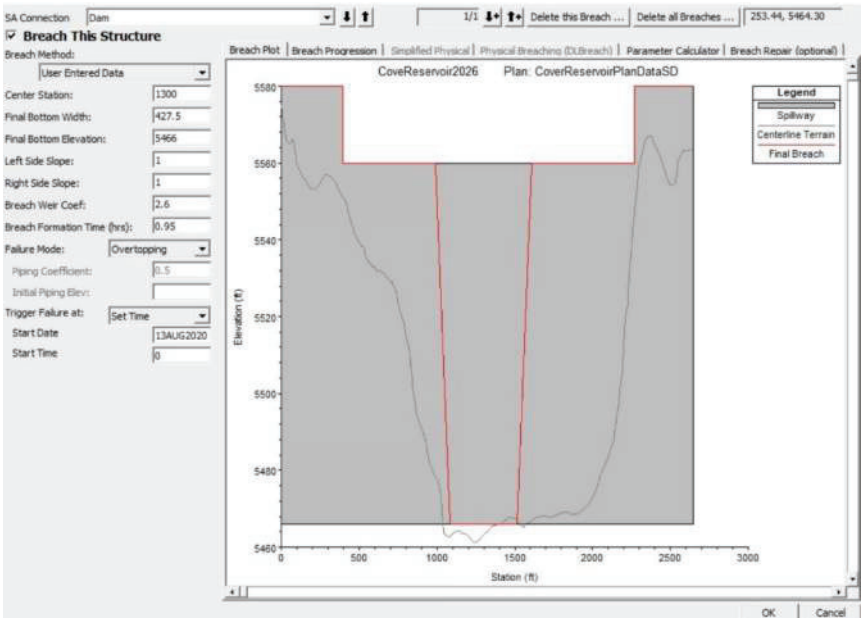
Flow Hydrograph = No Storm

	SA/2D/IC Point	Initial Elevation
1	SA: CoveReservoir	5550
2	2D: Downstream2D	

Unsteady Flow Analysis



Storage Area Connection Breach Data



Rainy Day

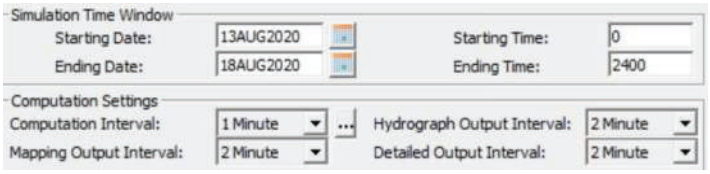
Unsteady Flow Data

	Storage/2D Flow Areas		Boundary Condition
1	CoveReservoir		Flow Hydrograph
2	Downstream2D	BCLine: DownStream	
3	Downstream2D	BCLine: Upstream	Flow Hydrograph
4	Downstream2D	BCLine: Downstream	Normal Depth

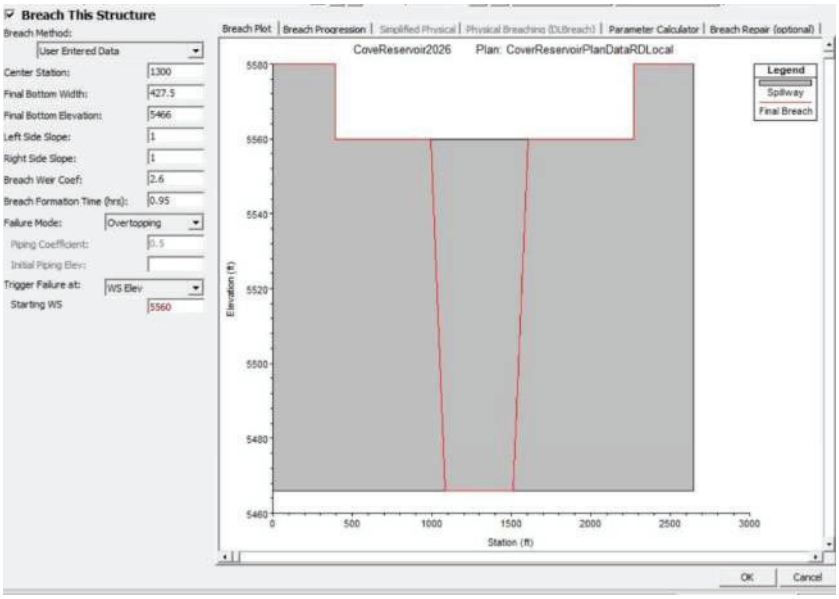
Flow Hydrograph = FBH-L

	SA/2D/IC Point	Initial Elevation
1	SA: CoveReservoir	5550
2	2D: Downstream2D	

Unsteady Flow Analysis



Storage Area Connection Breach Data



Water Model Report: Cove Reservoir
Addendum #1
Design Report

July 21, 2026

The following additional information and clarifications shall be incorporated into the design report for the *Water Model Report: Cove Reservoir – Updated July 2026.*

Item #1:

Additional analysis was performed to compare pre- and post-reservoir river flows in the Virgin River to the USGS gauge records at Springdale and Mount Carmel. The Springdale analysis utilized the USGS 09405500 North Fork Virgin River Near Springdale, Utah gauge, and the Mount Carmel analysis utilized the USGS 09404700 East Fork Virgin River Near Mount Carmel Junction, Utah gauge. Section **3: Flow Regime Comparison, Appendix C: Flow Regime Comparisons Calcs,** & **Appendix D: Model Output Without WCWCD Delivery** has been added to the report to document this analysis.

Item #2:

It was identified that the original water model did not reflect the flow diverted by the MCIC in the final modeled river flows. The model results in **Appendix A** have been updated along with the values reports in **Section 2: Water Model, Section D: Downstream River Changes (Pages 12-15)**.

Item #3

Paragraph 3 on page 10 has been changed to read the following:

"The GIC, OIC, and MCIC will divert water as required by the consumptive use of the crop being irrigated with sprinkler **and some flood** irrigation methods. This results in a more efficient use of the water requiring less water to be diverted. However, the depletion of water remains the same according to the Division of Water Rights. The benefit of the reservoir is supplying water to the agricultural areas when it is needed thus providing higher crop yields."

End of Addendum #1

Updated August 2026

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Section 1 Introduction

The Kane County Water Conservancy District (KCWCD) and its partners are proposing to install a new reservoir known as Cove Reservoir with associated facilities located near Orderville, Utah. The reservoir is a joint venture between KCWCD, the Washington County Water Conservancy District (WCWCD), and local irrigation companies. The system will store water rights from local irrigation companies and the WCWCD for use throughout the year. This reservoir was contemplated as part of the Zion National Park Water Rights Settlement Agreement.

The project includes the construction of an off-stream reservoir less than one mile off the main drainage course, East Fork Virgin River (see **Figure 1** below). The reservoir is designed to hold approximately 6,000 acre-feet of water. The dam is expected to be an earthen structure with principal and emergency spillways adjacent to the left abutment[1]. To convey flows to and from the reservoir, new piping will be installed to connect into existing water transmission facilities.

This report is being prepared as an analysis of the reservoir function as it relates to water diversion and usage in the area and the increased availability that would come with the project along with its associated affects. A model of the entire Virgin River was prepared previously by the Utah State Division of Water Resources (DOWR) that included the Cove Reservoir and was used in the development of the Zion National

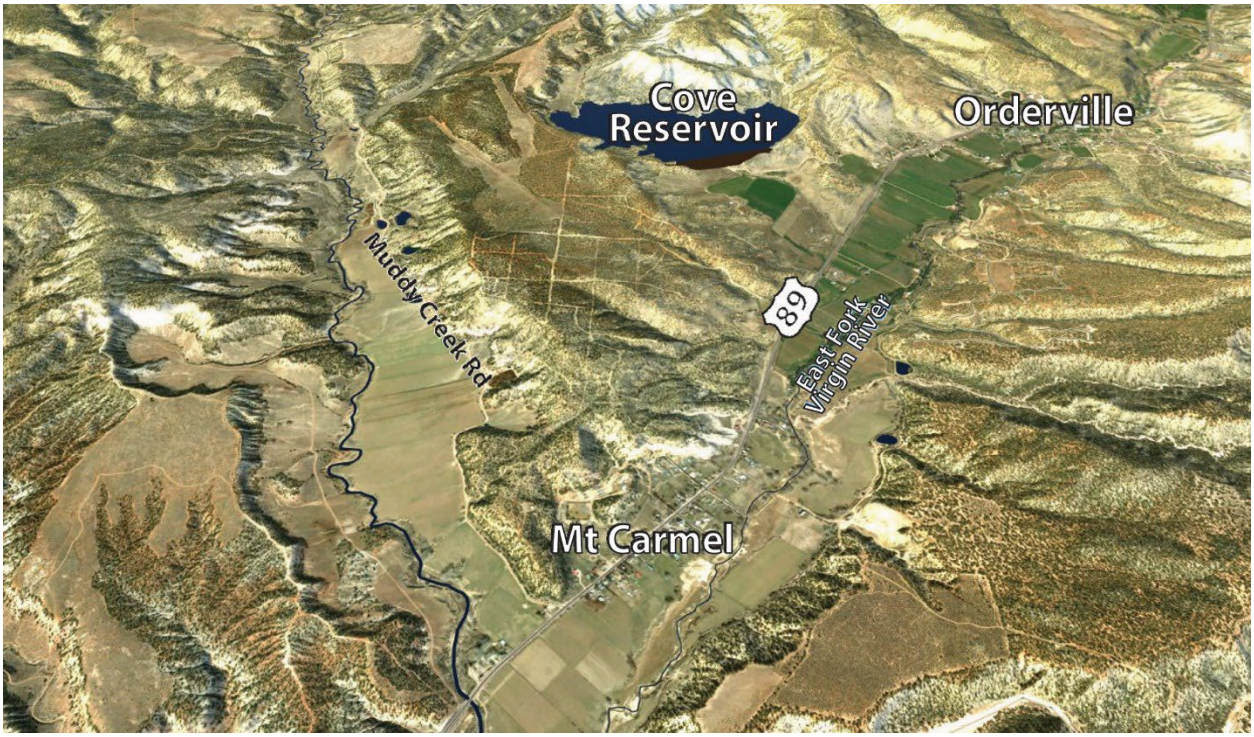


Figure 1 Cove Reservoir Location

[1] Cove Dam Feasibility Report June 2004 RB&G Engineering

Park Agreement. This model provides localized information relative to the actual proposed reservoir to establish project yield, conservation efficiencies, and anticipated changes in river conditions.

Section 2 Water Model

A. Model Constraints

a. Water Gauge Flow Data

The basis for the model was from USGS gauging station 09404450 which is located just above Glendale below the Glendale Irrigation Company (GIC) Diversion Dam. Modeling is based on monthly discharge data from this station, which has a continuous record from 1967 to 2020. **Figure 2** below shows the average monthly discharge in the river. The gauge data were analyzed across the entire 54-year period of record and across the last 20 years recognizing that the recent time period has exhibited a drier hydrology and may be indicative of reliable future expectations

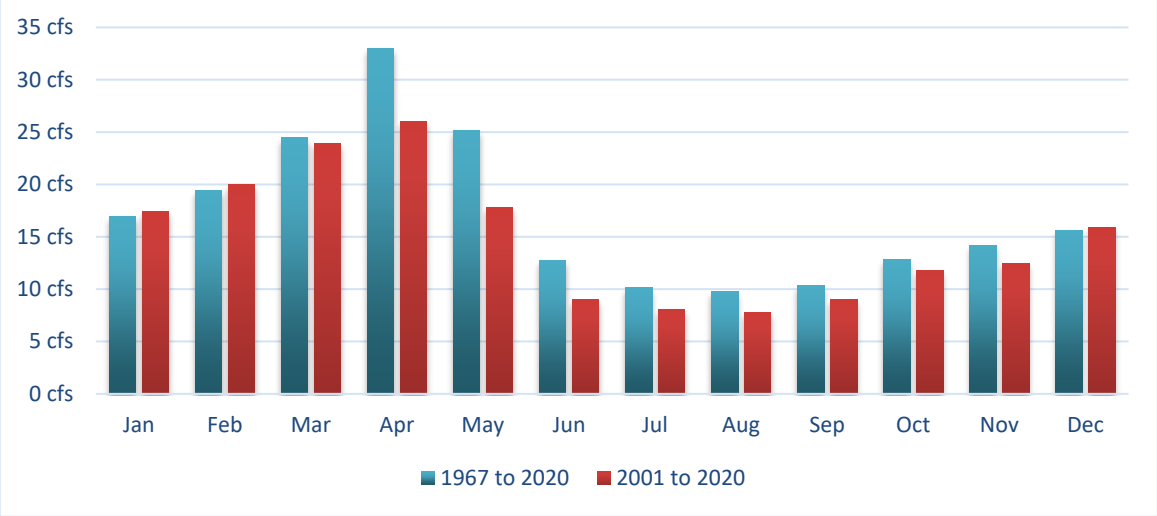


Figure 2 Average 09404450 Glendale USGS Gauge Data

It should be noted that the diversion for the Glendale Irrigation Company is above the USGS Gauging Station. In addition, there is additional drainage area that contributes flow to the East Fork of the Virgin River as the stream channel traverses between the various irrigation company diversion dams. Using a program developed by the USGS referred to as Streamstats, stream flows available for diversion were increased or decreased from the USGS gauge based on the following percentages:

Location	Drainage Area Square Miles	USGS Streamstats Ave. Flow CFS	% Change
Glendale Diversion	58.3	15.8	-19%
Glendale USGS Stream Gauge	74.5	19.4	0%
Orderville Diversion Dam	92.8	23.3	20%
Mt. Carmel Diversion Dam	106	25.9	13%

Table 1 Stream Flow Percentage Increases

The diversion for the Glendale Irrigation Company (GIC) is upstream of the gauging station so the gauging station does not capture the amount of water that has been diverted. The flows at each of the diversion dams were increased or decreased based on the percentage changes as noted in the table above.

b. *Water Rights*

The total combined water right for these three companies are broken down as:

- Glendale Irrigation Company (GIC): 434 acres (ac).
- Orderville Irrigation Company (OIC): 286 ac.
- Mt Carmel Irrigation Company (MCIC): 404 ac.
- **TOTAL: 1,124 ac.**

Annual usage for the three irrigation companies has been established at 5 acre feet per acre. It is anticipated that with this project that the acres being irrigated will be able to be reduced from the usage of 5-acre feet per acre. Shown below in **Figure 3** is the distribution of these water rights throughout the irrigation season, based on consumptive use requirements for alfalfa per Utah State University Research Report 145[2] (USU Report 145) for the Orderville area.

[2] Consumptive Use of Irrigated Crops in Utah Research Report 145, Reprinted February 1998

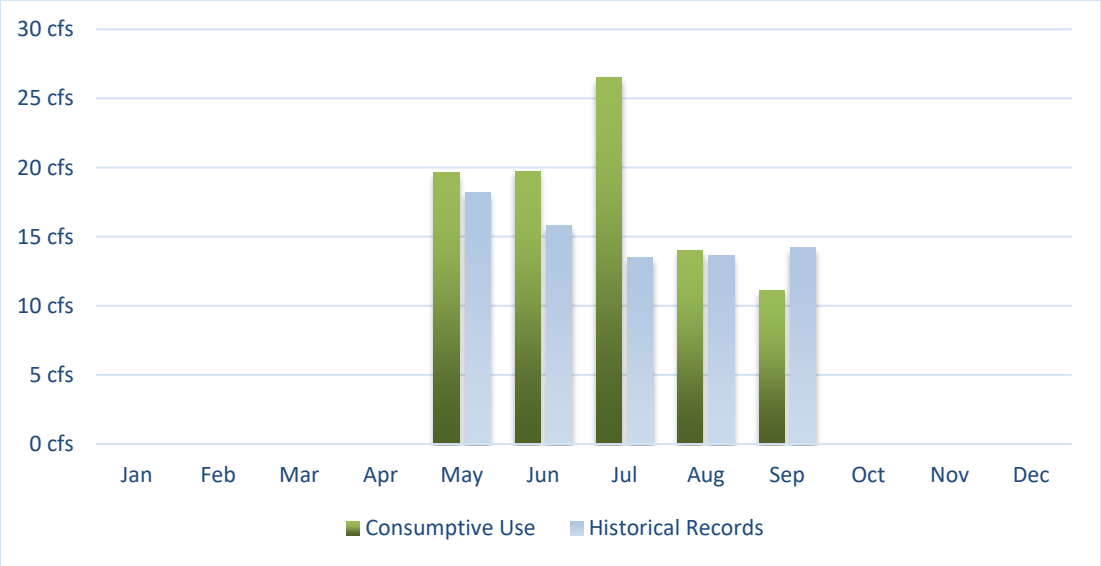


Figure 3 Consumptive Use for Irrigation Companies

Historical diversion data was taken from the Division of Water Rights website and is provided in **Appendix B**. The average monthly historical river diversions are shown for the GIC, OIC, and MCIC in comparison to the calculated crop consumptive use in **Figure 3**. The data were analyzed to determine which years there were adequate river flows to meet the crop demands. Since the irrigation companies share equally in reduction of diversions due to lower river flows; they equally do not meet irrigation demands. The information shown is based on averages. Depending on the year there are several months that do not meet minimum crop requirements. Reviewing **Figure 3** it appears diversions were made outside of the consumptive use requirements of the crops being irrigated. The water rights of the three irrigation companies allow the diversion of water year-round. With the reservoir in place water in excess of crop requirements within the irrigation companies' diversion right could be stored and delivered during low river flow periods.

Figure 4 shows the river discharge available for diversion, including tributary flows between the USGS gauging station and Mt. Carmel, in comparison to the irrigation demand for the three irrigation companies.

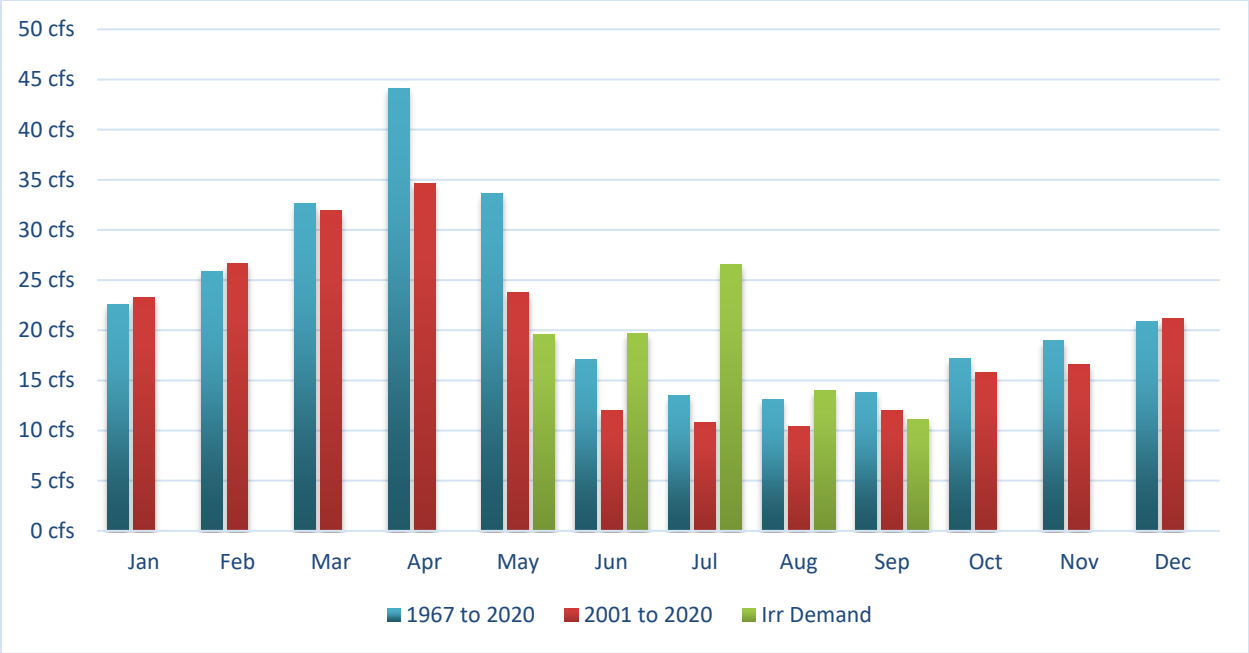


Figure 4 River Discharge and Irrigation Demand

As illustrated in the above chart, the deficiency in available river discharge would likely begin in June but become more deficient as the summer progresses. While there appears to be available river discharge September through May, demand cannot be met without any facilities to store the available river discharge. It should be noted that while each of the three irrigation companies use a different amount of water, the percentage of the water demand received by each company is the same due to cooperative river management.

c. *Irrigation Efficiency*

The local duty of 5-acre feet per acre allows for 60 inches of water applied to the crops. As is present in the local area, dominantly sprinkler irrigation and some flood irrigation are occurring. Assuming an efficient system and process, alfalfa in this area requires 41.17 inches of water, or 3.43 acre-feet/acre[3] expected efficiency. If the entire irrigation area is converted to pressurized irrigation, it becomes more efficient and requires less water.

Currently all the system is not effective and functional because water is not available when the crop requires it. As noted earlier, the irrigators have historically overwatered in times of water availability and not meeting the needs of the crops when river levels are low. The goal of this project is to meet irrigation needs and crop production by storing water during periods of availability and then using it to meet crop needs.

[3] Consumptive Use of Irrigated Crops in Utah Research Report 145, Reprinted February 1998 – Orderville area

System efficiency in the Mt. Carmel Irrigation Company area will also be improved by piping existing open unlined ditches. The areas served by the opened unlined ditches currently are using flood irrigation to water their crops. The new piping will provide for future on-farm pressurized irrigation which will provide for additional efficiency. Approximately 50% of the Mt. Carmel Irrigation system uses flood irrigation. The remainder of the irrigation systems in the Glendale, Orderville, and Mt. Carmel irrigation companies use sprinkler irrigation, which is more efficient, but an adequate water supply is typically not available during the hot summer months. The net effect will be the reduction of water usage required for the three irrigation companies from 5 to 3.43 acre-feet per acre or 1,741 acre-feet which could be diverted and released from the reservoir in such a way as to satisfy downstream water rights and comply with the terms of the 1996 Zion Water Rights Settlement Agreement.

d. *Instream River Flows*

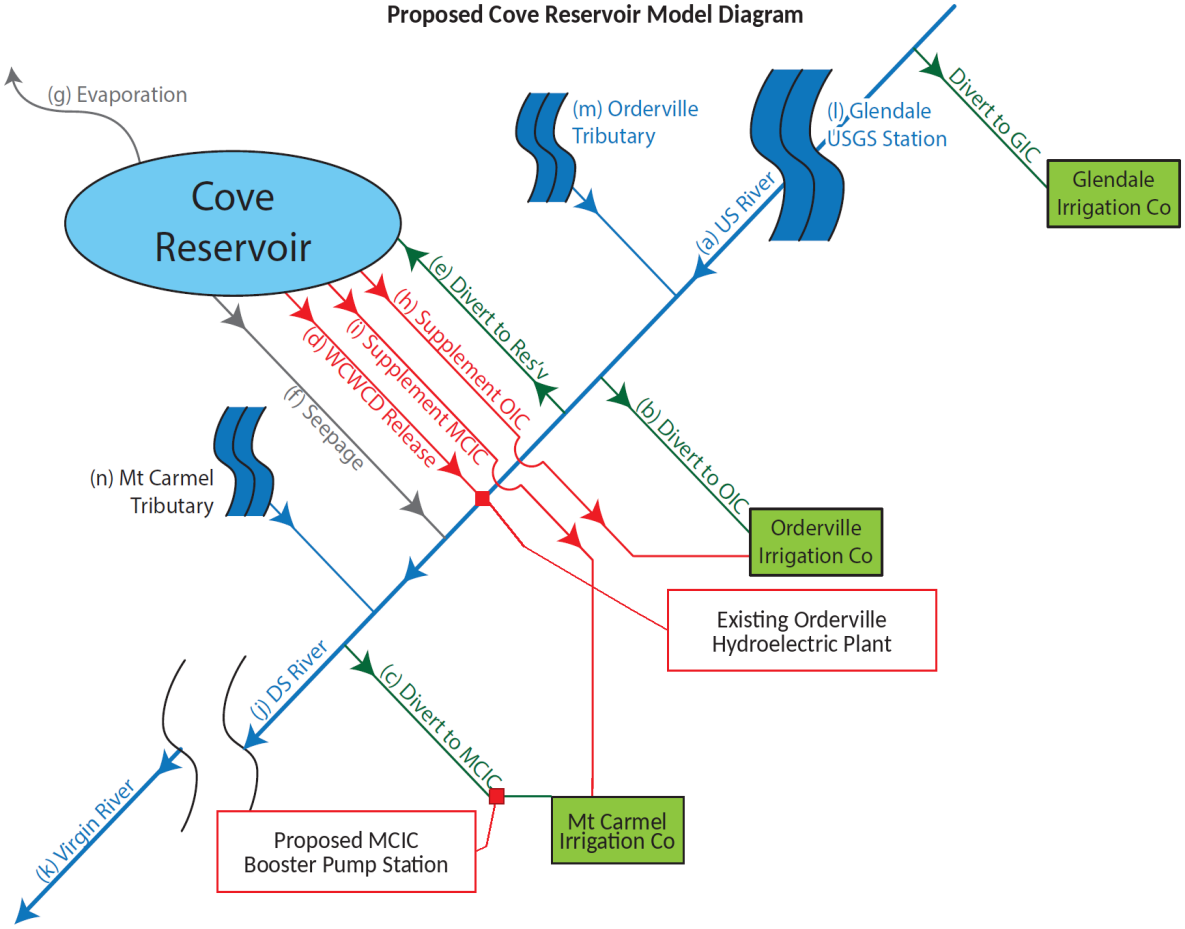
An agreement was established between the KCWCD, OIC, US Fish and Wildlife Service and Utah Division of Wildlife Resources in 2001 which requires a minimum discharge of 3.5 cfs below the OIC diversion dam when neither the MCIC or the OIC are diverting water for irrigation purposes, which is normally during the winter. This requirement is incorporated into the water model.

e. *Evaporation and Seepage*

Evaporation calculations were based on estimates from USU Report 145 for the Orderville area and monthly rates range from 0.18 to 4.95 inches, for a total of 26.61 inches annually. The model takes the modeled surface area of the reservoir and monthly evaporation rate into consideration when calculating evaporation quantities. RB&G Engineering[4] has provided estimated seepage rates of approximately 1/8 inch/day when the reservoir is full to zero when the reservoir is empty. Seepage losses are prorated based on reservoir elevation. This information is used in the model created for the reservoir. Based on geotechnical studies[5], seepage from the reservoir will return to the East Fork of the Virgin River stream channel. It is estimated there will be an average of 1 cfs (608 acre-feet/year) from the reservoir which will return to the stream channel below the reservoir.

[4] RB&G Tech Memo dated 5-19-2022
[5] RB&G Tech Memo dated 5-19-2022

B. Model Results



With information presented above, a model was created simulating the Cove Reservoir (See attached **Appendix B** for output). A diagram of the model is shown on **Figure 5**.

a. *Reservoir Diversion*

Water is currently piped through an existing 24-inch irrigation pipeline from the OIC diversion dam during periods of non-use by the irrigation companies for power production, while maintaining 3.5 cfs minimum water flow in the river below the OIC diversion during the winter months (or existing stream flow if below 3.5 cfs).

For purposes of modeling, the capacity of the existing diversion and piping system was evaluated. The irrigation pipeline has a capacity to deliver 22.2 cfs from the OIC diversion to the reservoir when it is empty and 12.6 cfs when full, based on head difference between diversion and reservoir level. Flows are released from the reservoir during the irrigation season to meet the consumptive use requirements for the irrigation companies. **Figure 6** shows the amount of water diverted to the reservoir throughout the year.

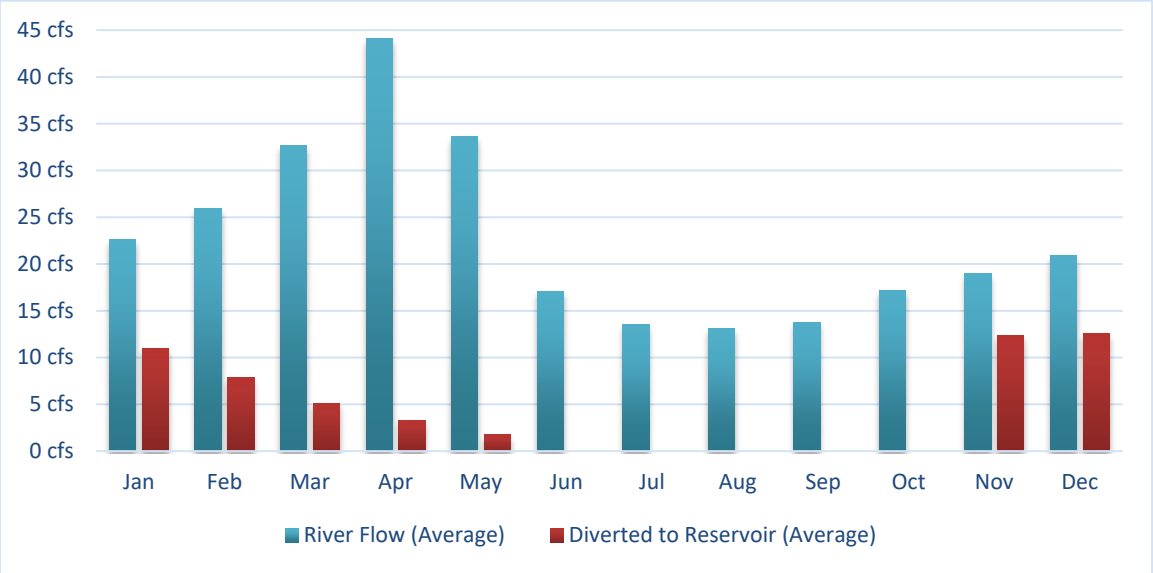


Figure 6 Average Diversion Rate to Cove Reservoir

b. *Local Irrigation Companies*

Prior to the proposed Cove Reservoir, water right demand has not fully been met 48 of 54 years of record, or a total of 6 years that water rights were fully met. This assumes 5 acre-feet of water required per irrigation acre. The three irrigation companies only had enough water to provide for full irrigation of 302 acres of their 1,109 acres during 90% of the years of record.

The three irrigation companies have the right to divert water year-round, not to exceed their maximum diversion rate and allotted annual diversion quantity. With implementation of the Cove Reservoir, the irrigation companies can store excess water when the crops do not require it and release stored water when the river flows do not meet crop demands. Water use demands would have been meet all 54 years of record for the GIC, OIC and MCIC. An average of 1,412 acre-feet of water is required to allow these irrigation companies to meet their full water right during the USGS period of record.

The GIC, OIC, and MCIC will divert water as required by the consumptive use of the crop being irrigated with sprinkler and some flood irrigation methods. This results in a more efficient use of the water requiring less water to be diverted. However, the depletion of water remains the same according to the Division of Water Rights. The benefit of the reservoir is supplying water to the agricultural areas when it is needed thus providing higher crop yields.

It is not possible to supplement Glendale Irrigation Company from the reservoir because the system is located higher than the reservoir, but the three irrigation companies work cooperatively and additional flows can be released to OIC and MCIC to satisfy their requirements while allowing GIC to divert their full water right. This increases the required demand supplemented from the reservoir to the OIC and MCIC, but not the overall demand when considering the three companies. **Figure 7** shows the irrigation demand for all three irrigation companies throughout the year, including average flows supplemented with this project.

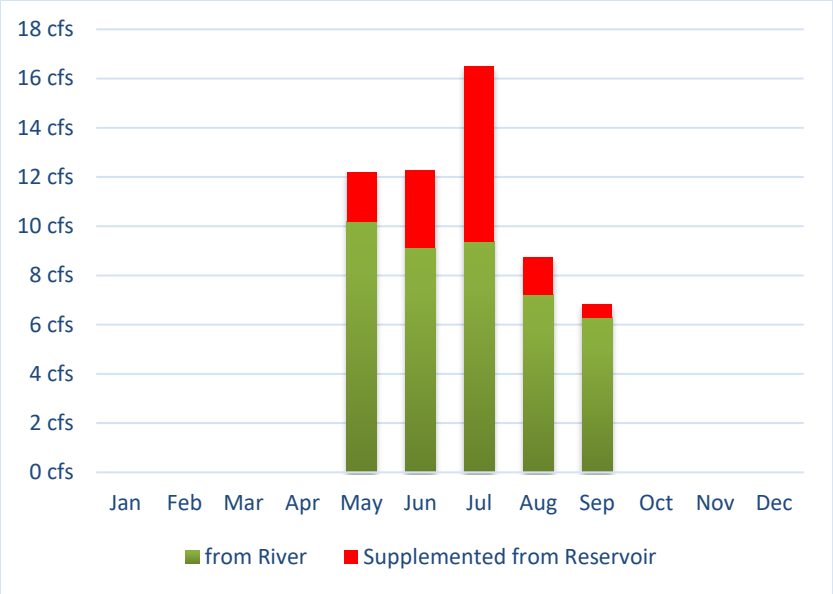


Figure 7 Irrigation Demand with Supplemented Flows

C. Washington County Water Conservancy District

The DOWR Model indicates the Cove Reservoir will provide up to an additional yield of approximately 700 acre-feet of water for use by the WCWCD with the WCWCD having water priority on the Virgin River. This is accomplished by diverting water during the non-irrigation season, November 1st to May 31st, when the existing downstream water rights are met and there is excess water available in the system when the Quail Creek Pipeline is full. This model shows a slightly different yield to the WCWCD as it does not model the Quail Creek Pipeline capacity.

The WCWCD will have the ability to store water during wet years and release water on dry years. **Figure 8** shows a conceptual release of 1,350-acre feet of water during a dry year to the WCWCD during the peak agricultural use period of June through August.

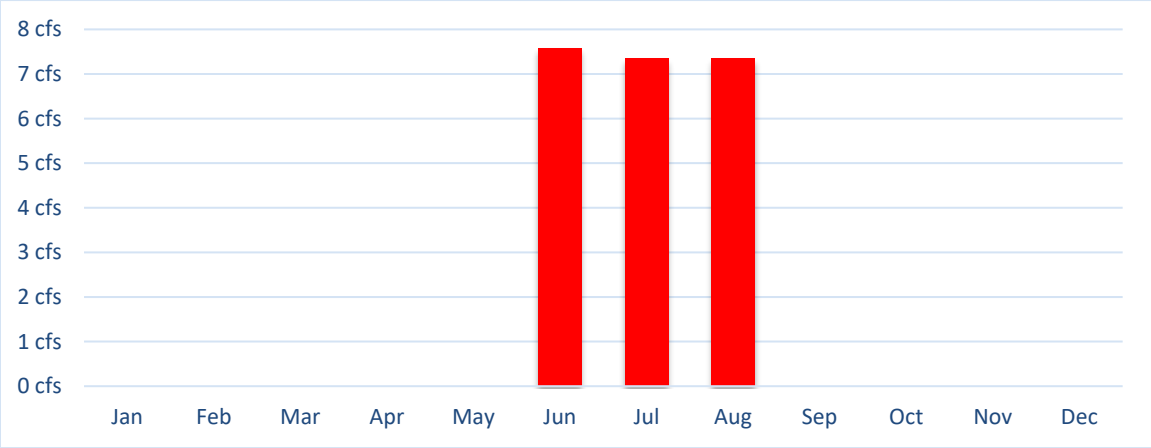


Figure 8 Flows Released to WCWCD

The WCWCD will be contracting with the Hurricane Canal Company (HCC) and providing water to its system in the Bench Lake area as well as provide for Municipal and Industrial use. During most years, there is not enough water in the river system to meet HCC's needs.

D. Downstream River Changes

An analysis was completed to determine the downstream effects to the East Fork of the Virgin River at Springdale as a result of the project, specifically analyzing water release from Cove Reservoir downstream to the WCWCD during June, July and August. The following are modeled stream stage and width changes expected as a result of changes in winter diversion of water and summer release:

- *Maximum Increase in river discharge: **+0.9 cfs** in August (**+2%** average discharge at Springdale)*
- *Maximum Decrease in Flow: **-11.7 cfs** in December (**-19%** average discharge at Springdale)*

The stream cross-section at the *East Fork at Springdale* USGS Gauging Station 9404900 is described in **Table 2**. The water depth and stream width in the channel is a function of river discharge.

Distance	Elevation	Distance	Elevation	Distance	Elevation
0	10.989	20	3.989	36	5.089
5	7.889	25	3.789	40	7.389
16	5.089	30	4.089	45	9.589
17	4.689	35	4.389		

Table 2 Stream Cross-Section at USGS Gauging Station 9404900 (Dimensions shown are in feet)

The rating curve is:

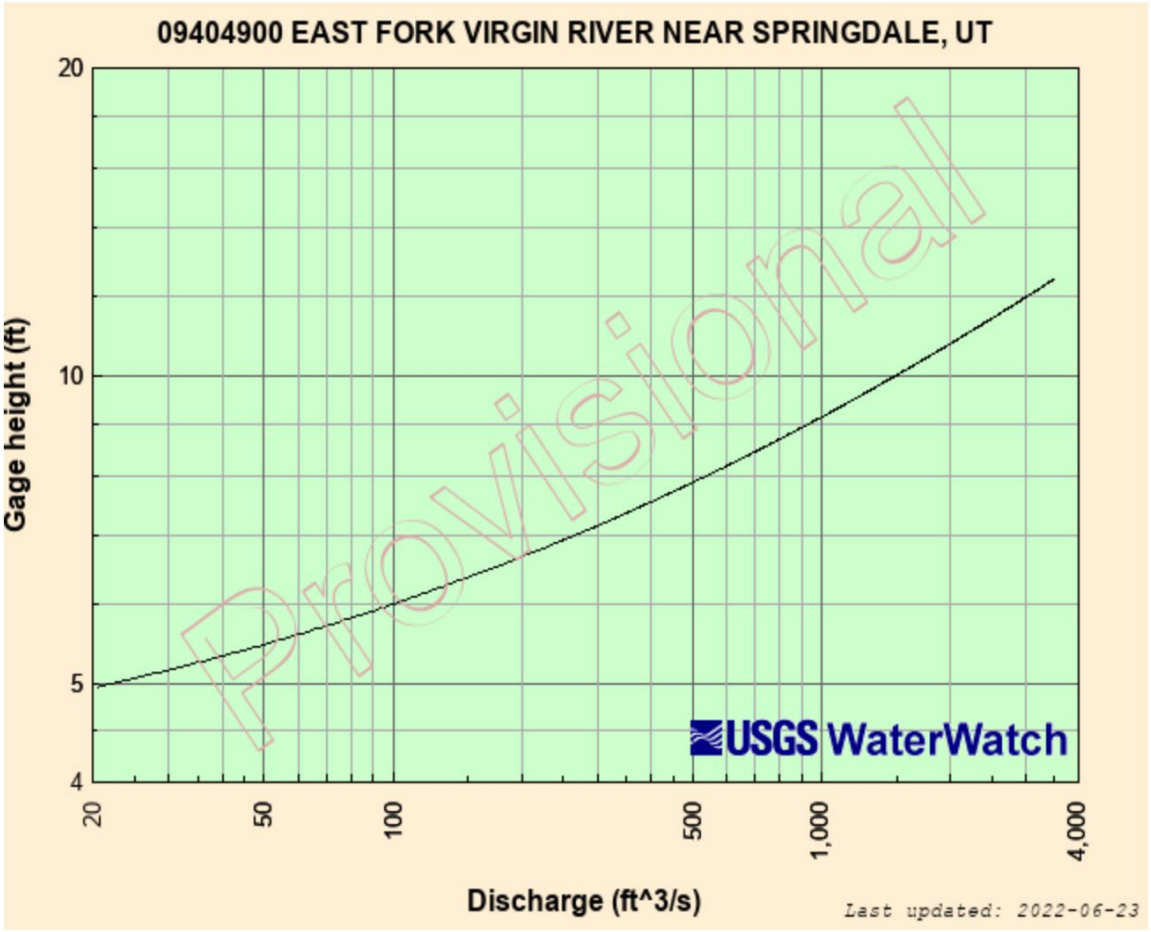


Figure 9 USGS rating curve for the East Fork Virgin River Near Springdale (USGS reference)

The maximum increase and depletion flows were incorporated into the stream gauge data and discharge rating curve to determine the change in the river cross-section (gauge height and stream cross-section width). The maximum increase in discharge was added to the wettest and driest August on record, while the maximum decrease in flow was subtracted from the wettest and driest December on record. The results are summarized below. In the tables on the following pages, "Elevation" reflects vertical depth and "Station" represents distance (spread) along the river section.

<u>Increase (+0.9 cfs in August)</u>

Wettest year discharge at Springdale (2022): 82.2 cfs
Driest year discharge at Springdale (2009): 34.8 cfs

Wettest Year (2013)

Depth

Before Project: 1.71 ft After Project: 1.72 ft

Width

Before Project: 22.31 ft After Project: 22.36 ft

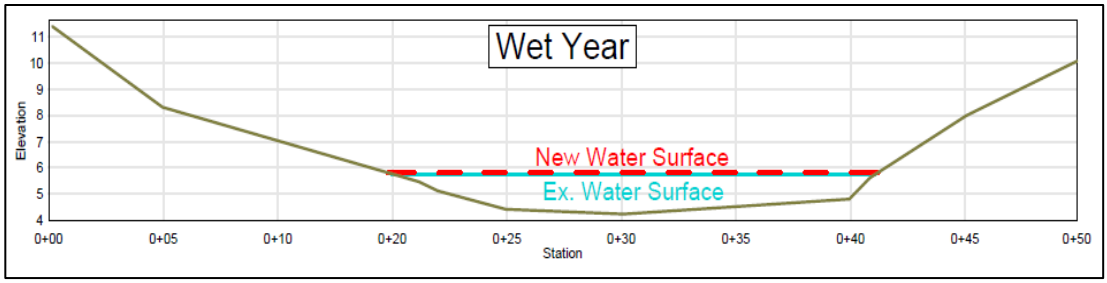


Figure 10 Increase in river cross-section (August) during wet year

Driest Year (2009)

Depth

Before Project: 1.13 ft After Project: 1.14 ft

Width

Before Project: 19.32 ft After Project: 19.37 ft

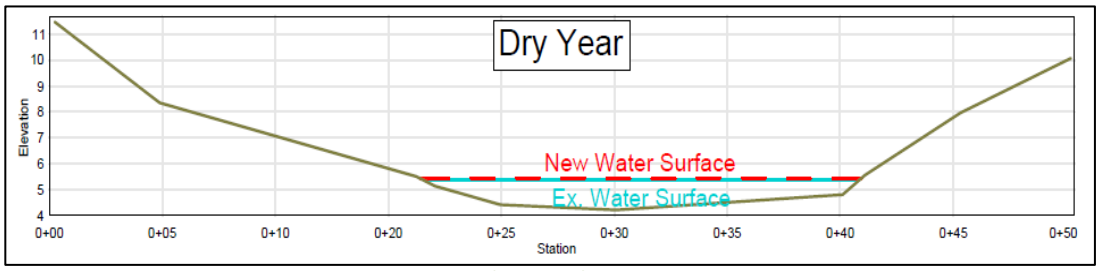


Figure 11 Increase in river cross-section (August) during dry year

<u>Decrease (-11.7 cfs in December)</u>

Wettest Year discharge in Channel at Springdale (2019): 64.9 cfs

Driest Year discharge in Channel at Springdale (2002): 44.7 cfs

Wettest Year (2019)

Depth

Before Project: 1.52 ft After Project: 1.38 ft

Width

Before Project: 21.24 ft After Project: 20.43 ft

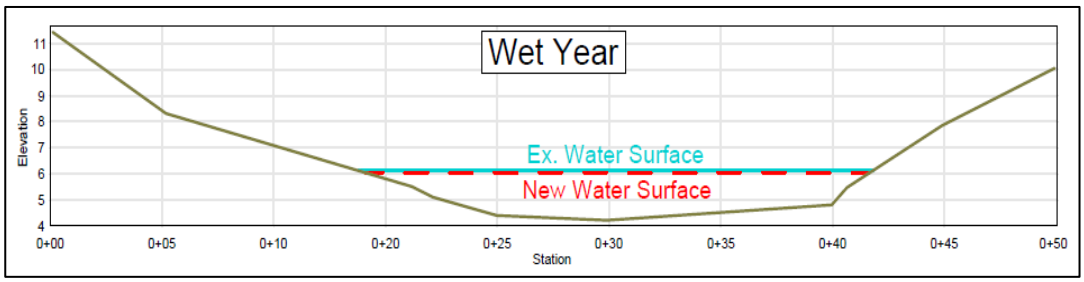


Figure 12 Decrease in river cross-section (December) during wet year

Driest Year (2002)

Depth

Before Project: 1.27 ft After Project: 1.10 ft

Width

Before Project: 19.86 ft After Project: 19.21 ft

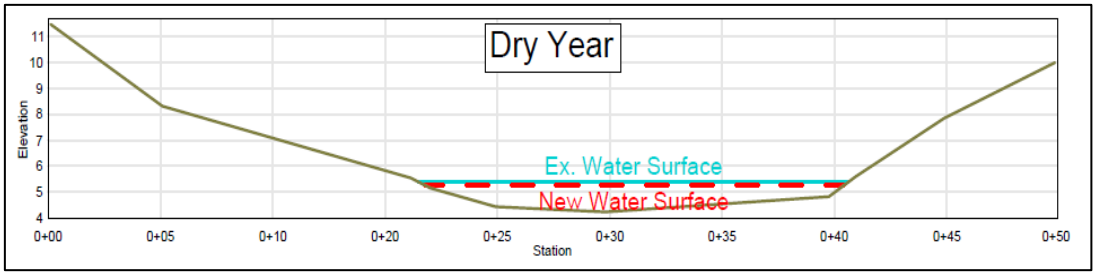


Figure 13 Decrease in river cross-section (December) during dry year

Highest and lowest discharge conditions were evaluated to capture the range of conditions that might occur on the river. Often average conditions in a data set, such as river discharge, may not be as meaningful or insightful.

Modelling of the change in low flow summer condition when 0.9 cfs of water would be released from the proposed Cove Reservoir to the East Fork of the Virgin River shows a net increase in river depth of 0.01 feet (0.12 inches) in the wettest August on record and a net increase in river depth of 0.01 feet (0.12 inches) in the driest August on record. Similarly, the same water release during the wettest and driest August on record shows the river width increasing 0.05 feet (0.6 inches) and 0.05 feet (0.6 inches), respectively.

Stream modeling of the winter conditions under which water would be diverted upstream from Cove Reservoir suggests a 11.7 cfs decrease in river discharge at the East Fork of the Virgin River at Springdale USGS gauge. This would be a net decrease in river depth of 0.14 feet (1.7 inches) and a net decrease in channel width of 0.81 ft in the wettest year on record for December. The net decrease in river depth would be 0.17 feet (2 inches) with a 0.65 ft decrease in channel width in the driest year on record for December.

Section 3 Flow Regime Comparison

A. Purpose

This analysis has been prepared to evaluate the anticipated changes in river flow associated with the proposed Cove Reservoir project. The purpose of this evaluation is to compare existing gauge records with modeled post-project river flows under conditions both without Washington County Water Conservancy District (WCWCD) deliveries and with an assumed WCWCD delivery of 15 cubic feet per second (cfs).

The analysis evaluates river flows at the Mount Carmel and Springdale gauges during average, driest, and wettest hydrologic conditions for each month of the year. Detailed results of the analysis are provided in **Appendix C** and **Appendix D** for water model results without WCWCD Delivery.

B. Objective

The objective of this analysis is to quantify anticipated changes in river flow resulting from reservoir operations and water deliveries. The analysis provides estimated changes in flow rates at the Mount Carmel and Springdale gauge locations.

The evaluation considers:

- Average monthly conditions.
- Driest recorded monthly conditions.
- Wettest recorded monthly conditions.
- Conditions without WCWCD delivery.
- Conditions with an assumed 15 cfs WCWCD delivery.

C. Methodology

The Water Model utilized historical streamflow data from the USGS Glendale Gauge (USGS 09404450 East Fork Virgin River Near Glendale, Utah) as the primary model input. Monthly flow records from January 1967 through December 2020 were used to develop representative hydrologic conditions and simulate reservoir operations.

The hydraulic model extends from the proposed reservoir to a downstream location near the Mount Carmel gauge. Model results were compared to observed flow records at the Mount Carmel and Springdale gauges to evaluate anticipated post-project river flows.

The Mount Carmel gauge (USGS 09404700 East Fork Virgin River Near Mount Carmel Junction, UT) is located immediately downstream of the modeled reach and therefore provides a direct

comparison between modeled conditions and observed river flows. Consequently, comparisons at the Mount Carmel gauge are considered representative of anticipated project impacts.

The Springdale gauge (USGS 09405500 North Fork Virgin River Near Springdale, Utah) is located approximately 20 miles downstream of the Mount Carmel gauge and receives additional tributary inflows and watershed contributions that are not represented within the original hydraulic model. Therefore, direct comparison between the model results and the Springdale gauge is not appropriate.

To estimate post-project conditions at Springdale, the differences between the observed Mount Carmel East Fork Virgin River gauge data and the modeled Mount Carmel results were applied to the observed Springdale East Fork Virgin River gauge records. This methodology provides an estimated post-project flow condition at the Springdale location while accounting for the additional downstream watershed contributions.

Additional analyses were performed to compare pre- and post-reservoir flows at both gauge locations under average, driest, and wettest hydrologic conditions.

Detailed monthly results and supporting figures are included in **Appendix C**.

D. Assumptions and Limitations

The following assumptions apply to this analysis:

- Historical flow records from the USGS Glendale gauge (January 1967 through December 2020) were used as the primary input to the original water model.
- The model simulates river conditions from the proposed reservoir to a location immediately downstream near the Mount Carmel gauge.
- Comparisons at the Mount Carmel gauge are considered representative because the gauge is located near the downstream extent of the modeled reach.
- The Springdale gauge includes additional tributary inflows and watershed contributions that are not represented in the original hydraulic model.
- Estimated post-project Springdale flows were developed by applying the modeled differences at Mount Carmel to the observed Springdale gauge records.
- An assumed WCWCD delivery of 15 cfs per scenario was evaluated separately from the hydraulic model.
- Any releases to the WCWCD would adhere to the settlement agreement which specifies releases from the reservoir “shall not increase the flow measured at the U.S. Geological Survey (USGS) gage on the East Fork Virgin River near Springdale (USGS No. 09404900), by more than 25 cfs during any 7-day period and shall not exceed the long-term monthly average at the Springdale gage by more than 15 cfs."

- The WCWCD delivery was not incorporated into the reservoir water surface calculations. Consequently, actual reservoir elevations under delivery conditions may be slightly lower than those predicted by the model.
- Results presented herein represent planning-level estimates and actual river flows may vary due to hydrologic conditions, operational practices, climate variability, and future water demands.

E. Summary of Findings

a. *Mount Carmel Gauge*

Under average monthly conditions without WCWCD delivery, modeled river flows generally decrease slightly during winter and spring months and increase during portions of the runoff season. Average monthly changes typically range from approximately -57 percent to +59 percent corresponding to a change in flow ranging from -11.0 cfs to +2.5 cfs in the months of November & July respectively.

During driest conditions, the project produces the largest relative changes. Without WCWCD delivery, reductions of approximately -70 percent to well over +3,400 percent occur, corresponding to a change in flow ranging from -11.9 cfs to +3.4 cfs in the months of December & August respectively.

Under wettest conditions, river flows generally remain similar to existing conditions, with changes ranging from approximately -16 percent to increases of +149 percent, corresponding to a change in flow ranging from -4.2 cfs to +97.0 cfs in the months of November & May respectively.

When the assumed 15 cfs WCWCD delivery is included, average monthly flows increase substantially. Average conditions show increases ranging from approximately +22 percent (+4.1 cfs in November) to well above +471 percent (+16.5 cfs in July). Driest conditions exhibit the largest relative increases, with December exceeding +18 percent (+3.1 cfs) and August exceeding 18,400 percent (+18.5 cfs) due to the relatively small existing flows. Wettest months average monthly flows shows increases ranging from +7% in March to 292% in July with corresponding river flow increases of 6.8 and 27.7 cfs.

b. *Springdale Gauge*

Because of additional watershed inflows between Mount Carmel and Springdale, the relative changes at the Springdale gauge are generally smaller.

Without WCWCD delivery, average monthly changes range from approximately -20 percent (-10.9 cfs in November) to +16 percent (+12.2 cfs in April). Driest conditions range from decreases of approximately -27 percent (-11.9 cfs in December) to increases of approximately +13 percent (+4.8 cfs in April & +4.6 cfs in October). Wettest conditions range from approximately -6 percent (-4.2 cfs in November) to increases of approximately 68 percent (+97.0 cfs in May).

With the assumed 15 cfs WCWCD delivery, average monthly flows at Springdale increase approximately +7 percent (+4.1 cfs in November) to +41 percent (+17.0 cfs in June). Driest conditions increase approximately +7 percent (+3.1 cfs in December) to +60 percent (+17.7 cfs in September), while wettest conditions increase approximately +4 percent (+6.8 cfs in March) to +78 percent (+112.0 cfs in May).

Overall, the analysis indicates that the relative effects of the project are greatest during low-flow periods and least during high-flow conditions when natural runoff dominates river flows.

F. Conclusions

The modeling indicates that the proposed project will result in measurable changes in river flows at both the Mount Carmel and Springdale gauges. The magnitude of change varies seasonally and is dependent upon hydrologic conditions.

The largest relative changes occur during dry periods when existing flows are relatively small. During wet periods, natural runoff generally dominates river conditions and the relative impacts become smaller.

The assumed 15 cfs WCWCD delivery substantially increases river flows under all hydrologic conditions. Because this delivery was not directly incorporated into the hydraulic model, actual reservoir water surface elevations under delivery conditions may be somewhat higher than those predicted by the model.

The tables and figures included with this addendum provide the detailed monthly flow comparisons and percentage changes for both gauge locations.

G. References

- USGS 09404700 East Fork Virgin River Near Mount Carmel Junction, Utah (January 1993 through October 2002).
- USGS 09405500 North Fork Virgin River Near Springdale, Utah (January 1992 through December 2025).
- USGS 09404500 East Fork Virgin River Near Glendale, Utah (January 1967 through December 2020).
- USGS 9404900 East Fork Virgin River Near Springdale Utah (October 1995 to December 2020).

Appendix A. Model Output

Model Parameters

Miscellaneous Parameters			
	Start Volume	0	af
Spillway Elevation		5550	ft
	Conservation	500	af
Volume at Spillway Crest		6032	af
Minimum flow in river		3.5	cfs
	Seepage	0.125	in/day

Hydro Parameters			
Hydro Elevation		5358	ft
Max Flow to Hydro		18	cfs
Hydro Efficiency		75%	
	Price per kW	$0.040	/kW

Tributary Parameters	Streamstats Average	% increase
Glendale USGS	19.4	0%
Orderville	23.3	20%
Mt Carmel	25.9	13%
pre-GIC USGS	15.8	-19%

Cove Reservoir Vlookup Parameters						
Elevation	Area, ac	Volume, af	Elevation[1]	Area, ac[1]	Volume, af[1]	Elevation
0	0	0	5470	0	0	0
5470	0	0	5472	0.1	0.1	5470
5472	0.1	0.1	5474	0.4	0.5	5472
5474	0.4	0.5	5476	2	2.8	5474
5476	2	2.8	5478	4.4	9.3	5476
5478	4.4	9.3	5480	7.2	20.9	5478
5480	7.2	20.9	5482	11.3	39.4	5480
5482	11.3	39.4	5484	14.5	65.2	5482
5484	14.5	65.2	5486	18.6	98.3	5484
5486	18.6	98.3	5488	22.2	139.2	5486
5488	22.2	139.2	5490	25.7	187.1	5488
5490	25.7	187.1	5492	29.8	242.6	5490
5492	29.8	242.6	5494	33.6	306	5492
5494	33.6	306	5496	37.2	276.8	5494
5496	37.2	276.8	5498	41.7	455.7	5496
5498	41.7	455.7	5500	45.8	543.1	5498
5500	45.8	543.1	5502	49.9	638.8	5500
5502	49.9	638.8	5504	54	742.7	5502
5504	54	742.7	5506	58.3	855	5504
5506	58.3	855	5508	63	976.3	5506
5508	63	976.3	5510	67.9	1107.2	5508
5510	67.9	1107.2	5512	73.1	1248.2	5510
5512	73.1	1248.2	5514	78	1399.3	5512
5514	78	1399.3	5516	82.4	1559.7	5514
5516	82.4	1559.7	5518	87.3	1729.4	5516
5518	87.3	1729.4	5520	92.3	1909	5518
5520	92.3	1909	5522	97.7	2098.9	5520
5522	97.7	2098.9	5524	103.3	2299.9	5522
5524	103.3	2299.9	5526	109.7	2513	5524
5526	109.7	2513	5528	115.7	2738.3	5526
5528	115.7	2738.3	5530	121.5	2975.5	5528
5530	121.5	2975.5	5532	127.4	3224.4	5530
5532	127.4	3224.4	5534	133.1	3484.9	5532
5534	133.1	3484.9	5536	139.2	3757.1	5534
5536	139.2	3757.1	5538	145.7	4042	5536
5538	145.7	4042	5540	152.4	4340	5538
5540	152.4	4340	5542	159.5	4652	5540
5542	159.5	4652	5544	166	4977.5	5542
5544	166	4977.5	5546	172.2	5315.7	5544
5546	172.2	5315.7	5548	178.8	5666.7	5546
5548	178.8	5666.7	5550	186.6	6032	5548
5550	186.6	6032	5552	193.2	6411.8	5550
5552	193.2	6411.8	5554	200.7	6805.7	5552
5554	200.7	6805.7	5556	206	7212.4	5554
5556	206	7212.4	5558	211.3	7629.7	5556
5558	211.3	7629.7	5560	217	8058	5558
5560	217	8058	0	0	0	5560

Monthly Parameters				
	Irrigate?	Max Hydro	ET	Divert?
Jan	n	0	0.00	y
Feb	n	0	0.00	y
Mar	n	0	0.71	y
Apr	n	0	2.53	y
May	y	0	4.31	y
Jun	y	0	4.95	n
Jul	y	0	4.95	n
Aug	y	0	3.96	n
Sep	y	0	3.23	n
Oct	n	0	1.79	n
Nov	n	0	0.18	y
Dec	n	0	0.00	y

Diversion to Cove based on Reservoir Water Level			
5470	22.2	cfs	
5560	12.6	cfs	

Water Right Calcs											
Required	5.00	af/ac		Irr Hours per Day		24.0					<< model outpu
Efficiency	45%	<< calc'd									
				GIC	434.00	OIC	286.00	MCIC	404.00	WC	
Month	Irr Days	Rate, in	Req'd Rate, in	GIC, af	GIC, cfs	OIC, af	OIC, cfs	MCIC, af	MCIC, cfs	YIELD, af	YIELD, cfs
January	0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
February	0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
March	0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
April	0	0.05	0.1	4.1	0.0	2.7	0.0	3.8	0.0	0.0	0.0
May	31	5.82	13.1	472.1	7.7	311.1	5.1	439.5	7.1	0.0	0.0
June	30	5.66	12.7	459.1	7.7	302.6	5.1	427.4	7.2	451.3	7.6
July	31	7.87	17.7	638.4	10.4	420.7	6.8	594.3	9.7	451.3	7.3
August	31	4.16	9.3	337.5	5.5	222.4	3.6	314.1	5.1	451.3	7.3
September	30	3.19	7.2	258.8	4.3	170.5	2.9	240.9	4.0	0.0	0.0
October	0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
November	0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
December	0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Annual	153	26.75	60.00	2170.00	7.2	1430.00	4.7	2020.00	6.7	1354.00	4.5

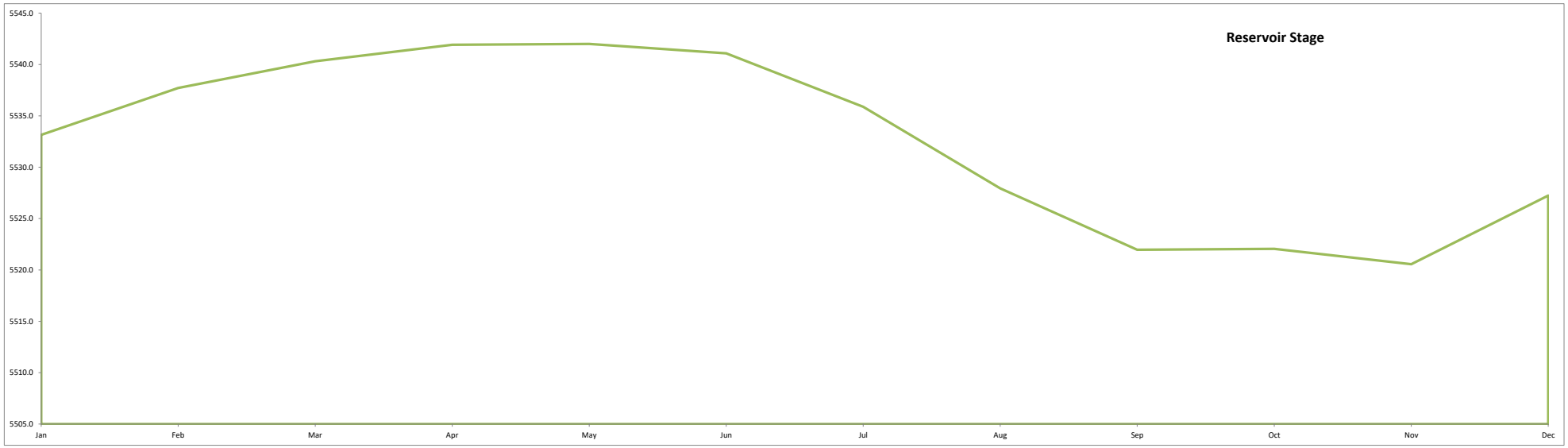
AF to CFS Calculator			
94,525,200.0	cf/yr	6.0	mo/yr
15,754,200.0	cf/irr mo	30	d/mo
525,140.0	cf/d	12.0	h/d
43,761.7	cf/h		
729.4	cf/m		
12.2	cfs		

5620.00

Average Annual Summary

Cove Reservoir Average Annual Simulation

	Reservoir at Beginning of Month			Pre-Glendale USGS Data	Glendale USGS Data	Orderville Tributary		Mt Carmel Tributary		Glendal Irr Co	Orderville Irr Co			Mt Carmel Irr Co			OIC + MCIC			Total Irr Co			WCWCD	Divert to Res'v	Losses		Supp to Irr Co	Supp to Irr Co & WCWCD	Final River (inc WCWCD)	Res'v Flux	Change in River
	Reservoir Stage	Reservoir Volume	Reservoir Surface Area	Flow	Flow	Flow	Cumulative Flow	Flow	Cumulative Flow	Demand	Demand	Demand, from River	Demand, from Res'v	Demand	Demand, from River	Demand, from Res'v	Demand	Demand, from River	Demand, from Res'v	Demand	Prorated Demand, from River	Prorated Demand, from Res'v	Release, from Res'v	In	Seepage	Evaporation	Out	Out	Flow	Volume	Flow
	ft	ac-ft	ac	cfs	cfs	cfs		cfs		cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	ac-ft	cfs
Jan	5533.2	3,374.3	130.7	13.8	16.9	3.4	20.3	2.3	22.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1	0.9	0.0	0.0	0.0	12.4	626.7	-10.2
Feb	5537.7	4,001.0	144.8	15.8	19.4	3.9	23.3	2.6	25.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.9	0.9	0.0	0.0	0.0	18.9	387.6	-7.0
Mar	5540.3	4,388.6	153.5	19.9	24.4	4.9	29.4	3.3	32.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	0.9	0.2	0.0	0.0	28.4	250.8	-4.3
Apr	5541.9	4,639.4	159.2	26.9	33.0	6.6	39.7	4.4	44.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	1.0	0.7	0.0	0.0	41.7	102.4	-2.4
May	5542.0	4,652.0	159.5	20.5	25.2	5.1	30.2	3.4	33.6	7.7	5.1	4.9	0.1	7.1	5.3	1.9	12.2	10.2	2.0	19.9	16.6	3.3	0.0	1.7	1.0	1.1	2.0	2.0	22.7	-142.9	-11.0
Jun	5541.1	4,509.1	156.2	10.4	12.8	2.6	15.3	1.7	17.0	7.7	5.1	4.6	0.5	7.2	4.6	2.6	12.3	9.1	3.2	20.0	14.8	5.1	7.6	0.0	0.9	1.2	3.2	10.7	16.4	-768.3	-0.6
Jul	5535.9	3,740.8	138.8	8.2	10.1	2.0	12.1	1.4	13.5	10.4	6.8	5.3	1.6	9.7	4.1	5.5	16.5	9.4	7.1	26.9	15.3	11.6	7.3	0.0	0.9	1.1	7.1	14.5	12.3	-1,008.6	-1.2
Aug	5527.9	2,732.2	115.5	8.0	9.8	2.0	11.8	1.3	13.1	5.5	3.6	3.4	0.2	5.1	3.8	1.3	8.7	7.2	1.5	14.2	11.7	2.5	7.3	0.0	0.7	0.8	1.5	8.9	14.0	-636.7	0.9
Sep	5522.0	2,095.4	97.6	8.4	10.3	2.1	12.4	1.4	13.8	4.3	2.9	2.8	0.0	4.0	3.5	0.5	6.9	6.3	0.6	11.3	10.2	0.9	-0.1	0.0	0.7	0.6	0.6	0.5	8.1	-103.6	-5.7
				10.5	12.9	2.6	15.5	1.7	17.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.3	0.0	0.0	17.8	-57.7	0.6
Nov	5520.6	1,962.0	93.8	11.6	14.2	2.9	17.1	1.9	19.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.4	0.7	0.0	0.0	0.0	7.3	690.2	-11.6
Dec	5527.2	2,652.2	113.4	12.7	15.6	3.1	18.8	2.1	20.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.6	0.8	0.0	0.0	0.0	9.1	722.1	-11.7
Average			**130**	**13.9**	**17.1**	**3.4**		**2.3**				**1.7**	**0.2**		**1.8**	**1.0**		**3.5**	**1.2**		**5.7**	**2.0**	**1.9**	**4.5**	**0.8**	**0.5**		**3.0**	**17.4**		
Total AF				**10056**	**12347**	**2482**		**1655**				**1265**	**151**		**1280**	**716**		**2546**	**867**		**4147**	**1412**	**1340**	**3267**	**607**	**355**		**2206**	**12618**		



Model Simulation

Date		Reservoir Start			Glendale USGS Data Backed to Glendale	to GIC					Glendale USGS Data	Orderville Tributary	River	to OIC					to COVE				Reservoir Int1			Seepage		Evaporation		Reservoir Int2			Mt Carmel Tributary	Seepage Return	River	to MCIC				WC Release	River	Reservoir End		
Yr	Mo	Volume	Elevation	Area	Ave Flow	From River		Supp	Pre Cove Full	Full?	Ave Flow	Ave Flow	Ave Flow	River	Supp	Pre Cove Full	Full?	Hydraulic Ca	to Fill Resv	Control	River	Volume	Elevation	Area					Volume	Elevation	Area	Ave Flow	Ave Flow	Ave Flow	River	Supp	Pre Cove Full	Full?	Supp	Ave Flow	Sum Supp	Volume	Elevation	Area
		af	ft	ac	cfs	cfs	Max Supp	cfs			cfs	cfs	cfs	cfs	cfs			cfs	cfs	cfs	cfs	af	ft	ac	af	cfs	af	cfs	af	ft	ac	cfs	cfs	cfs	cfs	cfs			cfs	cfs	cfs	af	ft	ac
1967	Jan	500.0	5499.0	43.8	14.7	0.0	0.0	0.0	Yes	Yes	18.0	3.6	21.6	0.0	0.0	Yes	Yes	19.1	90.0	19.1	18.1	1614.1	5516.6	84.0	27.1	0.4	0.0	0.0	1,587.0	5,516.3	83.2	2.4	0.4	6.4	0.0	0.0	Yes	Yes	0.0	6.4	0.0	1,587.0	5,516.3	83.2
1967	Feb	1587.0	5516.3	83.2	16.1	0.0	0.0	0.0	Yes	Yes	19.8	4.0	23.8	0.0	0.0	Yes	Yes	17.3	80.0	17.3	17.3	2545.5	5526.3	110.6	32.2	0.6	0.0	0.0	2,513.2	5,526.0	109.7	2.7	0.6	9.8	0.0	0.0	Yes	Yes	0.0	9.8	0.0	2,513.2	5,526.0	109.7
1967	Mar	2513.2	5526.0	109.7	17.8	0.0	0.0	0.0	Yes	Yes	21.9	4.4	26.3	0.0	0.0	Yes	Yes	16.2	57.2	16.2	16.2	3510.9	5534.2	133.7	43.2	0.7	7.9	0.1	3,459.9	5,533.8	132.6	2.9	0.7	13.7	0.0	0.0	Yes	Yes	0.0	13.7	0.0	3,459.9	5,533.8	132.6
1967	Apr	3459.9	5533.8	132.6	19.5	0.0	0.0	0.0	Yes	Yes	23.9	4.8	28.7	0.0	0.0	Yes	Yes	15.4	43.2	15.4	15.4	4375.9	5540.2	153.2	47.9	0.8	32.3	0.5	4,295.7	5,539.7	151.4	3.2	0.8	17.3	0.0	0.0	Yes	Yes	0.0	17.3	0.0	4,295.7	5,539.7	151.4
1967	May	4295.7	5539.7	151.4	16.9	7.7	0.0	0.0	Yes	Yes	20.7	4.2	24.9	5.1	0.0	Yes	Yes	14.8	28.2	14.8	14.8	5203.6	5545.3	170.1	54.9	0.9	61.1	1.0	5,087.5	5,544.7	168.0	2.8	0.9	8.7	5.2	1.9	Yes	Yes	0.0	3.5	1.9	4,968.0	5,543.9	165.8
1967	Jun	4968.0	5543.9	165.8	15.2	7.7	0.0	0.0	Yes	Yes	18.7	3.8	22.5	5.1	0.0	Yes	Yes	14.3	17.9	0.0	0.0	4968.0	5543.9	165.8	51.8	0.9	68.4	1.1	4,847.8	5,543.2	163.4	2.5	0.9	20.8	7.2	0.0	Yes	Yes	7.6	21.2	7.6	4,396.5	5,540.4	153.7
1967	Jul	4396.5	5540.4	153.7	10.9	10.4	0.0	0.0	Yes	Yes	13.4	2.7	16.1	6.8	0.0	Yes	Yes	14.7	26.6	0.0	0.0	4396.5	5540.4	153.7	49.6	0.8	63.4	1.0	4,283.4	5,539.6	151.1	1.8	0.8	11.9	8.4	1.3	No	Yes	7.3	10.8	8.7	3,751.5	5,536.0	139.1
1967	Aug	3751.5	5536.0	139.1	12.6	5.5	0.0	0.0	Yes	Yes	15.5	3.1	18.6	3.6	0.0	Yes	Yes	15.2	37.1	0.0	0.0	3751.5	5536.0	139.1	44.9	0.7	45.9	0.7	3,660.7	5,535.3	137.0	2.1	0.7	17.8	5.1	0.0	Yes	Yes	7.3	20.0	7.3	3,209.4	5,531.9	127.0
1967	Sep	3209.4	5531.9	127.0	14.6	4.3	0.0	0.0	Yes	Yes	17.9	3.6	21.5	2.9	0.0	Yes	Yes	15.6	47.4	0.0	0.0	3209.4	5531.9	127.0	39.7	0.7	34.2	0.6	3,135.5	5,531.3	125.3	2.4	0.7	21.7	4.0	0.0	Yes	Yes	0.0	17.7	0.0	3,135.5	5,531.3	125.3
1967	Oct	3135.5	5531.3	125.3	11.8	0.0	0.0	0.0	Yes	Yes	14.5	2.9	17.4	0.0	0.0	Yes	Yes	15.7	47.1	0.0	0.0	3135.5	5531.3	125.3	40.5	0.7	18.7	0.3	3,076.3	5,530.8	123.9	1.9	0.7	20.0	0.0	0.0	Yes	Yes	0.0	20.0	0.0	3,076.3	5,530.8	123.9
1967	Nov	3076.3	5530.8	123.9	12.9	0.0	0.0	0.0	Yes	Yes	15.8	3.2	19.0	0.0	0.0	Yes	Yes	15.7	49.7	15.7	15.5	3997.2	5537.7	144.7	45.2	0.8	2.2	0.0	3,949.8	5,537.4	143.6	2.1	0.8	6.4	0.0	0.0	No	Yes	0.0	6.4	0.0	3,949.8	5,537.4	143.6
1967	Dec	3949.8	5537.4	143.6	13.9	0.0	0.0	0.0	Yes	Yes	17.1	3.4	20.5	0.0	0.0	Yes	Yes	15.0	33.9	15.0	15.0	4873.1	5543.4	163.9	52.9	0.9	0.0	0.0	4,820.2	5,543.0	162.9	2.3	0.9	8.7	0.0	0.0	No	Yes	0.0	8.7	0.0	4,820.2	5,543.0	162.9
1968	Jan	4820.2	5543.0	162.9	14.1	0.0	0.0	0.0	Yes	Yes	17.3	3.5	20.8	0.0	0.0	Yes	Yes	14.4	19.7	14.4	14.4	5706.2	5548.2	179.6	58.0	0.9	0.0	0.0	5,648.2	5,547.9	178.5	2.3	0.9	9.6	0.0	0.0	No	Yes	0.0	9.6	0.0	5,648.2	5,547.9	178.5
1968	Feb	5648.2	5547.9	178.5	17.9	0.0	0.0	0.0	Yes	Yes	22.0	4.4	26.4	0.0	0.0	Yes	Yes	13.9	6.9	6.9	6.9	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.9	1.0	23.4	0.0	0.0	No	Yes	0.0	23.4	0.0	5,977.6	5,549.7	185.4
1968	Mar	5977.6	5549.7	185.4	20.4	0.0	0.0	0.0	Yes	Yes	25.1	5.0	30.1	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	3.4	1.0	33.6	0.0	0.0	No	Yes	0.0	33.6	0.0	5,960.7	5,549.6	185.1
1968	Apr	5960.7	5549.6	185.1	21.5	0.0	0.0	0.0	Yes	Yes	26.4	5.3	31.7	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	3.5	1.0	35.0	0.0	0.0	No	Yes	0.0	35.0	0.0	5,934.3	5,549.5	184.5
1968	May	5934.3	5549.5	184.5	18.1	7.7	0.0	0.0	Yes	Yes	22.2	4.5	26.7	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	3.0	1.0	24.0	7.1	0.0	Yes	Yes	0.0	16.8	0.0	5,904.7	5,549.3	183.9
1968	Jun	5904.7	5549.3	183.9	12.8	7.7	0.0	0.0	Yes	Yes	15.7	3.2	18.9	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	2.1	1.0	16.8	7.2	0.0	Yes	Yes	7.6	17.2	7.6	5,320.1	5,546.0	172.3
1968	Jul	5320.1	5546.0	172.3	11.7	10.4	0.0	0.0	Yes	Yes	14.4	2.9	17.3	6.8	0.0	Yes	Yes	14.1	11.6	0.0	0.0	5320.1	5546.0	172.3	55.6	0.9	71.1	1.2	5,193.4	5,545.3	170.0	1.9	0.9	13.3	9.7	0.0	No	Yes	7.3	11.0	7.3	4,742.0	5,542.6	161.3
1968	Aug	4742.0	5542.6	161.3	14.6	5.5	0.0	0.0	Yes	Yes	17.9	3.6	21.5	3.6	0.0	Yes	Yes	14.8	21.0	0.0	0.0	4742.0	5542.6	161.3	52.1	0.8	53.2	0.9	4,636.7	5,541.9	159.2	2.4	0.8	21.1	5.1	0.0	Yes	Yes	7.3	23.4	7.3	4,185.4	5,539.0	148.9
1968	Sep	4185.4	5539.0	148.9	9.5	4.3	0.0	0.0	Yes	Yes	11.7	2.4	14.1	2.9	0.0	Yes	Yes	14.8	31.0	0.0	0.0	4185.4	5539.0	148.9	46.5	0.8	40.1	0.7	4,098.8	5,538.4	147.0	1.6	0.8	13.5	4.0	0.0	Yes	Yes	0.0	9.5	0.0	4,098.8	5,538.4	147.0
1968	Oct	4098.8	5538.4	147.0	10.8	0.0	0.0	0.0	Yes	Yes	13.3	2.7	16.0	0.0	0.0	Yes	Yes	14.9	31.4	0.0	0.0	4098.8	5538.4	147.0	47.5	0.8	21.9	0.4	4,029.4	5,537.9	145.4	1.8	0.8	18.5	0.0	0.0	No	Yes	0.0	18.5	0.0	4,029.4	5,537.9	145.4
1968	Nov	4029.4	5537.9	145.4	12.0	0.0	0.0	0.0	Yes	Yes	14.7	3.0	17.7	0.0	0.0	Yes	Yes	15.0	33.7	15.0	14.2	4871.7	5543.3	163.9	51.2	0.9	2.5	0.0	4,818.0	5,543.0	162.8	2.0	0.9	6.3	0.0	0.0	No	Yes	0.0	6.3	0.0	4,818.0	5,543.0	162.8
1968	Dec	4818.0	5543.0	162.8	12.1	0.0	0.0	0.0	Yes	Yes	14.8	3.0	17.8	0.0	0.0	Yes	Yes	14.4	19.7	14.4	14.3	5695.8	5548.2	179.4	57.9	0.9	0.0	0.0	5,637.8	5,547.8	178.3	2.0	0.9	6.4	0.0	0.0	No	Yes	0.0	6.4	0.0	5,637.8	5,547.8	178.3
1969	Jan	5637.8	5547.8	178.3	20.4	0.0	0.0	0.0	Yes	Yes	25.0	5.0	30.0	0.0	0.0	Yes	Yes	13.9	6.4	6.4	6.4	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	3.4	1.0	27.9	0.0	0.0	No	Yes	0.0	27.9	0.0	5,971.7	5,549.7	185.3
1969	Feb	5971.7	5549.7	185.3	17.8	0.0	0.0	0.0	Yes	Yes	21.8	4.4	26.2	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.9	1.0	29.0	0.0	0.0	No	Yes	0.0	29.0	0.0	5,977.6	5,549.7	185.4
1969	Mar	5977.6	5549.7	185.4	25.7	0.0	0.0	0.0	Yes	Yes	31.5	6.3	37.8	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	4.2	1.0	42.1	0.0	0.0	No	Yes	0.0	42.1	0.0	5,960.7	5,549.6	185.1
1969	Apr	5960.7	5549.6	185.1	107.5	0.0	0.0	0.0	Yes	Yes	132.0	26.5	158.5	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	17.7	1.0	176.0	0.0	0.0	No	Yes	0.0	176.0	0.0	5,934.3	5,549.5	184.5
1969	May	5934.3	5549.5	184.5	63.5	7.7	0.0	0.0	Yes	Yes	78.0	15.7	93.7	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	10.5	1.0	98.5	7.1	0.0	No	Yes	0.0	91.3	0.0	5,904.7	5,549.3	183.9
1969	Jun	5904.7	5549.3	183.9	26.8	7.7	0.0	0.0	Yes	Yes	32.9	6.6	39.5	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	4.4	1.0	39.8	7.2	0.0	Yes	Yes	7.6	40.2	7.6	5,320.1	5,546.0	172.3
1969	Jul	5320.1	5546.0	172.3	22.7	10.4	0.0	0.0	Yes	Yes	27.9	5.6	33.5	6.8	0.0	Yes	Yes	14.1	11.6	0.0	0.0	5320.1	5546.0	172.3	55.6	0.9	71.1	1.2	5,193.4	5,545.3	170.0	3.7	0.9	31.3	9.7	0.0	Yes	Yes	7.3	29.0	7.3	4,742.0	5,542.6	161.3
1969	Aug	4742.0	5542.6	161.3	16.9	5.5	0.0	0.0	Yes	Yes	20.8	4.2	25.0	3.6	0.0	Yes	Yes	14.5	21.0	0.0	0.0	4742.0	5542.6	161.3	52.1	0.8	53.2	0.9	4,636.7	5,541.9	159.2	2.8	0.8	25.0	5.1	0.0	Yes	Yes	7.3	27.2	7.3	4,185.4	5,539.0	148.9
1969	Sep	4185.4	5539.0	148.9	13.5	4.3	0.0	0.0	Yes	Yes	16.6	3.3	19.9	2.9	0.0	Yes	Yes	14.8	31.0	0.0	0.0	4185.4	5539.0	148.9	46.5	0.8	40.1	0.7	4,098.8	5,538.4	147.0	2.2	0.8	20.1	4.0	0.0	Yes	Yes	0.0	16.0	0.0	4,098.8	5,538.4	147.0
1969	Oct	4098.8	5538.4	147.0	15.0	0.0	0.0	0.0	Yes	Yes	18.4	3.7	22.1	0.0	0.0	Yes	Yes	14.9	31.4	0.0	0.0	4098.8	5538.4	147.0	47.5	0.8	21.9	0.4	4,029.4	5,537.9	145.4	2.5	0.8	25.3	0.0	0.0	No	Yes	0.0	25.3	0.0	4,029.4	5,537.9	145.4
1969	Nov	4029.4	5537.9	145.4	15.6	0.0	0.0	0.0	Yes	Yes	19.1	3.8	22.9	0.0	0.0	Yes	Yes	15.0	33.7	15.0	15.0	4919.3	5543.6	164.8	51.5	0.9	2.5	0.0	4,865.4	5,543.3	163.8	2.6	0.9	11.4	0.0	0.0	No	Yes	0.0	11.4	0.0	4,865.4	5,543.3	163.8
1969	Dec	4865.4	5543.3	163.8	14.1	0.0	0.0	0.0	Yes	Yes	17.3	3.5	20.8	0.0	0.0	Yes	Yes	14.4	19.0	14.4	14.4	5749.6	5548.6	180.6	58.3	0.9	0.0	0.0	5,691.2	5,548.1	179.3	2.3	0.9	9.7	0.0	0.0	No	Yes	0.0	9.7	0.0	5,691.2	5,548.1	179.3
1970	Jan	5691.2	5548.1	179.3	14.3	0.0	0.0	0.0	Yes	Yes	17.6	3.5	21.1	0.0	0.0	Yes	Yes	13.9	5.5	5.5	5.5	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.4	1.0	18.9	0.0	0.0	No	Yes	0.0	18.9	0.0	5,971.7	5,549.7	185.3
1970	Feb	5971.7	5549.7	185.3	19.6	3.9	0.0	0.0	Yes	Yes	23.5	4.7	28.2	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.6	1.0	26.1	0.0	0.0	No	Yes	0.0	26.1	0.0	5,977.6	5,549.7	185.4
1970	Mar	5977.6	5549.7	185.4	17.2	0.0	0.0	0.0	Yes	Yes	21.1	4.2	25.3	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	2.8	1.0	28.3	0.0	0.0	No	Yes	0.0	28.3	0.0	5,960.7	5,549.6	185.1
1970	Apr	5960.7	5549.6	185.1	13.3	0.0	0.0	0.0	Yes	Yes	16.3	3.3	19.6	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	2.2	1.0	21.5	0.0	0.0	No	Yes	0.0	21.5	0.0	5,934.3	5,549.5	184.5
1970	May	5934.3	5549.5	184.5	11.8	7.7	0.0	0.0	Yes	Yes	14.5	2.9	17.4	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	1.9	1.0	13.7	7.1	0.0	Yes	Yes	0.0	6.5	0.0	5,904.7	5,549.3	183.9
1970	Jun	5904.7	5549.3	183.9	9.6	7.7	0.0	0.0	Yes	Yes	11.8	2.4	14.2	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	1.6	1.0	11.6	7.2	0.0	No	Yes	7.6	12.0	7.6	5,320.1	5,546.0	172.3
1970	Jul	5320.1	5546.0	172.3	9.0	0.0	0.0	No	No	No	11.0	2.2	13.2	6.8	0.0	Yes	Yes	14.1	11.6	0.0	0.0	5320.1	5546.0	172.3	55.6	0.9	71.1	1.2	5,193.4	5,545.3	170.0	1.5	0.9	8.7	5.2	4.4	No	Yes	7.3	10.8	11.8	4,470.4	5,540.8	155.4
1970	Aug	4470.4	5540.8	155.4	8.9	5.5	0.0	0.0	Yes	Yes	10.9	2.2	13.1	3.6	0.0	Yes	Yes	14.6	25.4	0.0	0.0	4470.4	5540.8	155.4	50.2	0.8	51.3	0.8	4,369.0	5,540.2	153.1	1.5	0.8	11.8	5.1	0.0	Yes	Yes	7.3	14.0	7.3	3,917.7	5,537.1	142.9
1970	Sep	3917.7	5537.1	142.9	9.0	4.3	0.0	0.0	Yes	Yes	11.0	2.2	13.2	2.9	0.0	Yes	Yes	15.0	35.5	0.0	0.0	3917.7	5537.1	142.9	44.6	0.8	38.5	0.6	3,834.6	5,536.5	141.0	1.5	0.8	12.6	4.0	0.0	Yes	Yes	0.0	8.5	0.0	3,834.6	5,536.5	141.0
1970	Oct	3834.6	5536.5	141.0	10.6	0.0	0.0	0.0	Yes	Yes	13.0	2.6	15.6	0.0	0.0	Yes	Yes	15.1	35.7	0.0	0.0	3834.6	5536.5	141.0	45.5	0.7	21.0	0.3	3,768.0	5,536.1	139.4	1.7	0.7	18.1	0.0	0.0	No	Yes	0.0	18.1	0.0	3,768.0	5,536.1	139.4
1970	Nov	3768.0	5536.1	139.4	13.0	0.0	0.0	0.0	Yes	Yes	16.0	3.2	19.2	0.0	0.0	Yes	Yes	15.2	38.0	15.2	15.2	4669.6	5542.1	159.9	50.0	0.8	2.4	0.0	4,617.3	5,541.8	158.7	2.1	0.8	7.0	0.0	0.0	No	Yes	0.0	7.0	0.0	4,617.3	5,541.8	158.7
1970	Dec	4617.3	5541.8	158.7	12.9	0.0	0.0	0.0	Yes	Yes	15.9	3.2	19.1	0.0	0.0	Yes	Yes	14.5	23.0	14.5	14.5	5513.5	5547.1	175.9	56.8	0.9	0.0	0.0	5,454.7	5,546.8	174.8	2.1	0.9	7.6	0.0	0.0	No	Yes	0.0	7.6	0.0	5,454.7	5,546.8	174.8
1971	Jan	5454.7	5546.8	174.8	14.7	0.0	0.0	0.0	Yes	Yes	18.0	3.6	21.6	0.0	0.0	Yes	Yes	14.0	9.4	9.4	9.4	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.4	1.0	15.6	0.0	0.0	No	Yes	0.0	15.6	0.0	5,971.7	5,549.7	185.3
1971	Feb	5971.7	5549.7	185.3	13.8	0.0	0.0	0.0	Yes	Yes	17.0	3.4	20.4	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.3	1.0	22.6	0.0	0.0	No	Yes	0.0	22.6	0.0	5,977.6	5,549.7	185.4
1971	Mar	5977.6	5549.7	185.4	13.8	0.0	0.0	0.0	Yes	Yes	16.9	3.4	20.3	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	2.3	1.0	22.7	0.0	0.0	No	Yes	0.0	22.7	0.0	5,960.7	5,549.6	185.1
1971	Apr	5960.7	5549.6	185.1	11.2	0.0	0.0	0.0	Yes	Yes	13.7	2.8	16.5	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	1.8	1.0	18.1	0.0	0.0	No	Yes	0.0	18.1	0.0	5,934.3	5,549.5	184.5
1971	May	5934.3	5549.5	184.5	12.5	7.7	0.0	0.0	Yes	Yes	15.3	3.1	18.4	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	2.1	1.0	14.8	7.1	0.0	Yes	Yes	0.0	7.6	0.0	5,904.7	5,549.3	183.9
1971	Jun	5904.7	5549.3	183.9	9.0	7.7	0.0	0.0	Yes	Yes	11.0	2.2	13.2	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	1.5	1.0	10.6	7.1	0.1	No	Yes	7.6	11.1	7.3	5,143.1	5,546.0	172.2
1971	Jul	5313.1	5546.0	172.2	7.5	7.5	0.0	0.0	No	No	9.2	1.8	11.0	6.8	0.0	Yes	Yes	14.1	11.7	0.0	0.0	5313.1	5546.0	172.2	55.6	0.9	71.0	1.2	5,186.5	5,545.2	169.8	1.2	0.9	6.3	2.8	6.8	No	Yes	7.3	10.8	14.2	4,315.8	5,539.8	151.9
1971	Aug	4315.8	5539.8	151.9	8.6	5.5	0.0	0.0	Yes	Yes	10.6	2.1	12.7	3.6	0.0	Yes	Yes	14.8	27.9	0.0	0.0	4315.8	5539.8	151.9	49.0	0.8	50.1	0.8	4,216.7	5,539.2	149.6	1.4	0.8	11.3	5.1	0.0	Yes	Yes	7.3	13.6	7.3	3,765.3	5,536.1	139.4
1971	Sep	3765.3	5536.1	139.4	7.6	4.3	0.0	0.0	Yes	Yes	9.3	1.9	11.2	2.9	0.0	Yes	Yes	15.2	38.1	0.0	0.0	3765.3	5536.1	139.4	43.6	0.7	37.5	0.6	3,684.2	5,535.5	137.6	1.2	0.7	10.3	4.0	0.0	Yes	Yes	0.0	6.3	0.0	3,684.2	5,535.5	137.6
1971	Oct	3684.2	5535.5	136.1	10.7	0.0	0.0	0.0	Yes	Yes	13.1	2.6	15.7	0.0	0.0	Yes	Yes	15.2	38.2	0.0	0.0	3684.2	5535.5	137.6

Date		Reservoir Start			Glendale USGS Data Backed to Glendale	to GIC					Glendale USGS Data	Orderville Tributary	River	to OIC					to COVE				Reservoir Int1				Seepage		Evaporation		Reservoir Int2				Mt Carmel Tributary	Seepage Return	River	to MCIC				WC Release	River	Reservoir End		
Yr	Mo	Volume	Elevation	Area	Ave Flow	From River		Supp	Pre Cove Full	Full?	Ave Flow	Ave Flow	Ave Flow	River	Supp	Pre Cove Full	Full?	Hydraulic Ca	to Fill Resv	Control	River	Volume	Elevation	Area				Volume	Elevation	Area				Ave Flow	Ave Flow	Ave Flow	River	Supp	Pre Cove Full	Full?	Supp	Ave Flow	Sum Supp	Volume	Elevation	Area
		af	ft	ac	cfs	cfs	Max Supp	cfs			cfs	cfs	cfs	cfs	cfs			cfs	cfs	cfs	cfs	af	ft	ac	af	cfs	af	cfs	af	ft	ac	af	cfs	cfs	cfs	cfs	cfs			cfs	cfs	cfs	af	ft	ac
1976	Oct	3560.9	5534.6	134.8	9.6	0.0	0.0	0.0	Yes	Yes	11.8	2.4	14.2	0.0	0.0	Yes	Yes	15.3	40.2	0.0	0.0	3560.9	5534.6	134.8	43.5	0.7	20.1	0.3	3,497.2	5,534.1	133.4	1.6	0.7	16.5	0.0	0.0	Yes	Yes	0.0	16.5	0.0	3,497.2	5,534.1	133.4
1976	Nov	3497.2	5534.1	133.4	8.8	0.0	0.0	0.0	Yes	Yes	10.8	2.2	13.0	0.0	0.0	Yes	Yes	15.4	42.6	15.4	9.5	4060.8	5538.1	146.1	45.7	0.8	2.2	0.0	4,595.5	5,541.6	158.2	1.4	0.8	5.7	0.0	0.0	Yes	Yes	0.0	5.7	0.0	4,012.9	5,537.8	145.0
1976	Dec	4012.9	5537.8	145.0	9.4	0.0	0.0	0.0	Yes	Yes	11.5	2.3	13.8	0.0	0.0	Yes	Yes	15.0	32.8	15.0	10.3	4647.0	5542.0	159.4	51.5	0.8	0.0	0.0	4,595.5	5,541.6	158.2	1.5	0.8	5.9	0.0	0.0	Yes	Yes	0.0	5.9	0.0	4,595.5	5,541.6	158.2
1977	Jan	4595.5	5541.6	158.2	9.6	0.0	0.0	0.0	Yes	Yes	11.8	2.4	14.2	0.0	0.0	Yes	Yes	14.6	23.4	14.6	10.7	5251.7	5545.6	171.0	55.2	0.9	0.0	0.0	5,196.5	5,545.3	170.0	1.6	0.9	6.0	0.0	0.0	Yes	Yes	0.0	6.0	0.0	5,196.5	5,545.3	170.0
1977	Feb	5196.5	5545.3	170.0	9.9	0.0	0.0	0.0	Yes	Yes	12.1	2.4	14.5	0.0	0.0	Yes	Yes	14.2	15.0	14.2	11.0	5809.2	5548.8	181.8	53.0	1.0	0.0	0.0	5,756.2	5,548.5	180.7	1.6	1.0	6.1	0.0	0.0	Yes	Yes	0.0	6.1	0.0	5,756.2	5,548.5	180.7
1977	Mar	5756.2	5548.5	180.7	9.4	0.0	0.0	0.0	Yes	Yes	11.5	2.3	13.8	0.0	0.0	Yes	Yes	13.8	4.5	4.5	4.5	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	1.5	1.0	11.8	0.0	0.0	Yes	Yes	0.0	11.8	0.0	5,960.7	5,549.6	185.1
1977	Apr	5960.7	5549.6	185.1	9.0	0.0	0.0	0.0	Yes	Yes	11.2	2.2	13.2	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	1.5	1.0	14.5	0.0	0.0	Yes	Yes	0.0	14.5	0.0	5,934.3	5,549.5	184.5
1977	May	5934.3	5549.5	184.5	10.1	7.7	0.0	0.0	Yes	Yes	12.4	2.5	14.9	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	1.7	1.0	10.9	7.1	0.0	Yes	Yes	0.0	3.7	0.0	5,904.7	5,549.3	183.9
1977	Jun	5904.7	5549.3	183.9	7.3	7.3	0.0	0.0	No	No	8.9	1.8	10.7	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	1.2	1.0	7.8	4.3	2.9	No	Yes	7.6	11.1	10.5	5,147.9	5,545.0	169.1
1977	Jul	5147.9	5545.0	169.1	6.6	6.6	0.0	0.0	No	No	8.1	1.6	9.7	6.2	0.7	No	Yes	14.2	14.4	0.0	0.0	5147.9	5545.0	169.1	54.6	0.9	69.8	1.1	5,023.5	5,544.3	166.8	1.1	0.9	5.5	2.0	7.7	No	Yes	7.3	10.8	15.7	4,058.2	5,538.1	146.1
1977	Aug	4058.2	5538.1	146.1	6.7	5.5	0.0	0.0	Yes	Yes	8.2	1.6	9.8	3.6	0.0	Yes	Yes	14.9	32.1	0.0	0.0	4058.2	5538.1	146.1	47.2	0.8	48.2	0.8	3,962.9	5,537.4	143.9	1.1	0.8	8.1	4.6	0.5	No	Yes	7.3	10.8	7.9	3,479.3	5,534.0	133.0
1977	Sep	3479.3	5534.0	133.0	7.0	4.3	0.0	0.0	Yes	Yes	8.6	1.7	10.4	2.9	0.0	Yes	Yes	15.4	42.9	0.0	0.0	3479.3	5534.0	133.0	41.6	0.7	35.8	0.6	3,401.9	5,533.4	131.3	1.2	0.7	9.3	4.0	0.0	Yes	Yes	0.0	5.3	0.0	3,401.9	5,533.4	131.3
1977	Oct	3401.9	5533.4	131.3	8.5	0.0	0.0	0.0	Yes	Yes	10.4	2.1	12.5	0.0	0.0	Yes	Yes	15.4	42.8	0.0	0.0	3401.9	5533.4	131.3	42.4	0.7	19.6	0.3	3,340.0	5,532.9	129.9	1.4	0.7	14.6	0.0	0.0	Yes	Yes	0.0	14.6	0.0	3,340.0	5,532.9	129.9
1977	Nov	3340.0	5532.9	129.9	9.6	0.0	0.0	0.0	Yes	Yes	11.8	2.4	14.2	0.0	0.0	Yes	Yes	15.5	45.2	15.5	10.7	3975.0	5537.5	144.2	45.1	0.8	2.2	0.0	3,927.8	5,537.2	143.1	1.6	0.8	5.8	0.0	0.0	Yes	Yes	0.0	5.8	0.0	3,927.8	5,537.2	143.1
1977	Dec	3927.8	5537.2	143.1	9.9	0.0	0.0	0.0	Yes	Yes	12.1	2.4	14.5	0.0	0.0	Yes	Yes	15.0	34.2	15.0	11.0	4606.1	5541.7	158.5	51.2	0.8	0.0	0.0	4,555.0	5,541.4	157.3	1.6	0.8	6.0	0.0	0.0	Yes	Yes	0.0	6.0	0.0	4,555.0	5,541.4	157.3
1978	Jan	4555.0	5541.4	157.3	11.6	0.0	0.0	0.0	Yes	Yes	14.2	2.9	17.1	0.0	0.0	Yes	Yes	14.6	24.0	14.6	13.6	5388.4	5546.4	173.6	56.0	0.9	0.0	0.0	5,332.4	5,546.1	172.5	1.9	0.9	6.3	0.0	0.0	Yes	Yes	0.0	6.3	0.0	5,332.4	5,546.1	172.5
1978	Feb	5332.4	5546.1	172.5	14.5	0.0	0.0	0.0	Yes	Yes	17.8	3.6	21.4	0.0	0.0	Yes	Yes	14.1	12.6	12.6	12.6	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.4	1.0	12.1	0.0	0.0	Yes	Yes	0.0	12.1	0.0	5,977.6	5,549.7	185.4
1978	Mar	5977.6	5549.7	185.4	27.9	0.0	0.0	0.0	Yes	Yes	34.3	6.9	41.2	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	4.6	1.0	45.9	0.0	0.0	Yes	Yes	0.0	45.9	0.0	5,960.7	5,549.6	185.1
1978	Apr	5960.7	5549.6	185.1	38.9	0.0	0.0	0.0	Yes	Yes	47.8	9.6	57.4	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	6.4	1.0	63.6	0.0	0.0	Yes	Yes	0.0	63.6	0.0	5,934.3	5,549.5	184.5
1978	May	5934.3	5549.5	184.5	25.1	7.7	0.0	0.0	Yes	Yes	30.8	6.2	37.0	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	4.1	1.0	35.5	7.1	0.0	Yes	Yes	0.0	28.3	0.0	5,904.7	5,549.3	183.9
1978	Jun	5904.7	5549.3	183.9	13.2	7.7	0.0	0.0	Yes	Yes	16.2	3.3	19.5	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	2.2	1.0	17.5	7.2	0.0	Yes	Yes	7.6	17.9	7.6	5,320.1	5,546.0	172.3
1978	Jul	5320.1	5546.0	172.3	10.2	10.2	0.0	0.0	No	No	12.5	2.5	15.0	6.8	0.0	Yes	Yes	14.1	11.6	0.0	0.0	5320.1	5546.0	172.3	55.6	0.9	71.1	1.2	5,193.4	5,545.3	170.0	1.7	0.9	10.8	7.3	2.4	No	Yes	7.3	10.8	9.8	4,593.6	5,541.6	158.2
1978	Aug	4593.6	5541.6	158.2	9.2	5.5	0.0	0.0	Yes	Yes	11.3	2.3	13.6	3.6	0.0	Yes	Yes	14.6	23.4	0.0	0.0	4593.6	5541.6	158.2	51.1	0.8	52.2	0.8	4,490.3	5,541.0	155.8	1.5	0.8	12.3	5.1	0.0	Yes	Yes	7.3	14.5	7.3	4,039.0	5,538.0	145.6
1978	Sep	4039.0	5538.0	145.6	9.2	4.3	0.0	0.0	Yes	Yes	11.3	2.3	13.6	2.9	0.0	Yes	Yes	14.9	33.5	0.0	0.0	4039.0	5538.0	145.6	45.5	0.8	39.2	0.7	3,954.3	5,537.4	143.7	1.5	0.8	13.0	4.0	0.0	Yes	Yes	0.0	8.9	0.0	3,954.3	5,537.4	143.7
1978	Oct	3954.3	5537.4	143.7	9.8	0.0	0.0	0.0	Yes	Yes	12.0	2.4	14.4	0.0	0.0	Yes	Yes	15.0	33.8	0.0	0.0	3954.3	5537.4	143.7	46.4	0.8	21.4	0.3	3,886.4	5,536.9	142.2	1.6	0.8	16.8	0.0	0.0	Yes	Yes	0.0	16.8	0.0	3,886.4	5,536.9	142.2
1978	Nov	3886.4	5536.9	142.2	15.9	0.0	0.0	0.0	Yes	Yes	19.5	3.9	23.4	0.0	0.0	Yes	Yes	15.1	36.1	15.1	15.1	4782.7	5542.8	162.1	50.7	0.9	2.4	0.0	4,729.7	5,542.5	161.1	2.6	0.9	11.8	0.0	0.0	Yes	Yes	0.0	11.8	0.0	4,729.7	5,542.5	161.1
1978	Dec	4729.7	5542.5	161.1	13.4	0.0	0.0	0.0	Yes	Yes	16.5	3.3	19.8	0.0	0.0	Yes	Yes	14.5	21.2	14.5	14.5	5619.3	5547.7	177.9	57.4	0.9	0.0	0.0	5,561.9	5,547.4	176.8	2.2	0.9	8.5	0.0	0.0	Yes	Yes	0.0	8.5	0.0	5,561.9	5,547.4	176.8
1979	Jan	5561.9	5547.4	176.8	14.3	0.0	0.0	0.0	Yes	Yes	17.6	3.5	21.1	0.0	0.0	Yes	Yes	13.9	7.6	7.6	7.6	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.4	1.0	16.8	0.0	0.0	Yes	Yes	0.0	16.8	0.0	5,971.7	5,549.7	185.3
1979	Feb	5971.7	5549.7	185.3	15.6	0.0	0.0	0.0	Yes	Yes	19.1	3.8	22.9	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.6	1.0	25.4	0.0	0.0	Yes	Yes	0.0	25.4	0.0	5,977.6	5,549.7	185.4
1979	Mar	5977.6	5549.7	185.4	26.5	0.0	0.0	0.0	Yes	Yes	32.5	6.5	39.0	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	4.4	1.0	43.5	0.0	0.0	Yes	Yes	0.0	43.5	0.0	5,960.7	5,549.6	185.1
1979	Apr	5960.7	5549.6	185.1	108.3	0.0	0.0	0.0	Yes	Yes	133.0	26.7	159.7	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	17.8	1.0	177.3	0.0	0.0	Yes	Yes	0.0	177.3	0.0	5,934.3	5,549.5	184.5
1979	May	5934.3	5549.5	184.5	83.9	7.7	0.0	0.0	Yes	Yes	103.0	20.7	123.7	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	13.8	1.0	131.8	7.1	0.0	Yes	Yes	0.0	124.7	0.0	5,904.7	5,549.3	183.9
1979	Jun	5904.7	5549.3	183.9	25.9	7.7	0.0	0.0	Yes	Yes	31.8	6.4	38.2	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	4.3	1.0	38.3	7.2	0.0	Yes	Yes	7.6	38.7	7.6	5,320.1	5,546.0	172.3
1979	Jul	5320.1	5546.0	172.3	15.3	10.4	0.0	0.0	Yes	Yes	18.8	3.8	22.6	6.8	0.0	Yes	Yes	14.1	11.6	0.0	0.0	5320.1	5546.0	172.3	55.6	0.9	71.1	1.2	5,193.4	5,545.3	170.0	2.5	0.9	19.2	9.7	0.0	Yes	Yes	7.3	16.8	7.3	4,742.0	5,542.6	161.3
1979	Aug	4742.0	5542.6	161.3	14.4	5.5	0.0	0.0	Yes	Yes	17.7	3.6	21.3	3.6	0.0	Yes	Yes	14.5	21.0	0.0	0.0	4742.0	5542.6	161.3	52.1	0.8	53.2	0.9	4,636.7	5,541.9	159.2	2.4	0.8	20.9	5.1	0.0	Yes	Yes	7.3	23.1	7.3	4,185.4	5,539.0	148.9
1979	Sep	4185.4	5539.0	148.9	12.0	4.3	0.0	0.0	Yes	Yes	14.7	3.0	17.7	2.9	0.0	Yes	Yes	14.8	31.0	0.0	0.0	4185.4	5539.0	148.9	46.5	0.8	40.1	0.7	4,098.8	5,538.4	147.0	2.0	0.8	17.5	4.0	0.0	Yes	Yes	7.3	13.5	7.3	4,098.8	5,538.4	147.0
1979	Oct	4098.8	5538.4	147.0	13.0	0.0	0.0	0.0	Yes	Yes	16.0	3.2	19.2	0.0	0.0	Yes	Yes	14.9	31.4	0.0	0.0	4098.8	5538.4	147.0	47.5	0.8	21.9	0.4	4,029.4	5,537.9	145.4	2.1	0.8	22.1	0.0	0.0	Yes	Yes	7.3	22.1	0.0	4,029.4	5,537.9	145.4
1979	Nov	4029.4	5537.9	145.4	14.1	0.0	0.0	0.0	Yes	Yes	17.3	3.5	20.8	0.0	0.0	Yes	Yes	15.0	33.7	15.0	15.0	4919.3	5543.6	164.8	51.5	0.9	2.5	0.0	4,865.4	5,543.3	163.8	2.3	0.9	9.0	0.0	0.0	Yes	Yes	0.0	9.0	0.0	4,865.4	5,543.3	163.8
1979	Dec	4865.4	5543.3	163.8	14.9	0.0	0.0	0.0	Yes	Yes	18.3	3.7	22.0	0.0	0.0	Yes	Yes	14.4	19.0	14.4	14.4	5749.6	5548.5	180.6	58.3	0.9	0.0	0.0	5,691.2	5,548.1	179.3	2.5	0.9	11.0	0.0	0.0	Yes	Yes	0.0	11.0	0.0	5,691.2	5,548.1	179.3
1980	Jan	5691.2	5548.1	179.3	21.3	0.0	0.0	0.0	Yes	Yes	26.2	5.3	31.5	0.0	0.0	Yes	Yes	13.9	5.5	5.5	5.5	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	3.5	1.0	30.4	0.0	0.0	Yes	Yes	0.0	30.4	0.0	5,971.7	5,549.7	185.3
1980	Feb	5971.7	5549.7	185.3	29.6	0.0	0.0	0.0	Yes	Yes	36.4	7.3	43.7	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	4.9	1.0	48.5	0.0	0.0	Yes	Yes	0.0	48.5	0.0	5,977.6	5,549.7	185.4
1980	Mar	5977.6	5549.7	185.4	34.9	0.0	0.0	0.0	Yes	Yes	42.9	8.6	51.5	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	5.7	1.0	57.4	0.0	0.0	Yes	Yes	0.0	57.4	0.0	5,960.7	5,549.6	185.1
1980	Apr	5960.7	5549.6	185.1	118.1	0.0	0.0	0.0	Yes	Yes	145.0	29.1	174.1	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	19.4	1.0	193.4	0.0	0.0	Yes	Yes	0.0	193.4	0.0	5,934.3	5,549.5	184.5
1980	May	5934.3	5549.5	184.5	106.7	7.7	0.0	0.0	Yes	Yes	131.0	26.3	157.3	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	17.6	1.0	169.2	7.1	0.0	Yes	Yes	0.0	162.1	0.0	5,904.7	5,549.3	183.9
1980	Jun	5904.7	5549.3	183.9	35.5	7.7	0.0	0.0	Yes	Yes	43.6	8.8	52.4	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	5.8	1.0	54.1	7.2	0.0	Yes	Yes	7.6	54.5	7.6	5,320.1	5,546.0	172.3
1980	Jul	5320.1	5546.0	172.3	22.8	10.4	0.0	0.0	Yes	Yes	28.0	5.6	33.6	6.8	0.0	Yes	Yes	14.1	11.6	0.0	0.0	5320.1	5546.0	172.3	55.6	0.9	71.1	1.2	5,193.4	5,545.3	170.0	3.8	0.9	31.4	9.7	0.0	Yes	Yes	7.3	29.1	7.3	4,742.0	5,542.6	161.3
1980	Aug	4742.0	5542.6	161.3	21.1	5.5	0.0	0.0	Yes	Yes	25.9	5.2	31.1	3.6	0.0	Yes	Yes	14.5	21.0	0.0	0.0	4742.0	5542.6	161.3	52.1	0.8	53.2	0.9	4,636.7	5,541.9	159.2	3.5	0.8	31.8	5.1	0.0	Yes	Yes	7.3	34.0	7.3	4,185.4	5,539.0	148.9
1980	Sep	4185.4	5539.0	148.9	20.1	4.3	0.0	0.0	Yes	Yes	24.7	5.0	29.7	2.9	0.0	Yes	Yes	14.8	31.0	0.0	0.0	4185.4	5539.0	148.9	46.5	0.8	40.1	0.7	4,098.8	5,538.4	147.0	3.3	0.8	30.8	4.0	0.0	Yes	Yes	7.3	26.8	0.0	4,098.8	5,538.4	147.0
1980	Oct	4098.8	5538.4	147.0	18.2	0.0	0.0	0.0	Yes	Yes	22.3	4.5	26.8	0.0	0.0	Yes	Yes	14.9	31.4	0.0	0.0	4098.8	5538.4	147.0	47.5	0.8	21.9	0.4	4,029.4	5,537.9	145.4	3.0	0.8	30.5	0.0	0.0	Yes	Yes	0.0	30.5	0.0	4,029.4	5,537.9	145.4
1980	Nov	4029.4	5537.9	145.4	14.7	0.0	0.0	0.0	Yes	Yes	21.7	4.4	26.1	0.0	0.0	Yes	Yes	15.0	33.7	15.0	15.0	4919.3	5543.6	164.8	51.5	0.9	2.5	0.0	4,865.4	5,543.3	163.8	2.9	0.9	14.9	0.0	0.0	Yes	Yes	0.0	14.9	0.0	4,865.4	5,543.3	163.8
1980	Dec	4865.4	5543.3	163.8	18.2	0.0	0.0	0.0	Yes	Yes	22.4	4.5	26.9	0.0	0.0	Yes	Yes	14.4	19.0	14.4	14.4	5749.6	5548.5	180.6	58.3	0.9	0.0	0.0	5,691.2	5,548.1	179.3	3.0	0.9	16.5	0.0	0.0	Yes	Yes	0.0	16.5	0.0	5,691.2	5,548.1	179.3
1981	Jan	5691.2	5548.1	179.3	17.8	0.0	0.0	0.0	Yes	Yes	21.8	4.4	26.2	0.0	0.0	Yes	Yes	13.9	5.5	5.5	5.5	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.9	1.0	24.5	0.0	0.0	Yes	Yes	0.0	24.5	0.0	5,971.7	5,549.7	185.3
1981	Feb	5971.7	5549.7	185.3	18.2	0.0	0.0	0.0	Yes	Yes	22.4	4.5	26.9	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	3.0	1.0	29.8	0.0	0.0	Yes	Yes	0.0	29.8	0.0	5,977.6	5,549.7	185.4
1981	Mar	5977.6	5549.7	185.4	21.3	0.0	0.0	0.0	Yes	Yes	26.2	5.3	31.5	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	3.5	1.0	35.1	0.0	0.0	Yes	Yes	0.0	35.1	0.0	5,960.7	5,549.6	185.1
1981	Apr	5960.7	5549.6	185.1	18.0	0.0	0.0	0.0	Yes	Yes	22.1	4.4	26.5	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	3.0	1.0	29.3	0.0	0.0	Yes	Yes	0.0	29.3	0.0	5,934.3	5,549.5	184.5
1981	May	5934.3	5549.5	184.5	14.7	7.7	0.0	0.0	Yes	Yes	18.1	3.6	21.7	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	2.4	1.0	18.5	7.1	0.0	Yes	Yes	0.0	11.3	0.0	5,904.7	5,549.3	183.9
1981	Jun	5904.7	5549.3	183.9	11.2	7.7	0.0	0.0	Yes	Yes	13.7	2.8	16.5	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	1.8	1.0	14.2	7.2	0.0	Yes	Yes	7.6	14.6	7.6	5,320.1	5,546.0	172.3
1981	Jul	5320.1	5546.0	172.3	9.5	9.5	0.0	0.0	No	No	11.7	2.4	14.1

Date		Reservoir Start			Glendale USGS Data Backed to Glendale	to GIC					Glendale USGS Data	Orderville Tributary	River	to OIC				to COVE				Reservoir Int1				Seepage		Evaporation		Reservoir Int2				Mt Carmel Tributary	Seepage Return	River	to MCIC				WC Release	River	Reservoir End		
Yr	Mo	Volume	Elevation	Area	Ave Flow	From River		Supp	Pre Cove Full	Full?	Ave Flow	Ave Flow	Ave Flow	River	Supp	Pre Cove Full	Full?	Hydraulic Ca	to Fill Res	Control	River	Volume	Elevation	Area				Volume	Elevation	Area			Ave Flow	Ave Flow	Ave Flow	River	Supp	Pre Cove Full	Full?	Supp	Ave Flow	Sum Supp	Volume	Elevation	Area
		af	ft	ac	cfs	cfs	Max Supp	cfs			cfs	cfs	cfs	cfs	cfs			cfs	cfs	cfs	cfs	af	ft	ac	af	cfs		af	cfs		af	ft	ac	cfs	cfs	cfs	cfs			cfs	cfs	af	af	ft	ac
1986	Jul	5222.6	5545.4	170.5	5.9	5.9	0.0	0.0	No	No	7.2	1.5	8.7	5.2	1.6	No	Yes	14.2	13.2	0.0	0.0	5222.6	5545.4	170.5	55.1	0.9	70.3	1.1	5,097.2	5,544.7	168.2	1.0	0.9	5.4	1.9	7.8	No	Yes	7.3	10.8	16.8	4,065.0	5,538.2	146.2
1986	Aug	4065.0	5538.2	146.2	6.9	5.5	0.0	0.0	Yes	Yes	8.4	1.7	10.1	3.6	0.0	Yes	Yes	14.9	32.0	0.0	0.0	4065.0	5538.2	146.2	47.2	0.8	48.3	0.8	3,969.6	5,537.5	144.0	1.1	0.8	8.4	4.9	0.2	No	Yes	7.3	10.8	7.5	3,505.7	5,534.2	133.6
1986	Sep	3505.7	5534.2	133.6	11.2	4.3	0.0	0.0	Yes	Yes	13.8	2.8	16.6	2.9	0.0	Yes	Yes	15.4	42.5	0.0	0.0	3505.7	5534.2	133.6	41.7	0.7	36.0	0.6	3,428.0	5,533.6	131.9	1.8	0.7	16.3	4.0	0.0	Yes	Yes	0.0	12.2	0.0	3,428.0	5,533.6	131.9
1986	Oct	3428.0	5533.6	131.9	14.8	0.0	0.0	0.0	Yes	Yes	18.2	3.7	21.9	0.0	0.0	Yes	Yes	15.4	42.3	0.0	0.0	3428.0	5533.6	131.9	42.6	0.7	19.7	0.3	3,365.8	5,533.1	130.5	2.4	0.7	25.0	0.0	0.0	Yes	Yes	0.0	25.0	0.0	3,365.8	5,533.1	130.5
1986	Nov	3365.8	5533.1	130.5	15.5	0.0	0.0	0.0	Yes	Yes	19.0	3.8	22.8	0.0	0.0	Yes	Yes	15.5	44.8	15.5	15.5	4286.4	5539.6	151.2	47.2	0.8	2.3	0.0	4,236.9	5,539.3	150.1	2.5	0.8	10.7	0.0	0.0	Yes	Yes	0.0	10.7	0.0	4,236.9	5,539.3	150.1
1986	Dec	4236.9	5539.3	150.1	14.9	0.0	0.0	0.0	Yes	Yes	18.3	3.7	22.0	0.0	0.0	Yes	Yes	14.8	29.2	14.8	14.8	5147.3	5545.0	169.1	54.6	0.9	0.0	0.0	5,092.7	5,544.7	168.1	2.5	0.9	10.5	0.0	0.0	Yes	Yes	0.0	10.5	0.0	5,092.7	5,544.7	168.1
1987	Jan	5092.7	5544.7	168.1	14.3	0.0	0.0	0.0	Yes	Yes	17.5	3.5	21.0	0.0	0.0	Yes	Yes	14.2	15.3	14.2	14.2	5967.9	5549.6	185.2	59.8	1.0	0.0	0.0	5,908.1	5,549.3	184.0	2.3	1.0	10.1	0.0	0.0	Yes	Yes	0.0	10.1	0.0	5,908.1	5,549.3	184.0
1987	Feb	5908.1	5549.3	184.0	15.2	0.0	0.0	0.0	Yes	Yes	18.7	3.8	22.5	0.0	0.0	Yes	Yes	13.7	2.2	2.2	2.2	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.5	1.0	23.7	0.0	0.0	Yes	Yes	0.0	23.7	0.0	5,977.6	5,549.7	185.4
1987	Mar	5977.6	5549.7	185.4	18.8	0.0	0.0	0.0	Yes	Yes	23.1	4.6	27.7	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	3.1	1.0	30.9	0.0	0.0	Yes	Yes	0.0	30.9	0.0	5,960.7	5,549.6	185.1
1987	Apr	5960.7	5549.6	185.1	13.9	0.0	0.0	0.0	Yes	Yes	17.1	3.4	20.5	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	2.3	1.0	22.6	0.0	0.0	Yes	Yes	0.0	22.6	0.0	5,934.3	5,549.5	184.5
1987	May	5934.3	5549.5	184.5	8.3	7.7	0.0	0.0	Yes	Yes	10.2	2.1	12.3	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	1.4	1.0	7.9	4.4	2.7	No	Yes	0.0	3.5	2.7	5,738.8	5,548.4	180.3
1987	Jun	5738.8	5548.4	180.3	5.6	5.6	0.0	0.0	No	No	6.9	1.4	8.3	4.8	0.3	No	Yes	13.8	4.9	0.0	0.0	5738.8	5548.4	180.3	56.4	0.9	74.4	1.3	5,608.1	5,547.7	177.7	0.9	0.9	5.4	1.9	5.3	No	Yes	7.6	11.1	13.2	4,824.6	5,543.1	162.9
1987	Jul	4824.6	5543.1	162.9	6.7	6.7	0.0	0.0	No	No	8.3	1.7	9.9	6.4	0.4	No	Yes	14.4	19.6	0.0	0.0	4824.6	5543.1	162.9	52.6	0.9	67.2	1.1	4,704.7	5,542.3	160.6	1.1	0.9	5.5	2.0	7.7	No	Yes	7.3	10.8	15.5	3,753.0	5,536.0	139.1
1987	Aug	3753.0	5536.0	139.1	8.9	5.5	0.0	0.0	Yes	Yes	10.9	2.2	13.1	3.6	0.0	Yes	Yes	15.2	37.1	0.0	0.0	3753.0	5536.0	139.1	44.9	0.7	45.9	0.7	3,662.2	5,535.3	137.1	1.5	0.7	11.7	5.1	0.0	Yes	Yes	7.3	13.9	7.3	3,210.9	5,531.9	127.1
1987	Sep	3210.9	5531.9	127.1	5.2	4.3	0.0	0.0	Yes	Yes	6.4	1.3	7.7	2.9	0.0	Yes	Yes	15.6	47.4	0.0	0.0	3210.9	5531.9	127.1	39.7	0.7	34.2	0.6	3,137.0	5,531.3	125.3	0.9	0.7	6.3	2.8	1.2	No	Yes	0.0	3.5	1.2	3,064.6	5,530.7	123.6
1987	Oct	3064.6	5530.7	123.6	7.9	0.0	0.0	0.0	Yes	Yes	9.7	1.9	11.6	0.0	0.0	Yes	Yes	15.7	48.3	0.0	0.0	3064.6	5530.7	123.6	39.9	0.6	18.4	0.3	3,006.3	5,530.2	122.2	1.3	0.6	13.6	0.0	0.0	Yes	Yes	0.0	13.6	0.0	3,006.3	5,530.2	122.2
1987	Nov	3006.3	5530.2	122.2	14.3	0.0	0.0	0.0	Yes	Yes	17.5	3.5	21.0	0.0	0.0	Yes	Yes	15.8	50.8	15.8	15.8	3944.9	5537.3	143.5	44.8	0.8	2.2	0.0	3,897.9	5,537.0	142.4	2.3	0.8	8.3	0.0	0.0	Yes	Yes	0.0	8.3	0.0	3,897.9	5,537.0	142.4
1987	Dec	3897.9	5537.0	142.4	11.5	0.0	0.0	0.0	Yes	Yes	14.1	2.8	16.9	0.0	0.0	Yes	Yes	15.1	34.7	15.1	13.4	4723.9	5542.4	160.9	52.0	0.8	0.0	0.0	4,672.0	5,542.1	159.9	1.9	0.8	6.2	0.0	0.0	Yes	Yes	0.0	6.2	0.0	4,672.0	5,542.1	159.9
1988	Jan	4672.0	5542.1	159.9	11.8	0.0	0.0	0.0	Yes	Yes	14.5	2.9	17.4	0.0	0.0	Yes	Yes	14.5	22.1	14.5	13.9	5527.6	5547.2	176.2	56.9	0.9	0.0	0.0	5,470.7	5,546.9	175.1	1.9	0.9	6.4	0.0	0.0	Yes	Yes	0.0	6.4	0.0	5,470.7	5,546.9	175.1
1988	Feb	5470.7	5546.9	175.1	14.9	0.0	0.0	0.0	Yes	Yes	18.3	3.7	22.0	0.0	0.0	Yes	Yes	14.0	10.1	10.1	10.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.5	1.0	15.3	0.0	0.0	Yes	Yes	0.0	15.3	0.0	5,977.6	5,549.7	185.4
1988	Mar	5977.6	5549.7	185.4	14.8	0.0	0.0	0.0	Yes	Yes	18.2	3.7	21.9	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	2.4	1.0	24.4	0.0	0.0	Yes	Yes	0.0	24.4	0.0	5,960.7	5,549.6	185.1
1988	Apr	5960.7	5549.6	185.1	15.1	0.0	0.0	0.0	Yes	Yes	18.6	3.7	22.3	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	2.5	1.0	24.6	0.0	0.0	Yes	Yes	0.0	24.6	0.0	5,934.3	5,549.5	184.5
1988	May	5934.3	5549.5	184.5	12.8	7.7	0.0	0.0	Yes	Yes	15.7	3.2	18.9	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	2.1	1.0	15.3	7.1	0.0	Yes	Yes	0.0	8.1	0.0	5,904.7	5,549.3	183.9
1988	Jun	5904.7	5549.3	183.9	6.8	6.8	0.0	0.0	No	No	8.4	1.7	10.0	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	1.1	1.0	7.0	3.5	3.6	No	Yes	7.6	11.1	11.2	5,103.4	5,544.7	168.3
1988	Jul	5103.4	5544.7	168.3	5.9	5.9	0.0	0.0	No	No	7.2	1.5	8.7	5.2	1.7	No	Yes	14.2	15.1	0.0	0.0	5103.4	5544.7	168.3	54.3	0.9	69.4	1.1	4,979.6	5,544.0	166.0	1.0	0.9	5.4	1.9	7.8	No	Yes	7.3	10.8	16.8	3,945.1	5,537.3	143.5
1988	Aug	3945.1	5537.3	143.5	6.7	5.5	0.0	0.0	Yes	Yes	8.2	1.7	9.9	3.6	0.0	Yes	Yes	15.0	33.9	0.0	0.0	3945.1	5537.3	143.5	46.3	0.8	47.4	0.8	3,851.4	5,536.7	141.4	1.1	0.8	8.1	4.6	0.5	No	Yes	7.3	10.8	7.8	3,371.1	5,533.1	130.6
1988	Sep	3371.1	5533.1	130.6	5.2	4.3	0.0	0.0	Yes	Yes	6.4	1.3	7.7	2.9	0.0	Yes	Yes	15.5	44.7	0.0	0.0	3371.1	5533.1	130.6	40.8	0.7	35.2	0.6	3,295.2	5,532.5	128.9	0.9	0.7	6.4	2.9	1.1	No	Yes	0.0	3.5	1.1	3,227.1	5,532.0	127.5
1988	Oct	3227.1	5532.0	127.5	8.2	0.0	0.0	0.0	Yes	Yes	10.1	2.0	12.1	0.0	0.0	Yes	Yes	15.6	45.6	0.0	0.0	3227.1	5532.0	127.5	41.2	0.7	19.0	0.3	3,166.9	5,531.5	126.0	1.4	0.7	14.2	0.0	0.0	Yes	Yes	0.0	14.2	0.0	3,166.9	5,531.5	126.0
1988	Nov	3166.9	5531.5	126.0	9.6	0.0	0.0	0.0	Yes	Yes	11.8	2.4	14.2	0.0	0.0	Yes	Yes	15.6	48.1	15.6	10.7	3802.0	5536.3	140.2	43.8	0.7	2.1	0.0	3,756.0	5,536.0	139.2	1.6	0.7	5.8	0.0	0.0	Yes	Yes	0.0	5.8	0.0	3,756.0	5,536.0	139.2
1988	Dec	3756.0	5536.0	139.2	10.7	0.0	0.0	0.0	Yes	Yes	13.1	2.6	15.7	0.0	0.0	Yes	Yes	15.2	37.0	15.2	12.2	4508.2	5541.1	156.2	50.4	0.8	0.0	0.0	4,457.8	5,540.8	155.1	1.8	0.8	6.1	0.0	0.0	Yes	Yes	0.0	6.1	0.0	4,457.8	5,540.8	155.1
1989	Jan	4457.8	5540.8	155.1	11.4	0.0	0.0	0.0	Yes	Yes	14.0	2.8	16.8	0.0	0.0	Yes	Yes	14.7	25.6	14.7	13.3	5276.5	5545.8	171.5	55.4	0.9	0.0	0.0	5,221.1	5,545.4	170.5	1.9	0.9	6.3	0.0	0.0	Yes	Yes	0.0	6.3	0.0	5,221.1	5,545.4	170.5
1989	Feb	5221.1	5545.4	170.5	13.7	0.0	0.0	0.0	Yes	Yes	16.8	3.4	20.2	0.0	0.0	Yes	Yes	14.2	14.6	14.2	14.2	6007.1	5549.9	186.1	54.3	1.0	0.0	0.0	5,952.8	5,549.6	184.9	2.3	1.0	9.3	0.0	0.0	Yes	Yes	0.0	9.3	0.0	5,952.8	5,549.6	184.9
1989	Mar	5952.8	5549.6	184.9	16.8	0.0	0.0	0.0	Yes	Yes	20.6	4.1	24.7	0.0	0.0	Yes	Yes	13.7	1.3	1.3	1.3	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	2.8	1.0	27.2	0.0	0.0	Yes	Yes	0.0	27.2	0.0	5,960.7	5,549.6	185.1
1989	Apr	5960.7	5549.6	185.1	7.3	0.0	0.0	0.0	Yes	Yes	8.9	1.8	10.7	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	1.2	1.0	11.7	0.0	0.0	Yes	Yes	0.0	11.7	0.0	5,934.3	5,549.5	184.5
1989	May	5934.3	5549.5	184.5	5.2	5.2	0.0	0.0	No	No	6.4	1.3	7.7	4.2	0.9	No	Yes	13.7	1.6	1.6	0.0	5934.3	5549.5	184.5	59.6	1.0	66.3	1.1	5,808.5	5,548.8	181.8	0.9	1.0	5.3	No	Yes	0.0	3.5	6.2	5,426.0	5,546.6	174.3
1989	Jun	5426.0	5546.6	174.3	4.2	4.2	0.0	0.0	No	No	5.2	1.0	6.2	2.7	2.4	No	Yes	14.0	10.2	0.0	0.0	5426.0	5546.6	174.3	54.5	0.9	71.9	1.2	5,299.6	5,545.9	171.9	0.7	0.9	5.3	1.6	5.6	No	Yes	7.6	11.1	15.5	4,374.4	5,540.2	153.2
1989	Jul	4374.4	5540.2	153.2	4.6	4.6	0.0	0.0	No	No	5.6	1.1	6.7	3.2	3.6	No	Yes	14.7	27.0	0.0	0.0	4374.4	5540.2	153.2	49.5	0.8	63.2	1.0	4,262.3	5,539.5	150.6	0.8	0.8	5.1	1.6	8.1	No	Yes	7.3	10.8	19.1	3,089.4	5,530.9	124.2
1989	Aug	3089.4	5530.9	124.2	4.9	4.9	0.0	0.0	No	No	6.1	1.2	7.3	3.6	0.0	Yes	Yes	15.7	47.9	0.0	0.0	3089.4	5530.9	124.2	40.1	0.7	41.0	0.7	3,008.3	5,530.3	122.3	0.8	0.7	5.1	1.6	3.5	No	Yes	7.3	10.8	10.8	2,342.0	5,524.4	104.6
1989	Sep	2342.0	5524.4	104.6	4.2	4.2	0.0	0.0	No	No	5.1	1.0	6.1	2.6	0.2	No	Yes	16.4	62.0	0.0	0.0	2342.0	5524.4	104.6	32.7	0.5	28.1	0.5	2,281.2	5,523.8	102.8	0.7	0.5	4.7	1.2	2.8	No	Yes	0.0	3.5	3.1	2,099.3	5,522.0	97.7
1989	Oct	2099.3	5522.0	97.7	5.4	0.0	0.0	0.0	Yes	Yes	6.6	1.3	7.9	0.0	0.0	Yes	Yes	16.7	64.0	0.0	0.0	2099.3	5522.0	97.7	31.6	0.5	14.6	0.2	2,053.2	5,521.5	96.4	0.9	0.5	9.3	0.0	0.0	Yes	Yes	0.0	9.3	0.0	2,053.2	5,521.5	96.4
1989	Nov	2053.2	5521.5	96.4	6.8	0.0	0.0	0.0	Yes	Yes	8.4	1.7	10.1	0.0	0.0	Yes	Yes	16.7	66.9	16.7	6.6	2443.8	5525.4	107.6	33.6	0.6	1.6	0.0	2,408.5	5,525.0	106.6	1.1	0.6	5.2	0.0	0.0	Yes	Yes	0.0	5.2	0.0	2,408.5	5,525.0	106.6
1989	Dec	2408.5	5525.0	106.6	7.8	0.0	0.0	0.0	Yes	Yes	9.6	1.9	11.5	0.0	0.0	Yes	Yes	16.3	58.9	16.3	8.0	2900.8	5529.4	119.7	38.6	0.6	0.0	0.0	2,862.2	5,529.0	118.7	1.3	0.6	5.4	0.0	0.0	Yes	Yes	0.0	5.4	0.0	2,862.2	5,529.0	118.7
1990	Jan	2862.2	5529.0	118.7	7.9	0.0	0.0	0.0	Yes	Yes	9.8	2.0	11.7	0.0	0.0	Yes	Yes	15.9	51.6	15.9	8.2	3367.0	5533.1	130.5	42.1	0.7	0.0	0.0	3,324.8	5,532.8	129.6	1.3	0.7	5.5	0.0	0.0	Yes	Yes	0.0	5.5	0.0	3,324.8	5,532.8	129.6
1990	Feb	3324.8	5532.8	129.6	9.1	0.0	0.0	0.0	Yes	Yes	11.2	2.3	13.5	0.0	0.0	Yes	Yes	15.5	48.7	15.5	10.0	3877.5	5536.8	141.9	41.4	0.7	0.0	0.0	3,836.1	5,536.6	141.0	1.5	0.7	5.7	0.0	0.0	Yes	Yes	0.0	5.7	0.0	3,836.1	5,536.6	141.0
1990	Mar	3836.1	5536.6	141.0	11.1	0.0	0.0	0.0	Yes	Yes	13.6	2.7	16.3	0.0	0.0	Yes	Yes	15.1	35.7	15.1	12.8	4625.2	5541.8	158.9	51.3	0.8	9.4	0.2	4,564.5	5,541.4	157.5	1.8	0.8	6.2	0.0	0.0	Yes	Yes	0.0	6.2	0.0	4,564.5	5,541.4	157.5
1990	Apr	4564.5	5541.4	157.5	8.4	0.0	0.0	0.0	Yes	Yes	10.3	2.1	12.4	0.0	0.0	Yes	Yes	14.6	24.7	14.6	8.9	5022.4	5547.4	168.1	52.5	0.9	35.4	0.6	5,004.4	5,546.7	166.5	1.4	0.9	5.8	0.0	0.0	Yes	Yes	0.0	5.8	0.0	5,004.4	5,546.7	166.5
1990	May	5004.4	5546.7	166.5	5.4	5.4	0.0	0.0	No	No	6.6	1.3	7.9	4.4	0.7	No	Yes	14.3	16.7	14.3	0.0	5004.4	5544.2	166.5	53.8	0.9	59.8	1.0	4,890.8	5,543.5	164.3	0.9	0.9	5.3	1.8	5.4	No	Yes	0.0	3.5	6.1	4,518.1	5,541.1	156.5
1990	Jun	4518.1	5541.1	156.5	4.5	4.5	0.0	0.0	No	No	5.7	1.1	6.6	3.1	2.0	No	Yes	14.6	25.4	0.0	0.0	4518.1	5541.1	156.5	48.9	0.8	64.5	1.1	4,404.7	5,540.4	153.9	0.7	0.8	5.1	1.6	5.6	No	Yes	7.6	11.1	15.2	3,501.7	5,534.1	133.5
1990	Jul	3501.7	5534.1	133.5	4.7	4.7	0.0	0.0	No	No	5.7	1.1	6.9	3.4	3.5	No	Yes	15.4	41.2	0.0	0.0	3501.7	5534.1	133.5	43.1	0.7	55.1	0.9	3,403.5	5,533.4	131.3	0.8	0.7	5.0	1.5	8.2	No	Yes	7.3	10.8	19.0	2,234.7	5,523.4	101.5
1990	Aug	2234.7	5523.4	101.5	4.7	4.7	0.0	0.0	No	No	5.7	1.2	6.9	3.4	3.2	No	Yes	16.5	61.8	0.0	0.0	2234.7	5523.4	101.5	32.8	0.5	33.5	0.5	2,168.4	5,522.7	99.6	0.8	0.5	4.8	1.3	3.8	No	Yes	7.3	10.8	11.4	1,468.5	5,514.9	79.3
1990	Sep	1468.5	5514.9	79.3	5.3	4.3	0.0	0.0	Yes	Yes	6.5	1.3	7.8	2.9	0.0	Yes	Yes	17.4	76.7	0.0	0.0	1468.5	5514.9	79.3	25.0	0.4	21.5	0.4	1,422.0	5,514.3	78.6	0.9	0.4	6.2	2.7	1.3	No	Yes	0.0	3.5	1.3	1,343.6	5,513.3	76.2
1990	Oct	1343.6	5513.3	76.2	7.4	0.0	0.0	0.0	Yes	Yes	9.1	1.8	10.9	0.0	0.0	Yes	Yes	17.6	76.2	0.0	0.0	1343.6	5513.3	76.2	24.6	0.4	11.4	0.2	1,307.7	5,512.8	75.0	1.2	0.4	12.6	0.0	0.0	Yes	Yes	0.0	12.6	0.0	1,307.7	5,512.8	75.0
1990	Nov	1307.7	5512.8	75.0	7.8	0.0	0.0	0.0	Yes	Yes	9.6	1.9	11.5	0.0	0.0	Yes	Yes	17.6	79.4	17.6	8.0	1782.6	5518.6	88.8	27.7	0.5	1.3	0.0	1,753.6	5,518.3	88.0	1.3	0.5	5.2	0.0	0.0	Yes	Yes	0.0	5.2	0.0	1,753.6	5,518.3	88.0
1990	Dec	1753.6	5518.3	88.0	7.9	0.0	0.0	0.0	Yes	Yes	9.7	2.0	11.7	0.0	0.0	Yes	Yes	17.1	69.6	17.1	8.2	2257.6	5523.6	102.1	33.0	0.5	0.0	0.0	2,224.7	5,523.3	101.2	1.3	0.5	5.3	0.0	0.0	Yes	Yes	0.0	5.3	0.0	2,224.7	5,523.3	101.2
1991	Jan	2224.7	5523.3	101.2	7.7	0.0	0.0	0.0	Yes	Yes	9.4	1.9	11.3	0.0	0.0	Yes	Yes	16.5	61.3	16.5	7.8	2703.6	5527.7	114.8	37.1	0.6	0.0	0.0	2,666.6	5,527.4	113.8	1.3	0.6	5.4	0.0	0.0	Yes	Yes	0.0	5.4	0.0	2,666.6	5,527.4	113.8
1991	Feb	2666.6	5527.4	113.8	8.1	0.0	0.0	0.0	Yes	Yes	9.9	2.0	11.9	0.0	0.0	Yes	Yes	16.1	60.6	16.1	8.4	3132.5	5531.3	125.2	36.5	0.7	0.0	0.0	3,096.0	5,531.0	124.4	1.3	0.7	5.5	0.0	0.0	Yes	Yes	0.0	5.5	0.0	3,096.0	5,531.0	124.4
1991	Mar	3096.0	5531.0	124.4	11.6	0.0	0.0	0.0	Yes	Yes	14.3	2.9	17.2	0.0	0.0	Yes	Yes	15.7	47.7	15.7	13.7	3936.8	5537.3	143.3	46.3	0.8	8.5	0.1	3,882.1	5,536.9	142.1	1.9	0.8	6.2	0.0	0.0	Yes	Yes	0.0	6.2	0.0	3,882.1	5,536.9	142.1
1991	Apr	3882.1	5536.9	142.1	9.5	0.0	0.0	0.0	Yes	Yes	11.7	2.4	14.1	0.0	0.0	Yes	Yes	15.1	36.1	15.1	10.6	4510.0	5541.1	156.3	48.8	0.8	32.9	0.6	4,428.2	5,540.6	154.4

Date		Reservoir Start			Glendale USGS Data Backed to Glendale	to GIC					Glendale USGS Data	Orderville Tributary	River	to OIC					to COVE				Reservoir Int1				Seepage		Evaporation		Reservoir Int2			Mt Carmel Tributary	Seepage Return	River	to MCIC				WC Release	River		Reservoir End		
Yr	Mo	Volume	Elevation	Area	Ave Flow	From River	Max Supp	Supp	Pre Cove Full	Full?	Ave Flow	Ave Flow	Ave Flow	River	Supp	Pre Cove Full	Full?	Hydraulic Ca	to Fill Resv	Control	River	Volume	Elevation	Area	af	cfs	af	cfs	Volume	Elevation	Area	Ave Flow	Ave Flow	Ave Flow	River	Supp	Pre Cove Full	Full?	Supp	Ave Flow	Sum Supp	Volume	Elevation	Area
		af	ft	ac	cfs	cfs	cfs	cfs			cfs	cfs	cfs	cfs	cfs			cfs	cfs	cfs	cfs	af	ft	ac	af	cfs	af	cfs	af	ft	ac	cfs	cfs	cfs	cfs	cfs			cfs	cfs	cfs	af	ft	ac
1996	Apr	5960.7	5549.6	185.1	9.2	0.0	0.0	0.0	Yes	Yes	11.3	2.3	13.6	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	1.5	1.0	14.9	0.0	0.0	Yes	Yes	0.0	14.9	0.0	5,934.3	5,549.5	184.5
1996	May	5934.3	5549.5	184.5	6.6	6.6	0.0	0.0	No	No	8.1	1.6	9.7	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.2	6005.4	5549.9	186.0	60.1	1.0	66.8	1.1	5,878.6	5,549.2	183.3	1.1	1.0	5.6	2.1	5.1	No	Yes	0.0	3.5	5.1	5,965.8	5,547.4	176.9
1996	Jun	5965.8	5547.4	176.9	4.6	4.6	0.0	0.0	No	No	5.7	1.1	6.8	3.3	1.7	No	Yes	13.9	7.8	0.0	0.0	5965.8	5547.4	176.9	55.3	0.9	73.0	1.2	5,437.6	5,546.7	174.5	0.8	0.9	5.2	1.7	5.5	No	Yes	7.6	11.1	14.8	4,556.1	5,541.4	157.3
1996	Jul	4556.1	5541.4	157.3	4.6	4.6	0.0	0.0	No	No	5.6	1.1	6.7	3.2	3.6	No	Yes	14.6	24.0	0.0	0.0	4556.1	5541.4	157.3	50.8	0.8	64.9	1.1	4,440.4	5,540.6	154.7	0.8	0.8	5.1	1.6	8.1	No	Yes	7.3	10.8	19.0	3,270.1	5,532.4	128.4
1996	Aug	3270.1	5532.4	128.4	4.2	4.2	0.0	0.0	No	No	5.1	1.0	6.1	2.6	1.0	No	Yes	15.5	44.9	0.0	0.0	3270.1	5532.4	128.4	41.5	0.7	42.4	0.7	3,186.3	5,531.7	126.5	0.7	0.7	4.9	1.4	3.8	No	Yes	7.3	10.8	12.1	2,443.4	5,525.3	107.6
1996	Sep	2443.4	5525.3	107.6	6.0	4.3	0.0	0.0	Yes	Yes	7.4	1.5	8.9	2.9	0.0	Yes	Yes	16.3	60.3	0.0	0.0	2443.4	5525.3	107.6	33.6	0.6	29.0	0.5	2,380.8	5,524.8	105.7	1.0	0.6	7.5	4.0	0.0	No	Yes	0.0	3.5	0.0	2,380.2	5,524.8	105.7
1996	Oct	2380.2	5524.8	105.7	8.0	0.0	0.0	0.0	Yes	Yes	9.8	2.0	11.8	0.0	0.0	Yes	Yes	16.4	59.4	0.0	0.0	2380.2	5524.8	105.7	34.1	0.6	15.8	0.3	2,330.3	5,524.3	104.2	1.3	0.6	13.7	0.0	0.0	Yes	Yes	0.0	13.7	0.0	2,330.3	5,524.3	104.2
1996	Nov	2330.3	5524.3	104.2	12.1	0.0	0.0	0.0	Yes	Yes	14.9	3.0	17.9	0.0	0.0	Yes	Yes	16.4	62.2	16.4	14.4	3186.9	5531.7	126.5	39.5	0.7	1.9	0.0	3,145.4	5,533.4	125.5	2.0	0.7	6.2	0.0	0.0	Yes	Yes	0.0	6.2	0.0	3,145.4	5,533.4	125.5
1996	Dec	3145.4	5533.4	125.5	12.5	0.0	0.0	0.0	Yes	Yes	15.3	3.1	18.4	0.0	0.0	Yes	Yes	15.7	46.9	15.7	14.9	4060.1	5538.1	146.1	47.2	0.8	0.0	0.0	4,012.9	5,537.8	145.0	2.1	0.8	6.3	0.0	0.0	Yes	Yes	0.0	6.3	0.0	4,012.9	5,537.8	145.0
1997	Jan	4012.9	5537.8	145.0	16.0	0.0	0.0	0.0	Yes	Yes	19.6	3.9	23.5	0.0	0.0	Yes	Yes	15.0	32.8	15.0	15.0	4933.3	5543.7	165.1	53.3	0.9	0.0	0.0	4,880.0	5,543.4	164.1	2.6	0.9	12.1	0.0	0.0	Yes	Yes	0.0	12.1	0.0	4,880.0	5,543.4	164.1
1997	Feb	4880.0	5543.4	164.1	11.5	0.0	0.0	0.0	Yes	Yes	14.1	2.8	16.9	0.0	0.0	Yes	Yes	14.4	20.7	14.4	13.4	5626.1	5547.8	178.0	51.9	0.9	0.0	0.0	5,574.2	5,547.5	177.1	1.9	0.9	6.3	0.0	0.0	Yes	Yes	0.0	6.3	0.0	5,574.2	5,547.5	177.1
1997	Mar	5574.2	5547.5	177.1	13.6	0.0	0.0	0.0	Yes	Yes	16.7	3.4	20.1	0.0	0.0	Yes	Yes	13.9	7.4	7.4	7.4	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	2.2	1.0	15.8	0.0	0.0	Yes	Yes	0.0	15.8	0.0	5,960.7	5,549.6	185.1
1997	Apr	5960.7	5549.6	185.1	11.4	0.0	0.0	0.0	Yes	Yes	14.0	2.8	16.8	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	1.9	1.0	18.5	0.0	0.0	Yes	Yes	0.0	18.5	0.0	5,934.3	5,549.5	184.5
1997	May	5934.3	5549.5	184.5	7.3	7.3	0.0	0.0	No	No	9.0	1.8	10.8	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	1.2	1.0	6.4	2.9	4.3	No	Yes	0.0	3.5	4.3	5,641.9	5,547.9	178.3
1997	Jun	5641.9	5547.9	178.3	5.9	5.9	0.0	0.0	No	No	7.3	1.5	8.7	5.1	0.0	Yes	Yes	13.9	6.6	0.0	0.0	5641.9	5547.9	178.3	55.7	0.9	73.6	1.2	5,512.7	5,547.1	175.9	1.0	0.9	5.6	2.1	5.1	No	Yes	7.6	11.1	12.7	4,757.1	5,542.6	161.6
1997	Jul	4757.1	5542.6	161.6	4.3	4.3	0.0	0.0	No	No	5.2	1.1	6.3	2.8	4.1	No	Yes	14.5	20.7	0.0	0.0	4757.1	5542.6	161.6	52.2	0.8	66.7	1.1	4,638.3	5,541.9	159.2	0.7	0.8	5.0	1.5	8.1	No	Yes	7.3	10.8	19.5	3,438.3	5,533.6	132.1
1997	Aug	3438.3	5533.6	132.1	5.9	5.5	0.0	0.0	Yes	Yes	7.2	1.4	8.7	3.6	0.0	Yes	Yes	15.4	42.2	0.0	0.0	3438.3	5533.6	132.1	42.7	0.7	43.6	0.7	3,352.0	5,533.0	130.2	1.0	0.7	6.7	3.2	1.9	No	Yes	7.3	10.8	9.2	2,783.5	5,528.4	116.8
1997	Sep	2783.5	5528.4	116.8	9.9	4.3	0.0	0.0	Yes	Yes	12.2	2.5	14.7	2.9	0.0	Yes	Yes	16.0	54.6	0.0	0.0	2783.5	5528.4	116.8	36.5	0.6	31.4	0.5	2,715.5	5,527.8	115.1	1.6	0.6	14.0	4.0	0.0	Yes	Yes	0.0	10.0	0.0	2,715.5	5,527.8	115.1
1997	Oct	2715.5	5527.8	115.1	9.8	0.0	0.0	0.0	Yes	Yes	12.0	2.4	14.4	0.0	0.0	Yes	Yes	16.0	53.9	0.0	0.0	2715.5	5527.8	115.1	37.2	0.6	17.2	0.3	2,661.2	5,527.3	113.6	1.6	0.6	16.6	0.0	0.0	Yes	Yes	0.0	16.6	0.0	2,661.2	5,527.3	113.6
1997	Nov	2661.2	5527.3	113.6	10.1	0.0	0.0	0.0	Yes	Yes	12.4	2.5	14.9	0.0	0.0	Yes	Yes	16.1	56.6	16.1	11.4	3339.1	5532.9	129.9	40.6	0.7	1.9	0.0	3,296.6	5,532.6	129.0	1.7	0.7	5.8	0.0	0.0	Yes	Yes	0.0	5.8	0.0	3,296.6	5,532.6	129.0
1997	Dec	3296.6	5532.6	129.0	9.4	0.0	0.0	0.0	Yes	Yes	11.6	2.3	13.9	0.0	0.0	Yes	Yes	15.5	44.5	15.5	10.4	3938.0	5537.3	143.3	46.3	0.8	0.0	0.0	3,891.7	5,536.9	142.3	1.6	0.8	5.8	0.0	0.0	Yes	Yes	0.0	5.8	0.0	3,891.7	5,536.9	142.3
1998	Jan	3891.7	5536.9	142.3	10.6	0.0	0.0	0.0	Yes	Yes	13.0	2.6	15.6	0.0	0.0	Yes	Yes	15.1	34.8	15.1	12.1	4636.5	5541.9	159.1	51.4	0.8	0.0	0.0	4,585.1	5,541.6	158.0	1.7	0.8	6.1	0.0	0.0	Yes	Yes	0.0	6.1	0.0	4,585.1	5,541.6	158.0
1998	Feb	4585.1	5541.6	158.0	15.7	0.0	0.0	0.0	Yes	Yes	19.3	3.9	23.2	0.0	0.0	Yes	Yes	14.6	26.1	14.6	14.6	5394.1	5546.4	173.7	50.7	0.9	0.0	0.0	5,343.4	5,546.2	172.7	2.6	0.9	12.1	0.0	0.0	Yes	Yes	0.0	12.1	0.0	5,343.4	5,546.2	172.7
1998	Mar	5343.4	5546.2	172.7	17.3	0.0	0.0	0.0	Yes	Yes	21.2	4.3	25.5	0.0	0.0	Yes	Yes	14.1	11.2	11.2	11.2	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	2.8	1.0	18.1	0.0	0.0	Yes	Yes	0.0	18.1	0.0	5,960.7	5,549.6	185.1
1998	Apr	5960.7	5549.6	185.1	27.0	0.0	0.0	0.0	Yes	Yes	33.1	6.7	39.8	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	4.4	1.0	44.0	0.0	0.0	Yes	Yes	0.0	44.0	0.0	5,934.3	5,549.5	184.5
1998	May	5934.3	5549.5	184.5	24.8	7.7	0.0	0.0	Yes	Yes	30.4	6.1	36.5	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	4.1	1.0	34.9	7.1	0.0	Yes	Yes	0.0	27.8	0.0	5,904.7	5,549.3	183.9
1998	Jun	5904.7	5549.3	183.9	12.0	7.7	0.0	0.0	Yes	Yes	14.7	3.0	17.7	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	2.0	1.0	15.5	7.2	0.0	Yes	Yes	7.6	15.9	7.6	5,320.1	5,546.0	172.3
1998	Jul	5320.1	5546.0	172.3	8.2	8.2	0.0	0.0	No	No	10.1	2.0	12.1	6.8	0.0	Yes	Yes	14.1	11.6	0.0	0.0	5320.1	5546.0	172.3	55.6	0.9	71.1	1.2	5,193.4	5,545.3	170.0	1.4	0.9	7.5	4.0	5.6	No	Yes	7.3	10.8	13.0	4,396.6	5,540.4	153.7
1998	Aug	4396.6	5540.4	153.7	5.9	5.5	0.0	0.0	Yes	Yes	7.2	1.4	8.6	3.6	0.0	Yes	Yes	14.7	26.6	0.0	0.0	4396.6	5540.4	153.7	49.6	0.8	50.7	0.8	4,296.2	5,539.7	151.4	1.0	0.8	6.8	3.3	1.8	No	Yes	7.3	10.8	9.2	3,733.0	5,535.8	138.7
1998	Sep	3733.0	5535.8	138.7	14.1	4.3	0.0	0.0	Yes	Yes	17.3	3.5	20.8	2.9	0.0	Yes	Yes	15.2	38.6	0.0	0.0	3733.0	5535.8	138.7	43.3	0.7	37.3	0.6	3,652.3	5,535.2	136.9	2.3	0.7	21.0	4.0	0.0	Yes	Yes	0.0	16.9	0.0	3,652.3	5,535.2	136.9
1998	Oct	3652.3	5535.2	136.9	13.8	0.0	0.0	0.0	Yes	Yes	17.0	3.4	20.4	0.0	0.0	Yes	Yes	15.2	38.7	0.0	0.0	3652.3	5535.2	136.9	44.2	0.7	20.4	0.3	3,587.7	5,534.8	135.4	2.3	0.7	23.4	0.0	0.0	Yes	Yes	0.0	23.4	0.0	3,587.7	5,534.8	135.4
1998	Nov	3587.7	5534.8	135.4	15.7	0.0	0.0	0.0	Yes	Yes	19.3	3.9	23.2	0.0	0.0	Yes	Yes	15.3	41.1	15.3	15.3	4497.7	5541.0	156.0	48.7	0.8	2.3	0.0	4,446.6	5,540.7	154.8	2.6	0.8	11.3	0.0	0.0	Yes	Yes	0.0	11.3	0.0	4,446.6	5,540.7	154.8
1998	Dec	4446.6	5540.7	154.8	13.1	0.0	0.0	0.0	Yes	Yes	16.1	3.2	19.3	0.0	0.0	Yes	Yes	14.7	25.8	14.7	14.7	5348.1	5546.2	172.8	55.8	0.9	0.0	0.0	5,292.3	5,545.9	171.8	2.2	0.9	7.7	0.0	0.0	Yes	Yes	0.0	7.7	0.0	5,292.3	5,545.9	171.8
1999	Jan	5292.3	5545.9	171.8	12.9	0.0	0.0	0.0	Yes	Yes	15.9	3.2	19.1	0.0	0.0	Yes	Yes	14.1	12.0	12.0	12.0	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.1	1.0	10.2	0.0	0.0	Yes	Yes	0.0	10.2	0.0	5,971.7	5,549.7	185.3
1999	Feb	5971.7	5549.7	185.3	13.0	0.0	0.0	0.0	Yes	Yes	16.0	3.2	19.2	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.1	1.0	21.3	0.0	0.0	Yes	Yes	0.0	21.3	0.0	5,977.6	5,549.7	185.4
1999	Mar	5977.6	5549.7	185.4	9.4	0.0	0.0	0.0	Yes	Yes	11.5	2.3	13.8	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	1.5	1.0	15.4	0.0	0.0	Yes	Yes	0.0	15.4	0.0	5,960.7	5,549.6	185.1
1999	Apr	5960.7	5549.6	185.1	11.6	0.0	0.0	0.0	Yes	Yes	14.2	2.9	17.1	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	1.9	1.0	18.7	0.0	0.0	Yes	Yes	0.0	18.7	0.0	5,934.3	5,549.5	184.5
1999	May	5934.3	5549.5	184.5	9.0	7.7	0.0	0.0	Yes	Yes	11.1	2.2	13.3	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	1.5	1.0	9.2	5.7	1.5	No	Yes	0.0	3.5	1.5	5,812.7	5,548.8	181.9
1999	Jun	5812.7	5548.8	181.9	7.7	7.7	0.0	0.0	No	No	9.4	1.9	11.3	5.1	0.0	Yes	Yes	13.8	3.7	0.0	0.0	5812.7	5548.8	181.9	56.8	1.0	75.0	1.3	5,680.8	5,548.1	179.1	1.3	1.0	8.4	4.9	2.2	No	Yes	7.6	11.1	9.8	5,095.6	5,544.7	168.2
1999	Jul	5095.6	5544.7	168.2	8.1	8.1	0.0	0.0	No	No	10.0	2.0	12.0	6.8	0.0	Yes	Yes	14.2	15.2	0.0	0.0	5095.6	5544.7	168.2	54.3	0.9	69.4	1.1	4,971.9	5,544.0	165.9	1.3	0.9	7.4	3.9	5.8	No	Yes	7.3	10.8	13.1	4,165.6	5,538.8	148.5
1999	Aug	4165.6	5538.8	148.5	6.8	5.5	0.0	0.0	Yes	Yes	8.4	1.7	10.1	3.6	0.0	No	Yes	14.9	30.4	0.0	0.0	4165.6	5538.8	148.5	47.9	0.8	49.0	0.8	4,068.6	5,538.2	146.3	1.1	0.8	8.3	4.8	0.3	No	Yes	7.3	10.8	7.6	3,600.6	5,534.9	135.7
1999	Sep	3600.6	5534.9	135.7	6.8	4.3	0.0	0.0	Yes	Yes	8.4	1.7	10.1	2.9	0.0	Yes	Yes	15.3	40.9	0.0	0.0	3600.6	5534.9	135.7	42.4	0.7	36.5	0.6	3,521.7	5,534.3	133.9	1.1	0.7	9.1	4.0	0.0	Yes	Yes	0.0	5.0	0.0	3,521.7	5,534.3	133.9
1999	Oct	3521.7	5534.3	133.9	7.5	0.0	0.0	0.0	Yes	Yes	9.2	1.9	11.1	0.0	0.0	Yes	Yes	15.3	40.8	0.0	0.0	3521.7	5534.3	133.9	43.2	0.7	20.0	0.3	3,458.5	5,533.8	132.5	1.2	0.7	13.0	0.0	0.0	Yes	Yes	0.0	13.0	0.0	3,458.5	5,533.8	132.5
1999	Nov	3458.5	5533.8	132.5	8.3	0.0	0.0	0.0	Yes	Yes	10.2	2.1	12.3	0.0	0.0	Yes	Yes	15.4	43.2	15.4	8.8	3979.2	5537.6	144.3	45.1	0.8	2.2	0.0	3,931.9	5,537.2	143.2	1.4	0.8	5.6	0.0	0.0	Yes	Yes	0.0	5.6	0.0	3,931.9	5,537.2	143.2
1999	Dec	3931.9	5537.2	143.2	8.1	0.0	0.0	0.0	Yes	Yes	10.0	2.0	12.0	0.0	0.0	Yes	Yes	15.0	34.2	15.0	8.5	4455.2	5540.7	155.0	50.1	0.8	0.0	0.0	4,405.1	5,540.4	153.9	1.3	0.8	5.7	0.0	0.0	Yes	Yes	0.0	5.7	0.0	4,405.1	5,540.4	153.9
2000	Jan	4405.1	5540.4	153.9	9.9	0.0	0.0	0.0	Yes	Yes	12.2	2.5	14.7	0.0	0.0	Yes	Yes	14.7	26.5	14.7	12.7	5090.9	5544.7	168.1	54.3	0.9	0.0	0.0	5,036.6	5,544.4	167.1	1.6	0.9	6.7	0.0	0.0	Yes	Yes	0.0	6.7	0.0	5,036.6	5,544.4	167.1
2000	Feb	5036.6	5544.3	167.1	12.9	0.0	0.0	0.0	Yes	Yes	15.9	3.2	19.1	0.0	0.0	Yes	Yes	14.3	17.9	14.3	14.3	5829.1	5548.9	182.3	53.2	1.0	0.0	0.0	5,775.9	5,548.6	181.1	2.1	1.0	7.9	0.0	0.0	Yes	Yes	0.0	7.9	0.0	5,775.9	5,548.6	181.1
2000	Mar	5775.9	5548.6	181.1	17.4	0.0	0.0	0.0	Yes	Yes	21.4	4.3	25.7	0.0	0.0	Yes	Yes	13.8	4.2	4.2	4.2	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	2.9	1.0	25.4	0.0	0.0	Yes	Yes	0.0	25.4	0.0	5,960.7	5,549.6	185.1
2000	Apr	5960.7	5549.6	185.1	9.9	0.0	0.0	0.0	Yes	Yes	12.1	2.4	14.5	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	1.6	1.0	15.9	0.0	0.0	Yes	Yes	0.0	15.9	0.0	5,934.3	5,549.5	184.5
2000	May	5934.3	5549.5	184.5	6.1	6.1	0.0	0.0	No	No	7.5	1.5	9.1	5.1	0.0	Yes	Yes	13.7	1.6	1.6	0.5	5964.8	5549.6	185.2	59.8	1.0	66.5	1.1	5,838.5	5,548.9	182.5	1.1	1.0	5.5	2.0	5.2	No	Yes	0.0	3.5	5.2	5,521.0	5,547.2	176.1
2000	Jun	5521.0	5547.2	176.1	4.3	4.3	0.0	0.0	No	No	5.3	1.1	6.4	2.9	2.2	No	Yes	14.0	8.6	0.0	0.0	5521.0	5547.2	176.1	55.0	0.9	72.6	1.2	5,393.3	5,546.4	173.7	0.7	0.9	5.1	1.6	5.5	No	Yes	7.6	11.1	15.4	4,479.8	5,540.9	155.6
2000	Jul	4479.8	5540.9	155.6	3.9	3.9	0.0	0.0	No	No	4.8	1.0	5.8	2.3	4.6	No	Yes	14.6	25.2	0.0	0.0	4479.8	5540.9	155.6	50.2	0.8	64.2	1.0	4,365.4	5,540.2	153.0	0.6	0.8	5.0	1.5	8.2	No	Yes	7.3	10.8	20.1	3,128.1	5,531.2	125.1
2000	Aug	3128.1	5531.2	125.1	3.9	3.9	0.0	0.0	No	No	4.8	1.0	5.7	2.2	1.4	No	Yes	15.7	47.2	0.0	0.0	3128.1	5531.2	125.1	40.4	0.7	41.3	0.7	3,046.4	5,530.6	123.2	0.6	0.7	4.8	1.3	3.8	No	Yes	7.3	10.8	12.6	2,273.7	5,523.7	102.6
2000	Sep	2273.7	5523.7	102.6	4.3	4.3	0.0	0.0	No	No	5.3	1.1	6.3	2.8	0.0	No	Yes	16.5	63.2	0.0	0.0	2273.7	5523.7	102.6	32.1	0.5	27.6	0.5	2,214.0	5,523.1	100.9	0.7	0.5	4.7	1.2	2.8	No	Yes	0.0	3.5	2.8	2,045.8	5,521.4	96.2
2000	Oct	2045.8	5521.4	96.2	9.9	0.0	0.0	0.0	Yes	Yes	12.2	2.5	14.7	0.0	0.0	Yes	Yes	16.7	64.8	0.0	0.0	2045.8	5521.4	96.2	31.1	0.5	14.3	0.2	2,002.4	5,521.0	94.9	1.6	0.5	16.8	0.0	0.0	Yes	Yes	0.0	16.8	0.0	2,002.4	5,521.0	94.9
2000	Nov	2000.4	5521.0	94.9	11.2	0.0	0.0	0.0	Yes	Yes	13.7	2.8	16.5	0.0	0.0	Yes	Yes	16.8	67.8	16.8	13.0	2771.2	5528.3	116.5	36.4	0.6	1.7	0.0	2,733.1	5,528.0	115.6	1.8	0.6	5.9	0.0	0.0	Yes	Yes	0.0	5.9	0.0	2,733.1	5,528.0	115.6
2000	Dec	2733.1	5528.0	115.6	10.6	0.0	0.0	0.0	Yes	Yes	13.0	2.6	15.6	0.0	0.0	Yes	Yes	16.0	53.7	16.0	12.1	3477.9	5533.9	132.9	42.9	0.7	0.0	0.0	3,435.0	5,533.6	132.0	1.7	0.7	5.9	0.0	0.0	Yes	Yes	0.0	5.9	0.0	3,435.0	5,533.6	132.0
2001	Jan	3435.0	5533.6	132.0	10.0	0.0	0.0	0.0	Yes	Yes	12.3	2.5	14.8	0.0	0.0	Yes	Yes	15.4	42.2	15.4	11.3	4128.1	5538.6	147.6	47.7	0.8	0.0	0.

Date		Reservoir Start			Glendale USGS Data Backed to Glendale	to GIC					Glendale USGS Data	Orderville Tributary	River	to OIC					to COVE				Reservoir Int1				Seepage		Evaporation		Reservoir Int2				Mt Carmel Tributary	Seepage Return	River	to MCIC				WC Release	River		Reservoir End		
Yr	Mo	Volume	Elevation	Area	Ave Flow	From River		Supp	Pre Cove Full	Full?	Ave Flow	Ave Flow	Ave Flow	River	Supp	Pre Cove Full	Full?	Hydraulic Ca	to Fill Resv	Control	River	Volume	Elevation	Area						Volume	Elevation	Area			Ave Flow	Ave Flow	River	Supp	Pre Cove Full	Full?	Supp	Ave Flow	Sum Supp	Volume	Elevation	Area
		af	ft	ac	cfs	cfs	Max Supp	cfs			cfs	cfs	cfs	cfs	cfs			cfs	cfs	cfs	cfs	af	ft	ac	af	cfs	af	cfs	af	ft	ac	cfs	cfs	cfs	cfs	cfs			cfs	cfs	cfs	af	ft	ac
2006	Jan	5691.2	5548.1	179.3	14.1	0.0	0.0	0.0	Yes	Yes	17.3	3.5	20.8	0.0	0.0	Yes	Yes	13.9	5.5	5.5	5.5	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.3	1.0	18.5	0.0	0.0	Yes	Yes	0.0	18.5	0.0	5,971.7	5,549.7	185.3
2006	Feb	5971.7	5549.7	185.3	14.3	0.0	0.0	0.0	Yes	Yes	17.5	3.5	21.0	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.3	1.0	23.3	0.0	0.0	Yes	Yes	0.0	23.3	0.0	5,977.6	5,549.7	185.4
2006	Mar	5977.6	5549.7	185.4	18.6	0.0	0.0	0.0	Yes	Yes	22.8	4.6	27.4	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	3.1	1.0	30.5	0.0	0.0	Yes	Yes	0.0	30.5	0.0	5,960.7	5,549.6	185.1
2006	Apr	5960.7	5549.6	185.1	16.4	0.0	0.0	0.0	Yes	Yes	20.1	4.0	24.1	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	2.7	1.0	26.6	0.0	0.0	Yes	Yes	0.0	26.6	0.0	5,934.3	5,549.5	184.5
2006	May	5934.3	5549.5	184.5	9.4	7.7	0.0	0.0	Yes	Yes	11.6	2.3	13.9	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	1.6	1.0	9.8	6.3	0.8	No	Yes	0.0	3.5	0.8	5,853.7	5,549.0	182.8
2006	Jun	5853.7	5549.0	182.8	6.6	6.6	0.0	0.0	No	No	8.1	1.6	9.7	5.1	0.0	Yes	Yes	13.8	3.0	0.0	0.0	5853.7	5549.0	182.8	57.1	1.0	75.4	1.3	5,721.2	5,548.3	180.0	1.1	1.0	6.7	3.2	4.0	No	Yes	7.6	11.1	11.6	5,031.4	5,544.3	167.0
2006	Jul	5031.4	5544.3	167.0	7.0	7.0	0.0	0.0	No	No	8.6	1.7	10.4	6.8	0.0	Yes	Yes	14.3	16.3	0.0	0.0	5031.4	5544.3	167.0	53.9	0.9	68.9	1.1	4,908.6	5,543.6	164.6	1.2	0.9	5.6	2.1	7.6	No	Yes	7.3	10.8	14.9	3,990.3	5,537.6	144.5
2006	Aug	3990.3	5537.6	144.5	6.0	5.5	0.0	0.0	Yes	Yes	7.4	1.5	8.8	3.6	0.0	Yes	Yes	15.0	33.2	0.0	0.0	3990.3	5537.6	144.5	46.7	0.8	47.7	0.8	3,895.9	5,537.0	142.4	1.0	0.8	7.0	3.5	1.7	No	Yes	7.3	10.8	9.0	3,342.9	5,532.9	130.0
2006	Sep	3342.9	5532.9	130.0	6.8	4.3	0.0	0.0	Yes	Yes	8.3	1.7	10.0	2.9	0.0	Yes	Yes	15.5	45.2	0.0	0.0	3342.9	5532.9	130.0	40.6	0.7	35.0	0.6	3,267.2	5,532.3	128.3	1.1	0.7	8.9	4.0	0.6	Yes	Yes	0.0	4.8	0.0	3,267.2	5,532.3	128.3
2006	Oct	3267.2	5532.3	128.3	12.4	0.0	0.0	0.0	Yes	Yes	15.2	3.1	18.3	0.0	0.0	Yes	Yes	15.6	45.0	0.0	0.0	3267.2	5532.3	128.3	41.4	0.7	19.1	0.3	3,206.7	5,531.9	127.0	2.0	0.7	21.0	0.0	0.0	Yes	Yes	0.0	21.0	0.0	3,206.7	5,531.9	127.0
2006	Nov	3206.7	5531.9	127.0	11.6	0.0	0.0	0.0	Yes	Yes	14.3	2.9	17.2	0.0	0.0	Yes	Yes	15.6	47.5	15.6	13.7	4020.4	5537.8	145.2	45.4	0.8	2.2	0.0	3,972.8	5,537.5	144.1	1.9	0.8	6.2	0.0	0.0	Yes	Yes	0.0	6.2	0.0	3,972.8	5,537.5	144.1
2006	Dec	3972.8	5537.5	144.1	11.0	0.0	0.0	0.0	Yes	Yes	13.5	2.7	16.2	0.0	0.0	Yes	Yes	15.0	33.5	15.0	12.7	4754.6	5542.6	161.5	52.2	0.8	0.0	0.0	4,702.4	5,542.3	160.5	1.8	0.8	6.2	0.0	0.0	Yes	Yes	0.0	6.2	0.0	4,702.4	5,542.3	160.5
2007	Jan	4702.4	5542.3	160.5	10.2	0.0	0.0	0.0	Yes	Yes	12.5	2.5	15.0	0.0	0.0	Yes	Yes	14.5	21.6	14.5	11.5	5410.3	5546.5	174.0	56.2	0.9	0.0	0.0	5,354.1	5,546.2	172.9	1.7	0.9	6.1	0.0	0.0	Yes	Yes	0.0	6.1	0.0	5,354.1	5,546.2	172.9
2007	Feb	5354.1	5546.2	172.9	11.6	0.0	0.0	0.0	Yes	Yes	14.2	2.9	17.1	0.0	0.0	Yes	Yes	14.1	12.2	12.2	12.2	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	1.9	1.0	7.7	0.0	0.0	Yes	Yes	0.0	7.7	0.0	5,977.6	5,549.7	185.4
2007	Mar	5977.6	5549.7	185.4	10.3	0.0	0.0	0.0	Yes	Yes	12.7	2.6	15.3	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	1.7	1.0	17.0	0.0	0.0	Yes	Yes	0.0	17.0	0.0	5,960.7	5,549.6	185.1
2007	Apr	5960.7	5549.6	185.1	9.2	0.0	0.0	0.0	Yes	Yes	11.3	2.3	13.6	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	1.5	1.0	14.9	0.0	0.0	Yes	Yes	0.0	14.9	0.0	5,934.3	5,549.5	184.5
2007	May	5934.3	5549.5	184.5	6.0	0.0	0.0	0.0	No	No	7.4	1.5	8.9	5.1	0.0	Yes	Yes	13.7	1.6	1.6	0.3	5954.5	5549.6	184.9	59.7	1.0	66.4	1.1	5,828.3	5,548.9	182.3	1.0	1.0	5.5	2.0	5.2	No	Yes	0.0	3.5	5.2	5,509.6	5,547.1	175.8
2007	Jun	5509.6	5547.1	175.8	4.2	4.2	0.0	0.0	No	No	5.2	1.0	6.2	2.7	2.3	No	Yes	14.0	8.8	0.0	0.0	5509.6	5547.1	175.8	55.0	0.9	72.5	1.2	5,382.1	5,546.4	173.4	0.7	0.9	5.1	1.6	5.6	No	Yes	7.6	11.1	15.5	4,460.5	5,540.8	155.1
2007	Jul	4460.5	5540.8	155.1	3.4	3.4	0.0	0.0	No	No	4.2	0.8	5.0	1.5	5.4	No	Yes	14.7	25.6	0.0	0.0	4460.5	5540.8	155.1	50.1	0.8	64.0	1.0	4,346.4	5,540.0	152.5	0.6	0.8	4.9	1.4	8.3	No	Yes	7.3	10.8	21.0	3,055.7	5,530.6	123.4
2007	Aug	3055.7	5530.6	123.4	3.7	3.7	0.0	0.0	No	No	4.5	0.9	5.4	1.9	1.7	No	Yes	15.7	48.4	0.0	0.0	3055.7	5530.6	123.4	39.8	0.6	40.7	0.7	2,975.1	5,530.0	121.5	0.6	0.6	4.8	1.3	3.9	No	Yes	7.3	10.8	12.9	2,182.9	5,522.8	100.0
2007	Sep	2182.9	5522.8	100.0	4.7	4.3	0.0	0.0	Yes	Yes	5.8	1.2	7.0	2.9	0.0	Yes	Yes	16.6	64.7	0.0	0.0	2182.9	5522.8	100.0	31.3	0.5	26.9	0.5	2,124.7	5,522.3	98.4	0.8	0.5	5.4	1.9	2.1	No	Yes	0.0	3.5	2.1	1,997.1	5,520.9	94.8
2007	Oct	1997.1	5520.9	94.8	6.8	0.0	0.0	0.0	Yes	Yes	8.4	1.7	10.1	0.0	0.0	Yes	Yes	16.8	65.6	0.0	0.0	1997.1	5520.9	94.8	30.6	0.5	14.1	0.2	1,952.3	5,520.5	93.5	1.1	0.5	11.7	0.0	0.0	Yes	Yes	0.0	11.7	0.0	1,952.3	5,520.5	93.5
2007	Nov	1952.3	5520.5	93.5	6.9	0.0	0.0	0.0	Yes	Yes	8.5	1.7	10.2	0.0	0.0	Yes	Yes	16.8	68.6	16.8	6.7	2310.1	5524.5	104.8	32.8	0.6	1.6	0.0	2,315.8	5,524.1	103.8	1.1	0.6	5.2	0.0	0.0	Yes	Yes	0.0	5.2	0.0	2,315.8	5,524.1	103.8
2007	Dec	2315.8	5524.1	103.8	10.3	0.0	0.0	0.0	Yes	Yes	12.7	2.6	15.3	0.0	0.0	Yes	Yes	16.4	60.4	16.4	11.8	3038.4	5530.5	123.0	39.7	0.6	0.0	0.0	2,998.7	5,530.2	122.1	1.7	0.6	5.8	0.0	0.0	Yes	Yes	0.0	5.8	0.0	2,998.7	5,530.2	122.1
2008	Jan	2998.7	5530.2	122.1	11.0	0.0	0.0	0.0	Yes	Yes	13.5	2.7	16.2	0.0	0.0	Yes	Yes	15.8	49.3	15.8	12.7	3780.5	5536.2	139.7	45.1	0.7	0.0	0.0	3,735.3	5,535.8	138.7	1.8	0.7	6.0	0.0	0.0	Yes	Yes	0.0	6.0	0.0	3,735.3	5,535.8	138.7
2008	Feb	3735.3	5535.8	138.7	12.3	0.0	0.0	0.0	Yes	Yes	15.1	3.0	18.1	0.0	0.0	Yes	Yes	15.2	41.4	15.2	14.6	4548.1	5541.3	157.1	45.8	0.8	0.0	0.0	4,502.3	5,541.0	156.1	2.0	0.8	6.3	0.0	0.0	Yes	Yes	0.0	6.3	0.0	4,502.3	5,541.0	156.1
2008	Mar	4502.3	5541.0	156.1	16.7	0.0	0.0	0.0	Yes	Yes	20.5	4.1	24.6	0.0	0.0	Yes	Yes	14.6	24.9	14.6	14.6	5401.4	5546.5	173.8	56.1	0.9	10.3	0.2	5,335.0	5,546.1	172.6	2.7	0.9	13.7	0.0	0.0	Yes	Yes	0.0	13.7	0.0	5,335.0	5,546.1	172.6
2008	Apr	5335.0	5546.1	172.6	11.8	0.0	0.0	0.0	Yes	Yes	14.5	2.9	17.4	0.0	0.0	Yes	Yes	14.1	11.7	11.7	11.7	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	1.9	1.0	8.6	0.0	0.0	Yes	Yes	0.0	8.6	0.0	5,934.3	5,549.5	184.5
2008	May	5934.3	5549.5	184.5	7.8	7.7	0.0	0.0	Yes	Yes	9.5	1.9	11.4	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	1.3	1.0	7.1	3.6	3.6	No	Yes	0.0	3.5	3.6	5,683.8	5,548.1	179.2
2008	Jun	5683.8	5548.1	179.2	5.4	5.4	0.0	0.0	No	No	6.6	1.3	7.9	4.4	0.7	No	Yes	14.9	3.3	0.0	0.0	5683.8	5548.1	179.2	56.0	0.9	73.9	1.2	5,553.9	5,547.4	176.7	0.9	0.9	5.3	1.8	5.4	No	Yes	7.6	11.1	13.6	4,744.6	5,542.6	161.3
2008	Jul	4744.6	5542.6	161.3	4.7	4.7	0.0	0.0	No	No	5.7	1.2	6.9	3.4	3.4	No	Yes	14.5	20.9	0.0	0.0	4744.6	5542.6	161.3	52.1	0.8	66.6	1.1	4,626.0	5,541.8	158.9	0.8	0.8	5.1	1.6	8.0	No	Yes	7.3	10.8	18.8	3,467.7	5,533.9	132.7
2008	Aug	3467.7	5533.9	132.7	4.1	4.1	0.0	0.0	No	No	5.1	1.0	6.1	2.6	1.0	No	Yes	15.4	41.7	0.0	0.0	3467.7	5533.9	132.7	42.9	0.7	43.8	0.7	3,381.1	5,533.2	130.8	0.7	0.7	4.9	1.4	3.7	No	Yes	7.3	10.8	12.1	2,637.1	5,527.1	113.0
2008	Sep	2637.1	5527.1	113.0	3.9	3.9	0.0	0.0	No	No	4.8	1.0	5.8	2.3	0.6	No	Yes	16.1	57.1	0.0	0.0	2637.1	5527.1	113.0	35.3	0.6	30.4	0.5	2,571.3	5,526.5	111.3	0.6	0.6	4.7	1.2	2.8	No	Yes	0.0	3.5	3.4	2,371.4	5,524.7	105.4
2008	Oct	2371.4	5524.7	105.4	5.9	0.0	0.0	0.0	Yes	Yes	7.2	1.5	8.7	0.0	0.0	Yes	Yes	16.4	59.5	0.0	0.0	2371.4	5524.7	105.4	34.1	0.6	15.7	0.3	2,321.7	5,524.2	104.0	1.0	0.6	10.2	0.0	0.0	Yes	Yes	0.0	10.2	0.0	2,321.7	5,524.2	104.0
2008	Nov	2321.7	5524.2	104.0	7.8	0.0	0.0	0.0	Yes	Yes	9.6	1.9	11.5	0.0	0.0	Yes	Yes	16.4	62.4	16.4	8.0	2796.6	5528.5	117.1	36.6	0.6	1.8	0.0	2,758.3	5,528.2	116.2	1.3	0.6	5.4	0.0	0.0	Yes	Yes	0.0	5.4	0.0	2,758.3	5,528.2	116.2
2008	Dec	2758.3	5528.2	116.2	8.9	0.0	0.0	0.0	Yes	Yes	10.9	2.2	13.1	0.0	0.0	Yes	Yes	16.0	53.2	16.0	9.6	3348.0	5532.9	130.1	42.0	0.7	0.0	0.0	3,306.0	5,532.6	129.2	1.5	0.7	5.6	0.0	0.0	Yes	Yes	0.0	5.6	0.0	3,306.0	5,532.6	129.2
2009	Jan	3306.0	5532.6	129.2	11.8	0.0	0.0	0.0	Yes	Yes	14.5	2.9	17.4	0.0	0.0	Yes	Yes	15.5	44.3	15.5	13.9	4161.6	5538.8	148.4	47.9	0.8	0.0	0.0	4,113.7	5,538.5	147.3	1.9	0.8	6.2	0.0	0.0	Yes	Yes	0.0	6.2	0.0	4,113.7	5,538.5	147.3
2009	Feb	4113.7	5538.5	147.3	12.9	0.0	0.0	0.0	Yes	Yes	15.8	3.2	19.0	0.0	0.0	Yes	Yes	14.9	34.5	14.9	14.9	4940.9	5543.8	165.3	48.2	0.9	0.0	0.0	4,892.7	5,543.5	164.3	2.1	0.9	7.1	0.0	0.0	Yes	Yes	0.0	7.1	0.0	4,892.7	5,543.5	164.3
2009	Mar	4892.7	5543.5	164.3	14.1	0.0	0.0	0.0	Yes	Yes	17.3	3.5	20.8	0.0	0.0	Yes	Yes	14.4	18.5	14.4	14.4	5775.8	5548.6	181.1	58.5	1.0	10.7	0.2	5,706.6	5,548.2	179.7	2.3	1.0	9.7	0.0	0.0	Yes	Yes	0.0	9.7	0.0	5,706.6	5,548.2	179.7
2009	Apr	5706.6	5548.2	179.7	12.2	0.0	0.0	0.0	Yes	Yes	15.0	3.0	18.0	0.0	0.0	Yes	Yes	13.9	5.5	5.5	5.5	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	2.0	1.0	15.5	0.0	0.0	Yes	Yes	0.0	15.5	0.0	5,934.3	5,549.5	184.5
2009	May	5934.3	5549.5	184.5	7.7	7.7	0.0	0.0	Yes	Yes	9.5	1.9	11.4	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	1.3	1.0	7.0	3.5	3.7	No	Yes	0.0	3.5	3.7	5,676.1	5,548.1	179.0
2009	Jun	5678.1	5548.1	179.0	5.8	5.8	0.0	0.0	No	No	7.1	1.4	8.5	5.0	0.1	No	Yes	13.9	5.9	0.0	0.0	5678.1	5548.1	179.0	56.0	0.9	73.9	1.2	5,548.3	5,547.3	176.6	0.9	0.9	5.4	1.9	5.3	No	Yes	7.6	11.1	13.0	4,777.1	5,542.8	162.0
2009	Jul	4777.1	5542.8	162.0	4.2	4.2	0.0	0.0	No	No	5.2	1.0	6.3	2.8	4.1	No	Yes	14.4	20.4	0.0	0.0	4777.1	5542.8	162.0	52.3	0.9	66.8	1.1	4,657.9	5,542.0	159.6	0.7	0.9	5.0	1.5	8.1	No	Yes	7.3	10.8	19.5	3,456.4	5,533.8	132.5
2009	Aug	3456.4	5533.8	132.5	3.9	3.9	0.0	0.0	No	No	4.7	1.0	5.7	2.2	1.4	No	Yes	15.4	41.9	0.0	0.0	3456.4	5533.8	132.5	42.8	0.7	43.7	0.7	3,369.9	5,533.1	130.6	0.6	0.7	4.8	1.3	3.8	No	Yes	7.3	10.8	12.5	2,598.7	5,526.8	112.0
2009	Sep	2598.7	5526.8	112.0	4.1	4.1	0.0	0.0	No	No	5.1	1.0	6.1	2.6	0.3	No	Yes	16.1	57.7	0.0	0.0	2598.7	5526.8	112.0	35.0	0.6	30.1	0.5	2,533.6	5,526.2	110.2	0.7	0.6	4.8	1.3	2.8	No	Yes	0.0	3.5	3.0	2,352.4	5,524.5	104.9
2009	Oct	2352.4	5524.5	104.9	5.4	0.0	0.0	0.0	Yes	Yes	6.6	1.3	7.9	0.0	0.0	Yes	Yes	16.4	59.8	0.0	0.0	2352.4	5524.5	104.9	33.9	0.6	15.6	0.3	2,302.9	5,524.0	103.4	0.9	0.6	9.3	0.0	0.0	Yes	Yes	0.0	9.3	0.0	2,302.9	5,524.0	103.4
2009	Nov	2302.9	5524.0	103.4	7.4	0.0	0.0	0.0	Yes	Yes	9.0	1.8	10.9	0.0	0.0	Yes	Yes	16.4	62.7	16.4	7.4	2740.7	5528.0	115.8	36.2	0.6	1.7	0.0	2,702.8	5,527.7	114.8	1.2	0.6	5.3	0.0	0.0	Yes	Yes	0.0	5.3	0.0	2,702.8	5,527.7	114.8
2009	Dec	2702.8	5527.7	114.8	9.9	0.0	0.0	0.0	Yes	Yes	12.1	2.4	14.5	0.0	0.0	Yes	Yes	16.0	54.1	16.0	11.0	3381.2	5533.2	130.8	42.2	0.7	0.0	0.0	3,338.9	5,532.9	129.9	1.6	0.7	5.8	0.0	0.0	Yes	Yes	0.0	5.8	0.0	3,338.9	5,532.9	129.9
2010	Jan	3338.9	5532.9	129.9	12.1	0.0	0.0	0.0	Yes	Yes	14.8	3.0	17.8	0.0	0.0	Yes	Yes	15.5	43.8	15.5	14.3	4216.7	5539.2	149.6	48.3	0.8	0.0	0.0	4,168.4	5,538.8	148.5	2.0	0.8	6.3	0.0	0.0	Yes	Yes	0.0	6.3	0.0	4,168.4	5,538.8	148.5
2010	Feb	4168.4	5538.8	148.5	13.9	0.0	0.0	0.0	Yes	Yes	17.1	3.4	20.5	0.0	0.0	Yes	Yes	14.9	33.6	14.9	14.9	4994.4	5544.1	166.3	48.5	0.9	0.0	0.0	4,944.9	5,543.8	165.3	2.3	0.9	8.8	0.0	0.0	Yes	Yes	0.0	8.8	0.0	4,944.9	5,543.8	165.3
2010	Mar	4944.9	5543.8	165.3	18.4	0.0	0.0	0.0	Yes	Yes	22.6	4.5	27.1	0.0	0.0	Yes	Yes	14.3	17.7	14.3	14.3	5825.9	5548.9	182.2	58.8	1.0	10.8	0.2	5,756.3	5,548.5	180.7	3.0	1.0	16.8	0.0	0.0	Yes	Yes	0.0	16.8	0.0	5,756.3	5,548.5	180.7
2010	Apr	5756.3	5548.5	180.7	21.7	0.0	0.0	0.0	Yes	Yes	26.6	5.3	31.9	0.0	0.0	Yes	Yes	13.8	4.6	4.6	4.6	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	3.6	1.0	31.9	0.0	0.0	Yes	Yes	0.0	31.9	0.0	5,934.3	5,549.5	184.5
2010	May	5934.3	5549.5	184.5	14.1	7.7	0.0	0.0	Yes	Yes	17.3	3.5	20.8	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	2.3	1.0	17.4	7.1	0.0	Yes	Yes	0.0	3.5	0.0	5,904.7	5,549.3	183.9
2010	Jun	5904.7	5549.3	183.9	7.7	7.7	0.0	0.0	Yes	Yes	9.5	1.9	11.4	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	1.3	1.0	8.6	5.1	2.1	No	Yes	7.6	11.1	9.7	5,193.2	5,545.3	170.0
2010	Jul	5193.2	5545.3	170.0	5.3	5.3	0.0	0.0	No	No	6.5	1.3	7.8	4.3	2.6	No	Yes	14.2	13.6	0.0	0.0	5193.2	5545.3	170.0	54.9	0.9	70.1	1.1	5,068.2	5,544.5	167.7	0.9	0.9	5.3	1.8	7.9	No	Yes	7.3	10.8	17.8	3,973.5	5,535.7	144.1
2010	Aug	3973.5	5535.7	144.1	5.2	5.2	0.0	0.0	No	No	6.4	1.3	7.7	3.6	0.0	Yes	Yes	15.0	33.5	0.0	0.0	3973.5	5537.5	144.1	46.5	0.8	47.6	0.8	3,879.4	5,536.9	142.0	0.9	0.8	5.6	2.1	3.0	No	Yes	7.3	10.8	10.3	3,245.8	5,532.2	127.9
2010	Sep	3245.8	5532.2	127.9	4.5	4.3	0.0	0.0	Yes	Yes	5.5	1.1	6.6	2.9	0.0	Yes	Yes	15.6	46.8	0.0	0.0	3245.8	5532.2	127.9	40.0	0.7	34.4	0.6	3,171.4	5,531.6	126.1	0.7	0.7	5.1	1.6	2.4	No	Yes	0.0	3.5	2.4	3,026.2	5,530.4	122.7
2010	Oct	3026.2	5530.4	122.7	9.0	0.0	0.0	0.0	Yes	Yes	11.0	2.2	13.2	0.0	0.0	Yes	Yes	15.8	48.9	0.0	0.0	3026.2	5530.4	122.7	39.6	0.6	18.3	0.3	2,968.3	5,529.9	121.3	1.

Date		Reservoir Start			Glendale USGS Data Backed to Glendale	to GIC					Glendale USGS Data	Orderville Tributary	River	to OIC				to COVE				Reservoir Int1			Seepage		Evaporation		Reservoir Int2			Mt Carmel Tributary	Seepage Return	River	to MCIC				WC Release	River		Reservoir End		
Yr	Mo	Volume	Elevation	Area	Ave Flow	From River		Supp	Pre Cove Full	Full?	Ave Flow	Ave Flow	Ave Flow	River	Supp	Pre Cove Full	Full?	Hydraulic Ca	to Fill Resv	Control	River	Volume	Elevation	Area					Volume	Elevation	Area	Ave Flow	Ave Flow	Ave Flow	River	Supp	Pre Cove Full	Full?	Supp	Ave Flow	Sum Supp	Volume	Elevation	Area
		af	ft	ac	cfs	cfs	Max Supp	cfs			cfs	cfs	cfs	cfs	cfs			cfs	cfs	cfs	cfs	af	ft	ac	af	cfs	af	cfs	af	ft	ac	cfs	cfs	cfs	cfs	cfs			cfs	cfs	cfs	af	ft	ac
2015	Oct	3222.4	5532.0	127.4	13.5	0.0	0.0	0.0	Yes	Yes	16.6	3.3	19.9	0.0	0.0	Yes	Yes	15.6	45.7	0.0	0.0	3222.4	5532.0	127.4	41.1	0.7	19.0	0.3	3,162.3	5,531.5	125.9	2.2	0.7	22.8	0.0	0.0	Yes	Yes	0.0	22.8	0.0	3,162.3	5,531.5	125.9
2015	Nov	3162.3	5531.5	125.9	10.2	0.0	0.0	0.0	Yes	Yes	12.5	2.5	15.0	0.0	0.0	Yes	Yes	15.6	48.2	15.6	11.5	3847.3	5536.6	141.3	44.1	0.7	2.1	0.0	3,801.1	5,536.3	140.2	1.7	0.7	5.9	0.0	0.0	Yes	Yes	0.0	5.9	0.0	3,801.1	5,536.3	140.2
2015	Dec	3801.1	5536.3	140.2	8.7	0.0	0.0	0.0	Yes	Yes	10.7	2.2	12.9	0.0	0.0	Yes	Yes	15.1	36.3	15.1	9.4	4376.0	5540.2	153.2	49.5	0.8	0.0	0.0	4,326.6	5,539.9	152.1	1.4	0.8	5.7	0.0	0.0	Yes	Yes	0.0	5.7	0.0	4,326.6	5,539.9	152.1
2016	Jan	4326.6	5539.9	152.1	10.2	0.0	0.0	0.0	Yes	Yes	12.5	2.5	15.0	0.0	0.0	Yes	Yes	14.7	27.7	14.7	11.5	5034.5	5544.3	167.0	53.9	0.9	0.0	0.0	4,980.5	5,544.0	166.1	1.7	0.9	6.1	0.0	0.0	Yes	Yes	0.0	6.1	0.0	4,980.5	5,544.0	166.1
2016	Feb	4980.5	5544.0	166.1	15.9	0.0	0.0	0.0	Yes	Yes	19.5	3.9	23.4	0.0	0.0	Yes	Yes	14.3	18.9	14.3	14.3	5775.0	5548.6	181.1	52.8	1.0	0.0	0.0	5,722.1	5,548.3	180.0	2.6	1.0	12.7	0.0	0.0	Yes	Yes	0.0	12.7	0.0	5,722.1	5,548.3	180.0
2016	Mar	5722.1	5548.3	180.0	16.6	0.0	0.0	0.0	Yes	Yes	20.4	4.1	24.5	0.0	0.0	Yes	Yes	13.8	5.0	5.0	5.0	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	2.7	1.0	23.2	0.0	0.0	Yes	Yes	0.0	23.2	0.0	5,960.7	5,549.6	185.1
2016	Apr	5960.7	5549.6	185.1	16.6	0.0	0.0	0.0	Yes	Yes	20.4	4.1	24.5	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	2.7	1.0	27.0	0.0	0.0	Yes	Yes	0.0	27.0	0.0	5,934.3	5,549.5	184.5
2016	May	5934.3	5549.5	184.5	14.0	7.7	0.0	0.0	Yes	Yes	17.2	3.5	20.7	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	2.3	1.0	17.3	7.1	0.0	Yes	Yes	0.0	10.1	0.0	5,904.7	5,549.3	183.9
2016	Jun	5904.7	5549.3	183.9	6.1	6.1	0.0	0.0	No	No	7.6	1.5	9.1	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	1.8	1.0	6.0	2.5	4.7	No	Yes	7.6	11.1	12.3	5,039.1	5,544.4	167.1
2016	Jul	5039.1	5544.4	167.1	4.9	4.9	0.0	0.0	No	No	6.0	1.2	7.2	3.7	3.1	No	Yes	14.3	16.1	0.0	0.0	5039.1	5544.4	167.1	54.0	0.9	68.9	1.1	4,916.2	5,543.6	164.8	0.8	0.9	5.2	1.7	8.0	No	Yes	7.3	10.8	18.5	3,780.3	5,536.2	139.7
2016	Aug	3780.3	5536.2	139.7	7.1	5.5	0.0	0.0	Yes	Yes	8.7	1.7	10.4	3.6	0.0	Yes	Yes	15.1	36.6	0.0	0.0	3780.3	5536.2	139.7	45.1	0.7	46.1	0.7	3,689.1	5,535.5	137.7	1.2	0.7	8.7	5.1	0.0	No	Yes	7.3	10.9	7.3	3,737.7	5,532.1	127.7
2016	Sep	3237.7	5532.1	127.7	9.0	4.3	0.0	0.0	Yes	Yes	11.0	2.2	13.2	2.9	0.0	Yes	Yes	15.6	47.0	0.0	0.0	3237.7	5532.1	127.7	39.9	0.7	34.4	0.6	3,163.5	5,531.5	126.0	1.5	0.7	12.5	4.0	0.0	Yes	Yes	0.0	8.4	0.0	3,163.5	5,531.5	126.0
2016	Oct	3163.5	5531.5	126.0	8.3	0.0	0.0	0.0	Yes	Yes	10.2	2.1	12.3	0.0	0.0	Yes	Yes	15.6	46.7	0.0	0.0	3163.5	5531.5	126.0	40.7	0.7	18.8	0.3	3,104.0	5,531.0	124.5	1.4	0.7	14.3	0.0	0.0	Yes	Yes	0.0	14.3	0.0	3,104.0	5,531.0	124.5
2016	Nov	3104.0	5531.0	124.5	7.3	0.0	0.0	0.0	Yes	Yes	8.9	1.8	10.7	0.0	0.0	Yes	Yes	15.7	49.2	15.7	7.2	3532.5	5534.3	134.2	41.9	0.7	2.0	0.0	3,488.6	5,534.0	133.2	1.2	0.7	5.4	0.0	0.0	Yes	Yes	0.0	5.4	0.0	3,488.6	5,534.0	133.2
2016	Dec	3488.6	5534.0	133.2	13.5	0.0	0.0	0.0	Yes	Yes	16.6	3.3	19.9	0.0	0.0	Yes	Yes	15.4	41.4	15.4	15.4	4433.7	5540.6	154.5	49.9	0.8	0.0	0.0	4,383.7	5,540.3	153.4	2.2	0.8	7.6	0.0	0.0	Yes	Yes	0.0	7.6	0.0	4,383.7	5,540.3	153.4
2017	Jan	4383.7	5540.3	153.4	33.1	0.0	0.0	0.0	Yes	Yes	40.7	8.2	48.9	0.0	0.0	Yes	Yes	14.7	26.8	14.7	14.7	5287.8	5545.8	171.7	55.4	0.9	0.0	0.0	5,232.4	5,545.5	170.7	5.5	0.9	40.5	0.0	0.0	Yes	Yes	0.0	40.5	0.0	5,232.4	5,545.5	170.7
2017	Feb	5232.4	5545.5	170.7	44.8	0.0	0.0	0.0	Yes	Yes	55.0	11.1	66.1	0.0	0.0	Yes	Yes	14.1	14.4	14.1	14.1	6018.0	5549.9	186.3	54.3	1.0	0.0	0.0	5,963.7	5,549.6	185.1	7.4	1.0	60.3	0.0	0.0	Yes	Yes	0.0	60.3	0.0	5,963.7	5,549.6	185.1
2017	Mar	5963.7	5549.6	185.1	33.1	0.0	0.0	0.0	Yes	Yes	40.7	8.2	48.9	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	5.5	1.0	54.2	0.0	0.0	Yes	Yes	0.0	54.2	0.0	5,960.7	5,549.6	185.1
2017	Apr	5960.7	5549.6	185.1	16.4	0.0	0.0	0.0	Yes	Yes	20.1	4.0	24.1	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	2.7	1.0	26.6	0.0	0.0	Yes	Yes	0.0	26.6	0.0	5,934.3	5,549.5	184.5
2017	May	5934.3	5549.5	184.5	10.5	7.7	0.0	0.0	Yes	Yes	12.9	2.6	15.5	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	1.7	1.0	11.6	7.1	0.0	Yes	Yes	0.0	4.4	0.0	5,904.7	5,549.3	183.9
2017	Jun	5904.7	5549.3	183.9	7.8	7.7	0.0	0.0	Yes	Yes	9.5	1.9	11.4	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	1.3	1.0	8.6	5.1	2.1	No	Yes	7.6	11.1	9.7	5,196.4	5,545.3	170.0
2017	Jul	5196.4	5545.3	170.0	7.1	7.1	0.0	0.0	No	No	8.7	1.7	10.4	6.8	0.0	Yes	Yes	14.2	13.6	0.0	0.0	5196.4	5545.3	170.0	54.9	0.9	70.1	1.1	5,071.3	5,544.6	167.7	1.2	0.9	5.6	2.1	7.6	No	Yes	7.3	10.8	14.9	4,155.6	5,538.8	148.3
2017	Aug	4155.6	5538.8	148.3	6.1	5.5	0.0	0.0	Yes	Yes	7.4	1.5	8.9	3.6	0.0	Yes	Yes	14.9	30.5	0.0	0.0	4155.6	5538.8	148.3	47.9	0.8	48.9	0.8	4,058.8	5,538.1	146.1	1.0	0.8	7.1	3.6	1.5	No	Yes	7.3	10.8	8.9	3,513.5	5,534.2	133.7
2017	Sep	3513.5	5534.2	133.7	8.9	4.3	0.0	0.0	Yes	Yes	10.9	2.2	13.1	2.9	0.0	Yes	Yes	15.4	42.3	0.0	0.0	3513.5	5534.2	133.7	41.8	0.7	36.0	0.6	3,435.7	5,533.6	132.0	1.5	0.7	12.4	4.0	0.0	Yes	Yes	0.0	8.3	0.0	3,435.7	5,533.6	132.0
2017	Oct	3435.7	5533.6	132.0	9.3	0.0	0.0	0.0	Yes	Yes	11.4	2.3	13.7	0.0	0.0	Yes	Yes	15.4	42.2	0.0	0.0	3435.7	5533.6	132.0	42.6	0.7	19.7	0.3	3,373.4	5,533.1	130.7	1.5	0.7	15.9	0.0	0.0	Yes	Yes	0.0	15.9	0.0	3,373.4	5,533.1	130.7
2017	Nov	3373.4	5533.1	130.7	9.9	0.0	0.0	0.0	Yes	Yes	12.1	2.4	14.5	0.0	0.0	Yes	Yes	15.5	44.7	15.5	11.0	4029.9	5537.9	145.4	45.4	0.8	2.2	0.0	3,982.2	5,537.6	144.3	1.6	0.8	5.9	0.0	0.0	Yes	Yes	0.0	5.9	0.0	3,982.2	5,537.6	144.3
2017	Dec	3982.2	5537.6	144.3	11.2	0.0	0.0	0.0	Yes	Yes	13.8	2.8	16.6	0.0	0.0	Yes	Yes	15.0	33.3	15.0	13.1	4786.1	5542.8	162.2	52.4	0.9	0.0	0.0	4,733.8	5,542.5	161.1	1.8	0.9	6.2	0.0	0.0	Yes	Yes	0.0	6.2	0.0	4,733.8	5,542.5	161.1
2018	Jan	4733.8	5542.5	161.1	12.1	0.0	0.0	0.0	Yes	Yes	14.8	3.0	17.8	0.0	0.0	Yes	Yes	14.5	21.1	14.5	14.3	5611.5	5547.7	177.8	57.4	0.9	0.0	0.0	5,554.1	5,547.4	176.7	2.0	0.9	6.4	0.0	0.0	Yes	Yes	0.0	6.4	0.0	5,554.1	5,547.4	176.7
2018	Feb	5554.1	5547.4	176.7	16.1	0.0	0.0	0.0	Yes	Yes	19.8	4.0	23.8	0.0	0.0	Yes	Yes	13.9	8.6	8.6	8.6	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.7	1.0	18.8	0.0	0.0	Yes	Yes	0.0	18.8	0.0	5,977.6	5,549.7	185.4
2018	Mar	5977.6	5549.7	185.4	10.1	0.0	0.0	0.0	Yes	Yes	12.4	2.5	14.9	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	1.7	1.0	16.6	0.0	0.0	Yes	Yes	0.0	16.6	0.0	5,960.7	5,549.6	185.1
2018	Apr	5960.7	5549.6	185.1	7.4	0.0	0.0	0.0	Yes	Yes	9.1	1.8	11.0	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	1.2	1.0	12.0	0.0	0.0	Yes	Yes	0.0	12.0	0.0	5,934.3	5,549.5	184.5
2018	May	5934.3	5549.5	184.5	4.7	4.7	0.0	0.0	No	No	5.8	1.2	7.0	3.5	1.6	No	Yes	13.7	1.6	1.6	0.0	5934.3	5549.5	184.5	59.6	1.0	66.3	1.1	5,808.5	5,548.8	181.8	0.8	1.0	5.2	1.7	5.4	No	Yes	0.0	3.5	7.0	5,377.5	5,546.4	173.4
2018	Jun	5377.5	5546.4	173.4	6.0	6.0	0.0	0.0	No	No	7.3	1.5	8.8	5.1	0.0	Yes	Yes	14.1	11.0	0.0	0.0	5377.5	5546.4	173.4	54.2	0.9	71.5	1.2	5,251.9	5,545.6	171.0	1.0	0.9	5.6	2.1	5.1	No	Yes	7.6	11.1	12.7	4,497.2	5,541.0	156.0
2018	Jul	4497.2	5541.0	156.0	4.6	4.6	0.0	0.0	No	No	5.6	1.1	6.7	3.2	3.6	No	Yes	14.6	25.0	0.0	0.0	4497.2	5541.0	156.0	50.4	0.8	64.3	1.0	4,382.5	5,540.3	153.4	0.8	0.8	5.1	1.6	8.1	No	Yes	7.3	10.8	19.0	3,211.8	5,531.9	127.1
2018	Aug	3211.8	5531.9	127.1	4.4	4.4	0.0	0.0	No	No	5.4	1.1	6.4	2.9	0.7	No	Yes	15.6	45.9	0.0	0.0	3211.8	5531.9	127.1	41.0	0.7	41.9	0.7	3,128.8	5,531.2	125.1	0.7	0.7	4.9	1.4	3.7	No	Yes	7.3	10.8	11.8	2,406.0	5,525.0	106.5
2018	Sep	2406.0	5525.0	106.5	7.7	4.3	0.0	0.0	Yes	Yes	9.5	1.9	11.4	2.9	0.0	Yes	Yes	16.3	60.9	0.0	0.0	2406.0	5525.0	106.5	33.3	0.6	28.7	0.5	2,344.0	5,524.4	104.6	1.3	0.6	10.3	4.0	0.0	Yes	Yes	0.0	6.3	0.0	2,344.0	5,524.4	104.6
2018	Oct	2344.0	5524.4	104.6	9.9	0.0	0.0	0.0	Yes	Yes	12.1	2.4	14.5	0.0	0.0	Yes	Yes	16.4	60.0	0.0	0.0	2344.0	5524.4	104.6	33.8	0.5	15.6	0.3	2,294.6	5,523.9	103.2	1.6	0.5	16.7	0.0	0.0	Yes	Yes	0.0	16.7	0.0	2,294.6	5,523.9	103.2
2018	Nov	2294.6	5523.9	103.2	11.2	0.0	0.0	0.0	Yes	Yes	13.7	2.8	16.5	0.0	0.0	Yes	Yes	16.4	62.8	16.4	13.0	3065.5	5530.7	123.6	38.6	0.6	1.9	0.0	3,025.0	5,530.4	122.7	1.8	0.6	6.0	0.0	0.0	Yes	Yes	0.0	6.0	0.0	3,025.0	5,530.4	122.7
2018	Dec	3025.0	5530.4	122.7	12.9	0.0	0.0	0.0	Yes	Yes	15.8	3.2	19.0	0.0	0.0	Yes	Yes	15.8	48.9	15.8	15.5	3976.6	5537.5	144.2	46.6	0.8	0.0	0.0	3,930.0	5,537.2	143.1	2.1	0.8	6.4	0.0	0.0	Yes	Yes	0.0	6.4	0.0	3,930.0	5,537.2	143.1
2019	Jan	3930.0	5537.2	143.1	12.5	0.0	0.0	0.0	Yes	Yes	15.3	3.1	18.4	0.0	0.0	Yes	Yes	15.0	34.2	15.0	14.9	4844.7	5543.2	163.3	52.7	0.9	0.0	0.0	4,791.9	5,542.9	162.3	2.1	0.9	6.4	0.0	0.0	Yes	Yes	0.0	6.4	0.0	4,791.9	5,542.9	162.3
2019	Feb	4791.9	5542.9	162.3	28.7	0.0	0.0	0.0	Yes	Yes	35.2	7.1	42.3	0.0	0.0	Yes	Yes	14.4	22.3	14.4	14.4	5593.2	5547.6	177.4	51.7	0.9	0.0	0.0	5,541.5	5,547.3	176.4	4.7	0.9	33.5	0.0	0.0	Yes	Yes	0.0	33.5	0.0	5,541.5	5,547.3	176.4
2019	Mar	5541.5	5547.3	176.4	43.7	0.0	0.0	0.0	Yes	Yes	53.7	10.8	64.5	0.0	0.0	Yes	Yes	14.0	8.0	8.0	8.0	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	7.2	1.0	64.7	0.0	0.0	Yes	Yes	0.0	64.7	0.0	5,960.7	5,549.6	185.1
2019	Apr	5960.7	5549.6	185.1	27.4	0.0	0.0	0.0	Yes	Yes	33.7	6.8	40.5	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	4.5	1.0	44.8	0.0	0.0	Yes	Yes	0.0	44.8	0.0	5,934.3	5,549.5	184.5
2019	May	5934.3	5549.5	184.5	18.6	7.7	0.0	0.0	Yes	Yes	22.8	4.6	27.4	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	3.1	1.0	24.8	7.1	0.0	Yes	Yes	0.0	17.6	0.0	5,904.7	5,549.3	183.9
2019	Jun	5904.7	5549.3	183.9	10.9	7.7	0.0	0.0	Yes	Yes	13.4	2.7	16.1	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	1.8	1.0	13.8	7.2	0.0	Yes	Yes	7.6	14.2	7.6	5,320.1	5,546.0	172.3
2019	Jul	5320.1	5546.0	172.3	8.6	8.6	0.0	0.0	No	No	10.5	2.1	12.6	6.8	0.0	Yes	Yes	14.1	11.6	0.0	0.0	5320.1	5546.0	172.3	55.6	0.9	71.1	1.2	5,193.4	5,545.3	170.0	1.4	0.9	8.1	4.6	5.1	No	Yes	7.3	10.8	12.4	4,429.4	5,540.6	154.4
2019	Aug	4429.4	5540.6	154.4	8.0	5.5	0.0	0.0	Yes	Yes	9.8	2.0	11.8	3.6	0.0	Yes	Yes	14.7	26.1	0.0	0.0	4429.4	5540.6	154.4	49.9	0.8	51.0	0.8	4,328.6	5,539.9	152.1	1.3	0.8	10.3	5.1	0.0	Yes	Yes	7.3	12.5	7.3	3,877.2	5,536.8	141.9
2019	Sep	3877.2	5536.8	141.9	10.4	4.3	0.0	0.0	Yes	Yes	12.8	2.6	15.4	2.9	0.0	Yes	Yes	15.1	36.2	0.0	0.0	3877.2	5536.8	141.9	44.4	0.7	38.2	0.6	3,794.7	5,536.3	140.1	1.7	0.7	15.0	4.0	0.0	Yes	Yes	0.0	10.9	0.0	3,794.7	5,536.3	140.1
2019	Oct	3794.7	5536.3	140.1	14.0	0.0	0.0	0.0	Yes	Yes	17.2	3.5	20.7	0.0	0.0	Yes	Yes	15.1	36.4	0.0	0.0	3794.7	5536.3	140.1	45.2	0.7	20.9	0.3	3,728.5	5,535.8	138.6	2.3	0.7	23.7	0.0	0.0	Yes	Yes	0.0	23.7	0.0	3,728.5	5,535.8	138.6
2019	Nov	3728.5	5535.8	138.6	17.3	0.0	0.0	0.0	Yes	Yes	21.2	4.3	25.5	0.0	0.0	Yes	Yes	15.2	38.7	15.2	15.2	4632.0	5541.9	159.0	49.7	0.8	2.4	0.0	4,579.9	5,541.5	157.9	2.8	0.8	14.0	0.0	0.0	Yes	Yes	0.0	14.0	0.0	4,579.9	5,541.5	157.9
2019	Dec	4579.9	5541.5	157.9	15.9	0.0	0.0	0.0	Yes	Yes	19.5	3.9	23.4	0.0	0.0	Yes	Yes	14.6	23.6	14.6	14.6	5475.7	5546.9	175.2	56.6	0.9	0.0	0.0	5,419.1	5,546.6	174.1	2.6	0.9	12.4	0.0	0.0	Yes	Yes	0.0	12.4	0.0	5,419.1	5,546.6	174.1
2020	Jan	5419.1	5546.6	174.1	16.0	0.0	0.0	0.0	Yes	Yes	19.6	3.9	23.5	0.0	0.0	Yes	Yes	14.0	10.0	10.0	10.0	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.6	1.0	17.2	0.0	0.0	Yes	Yes	0.0	17.2	0.0	5,971.7	5,549.7	185.3
2020	Feb	5971.7	5549.7	185.3	19.5	0.0	0.0	0.0	Yes	Yes	24.0	4.8	28.8	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	3.2	1.0	31.9	0.0	0.0	Yes	Yes	0.0	31.9	0.0	5,977.6	5,549.7	185.4
2020	Mar	5977.6	5549.7	185.4	17.1	0.0	0.0	0.0	Yes	Yes	21.0	4.2	25.2	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	2.8	1.0	28.1	0.0	0.0	Yes	Yes	0.0	28.1	0.0	5,960.7	5,549.6	185.1
2020	Apr	5960.7	5549.6	185.1	11.3	0.0	0.0	0.0	Yes	Yes	13.9	2.8	16.7	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	1.9	1.0	18.3	0.0	0.0	Yes	Yes	0.0	18.3	0.0	5,934.3	5,549.5	184.5
2020	May	5934.3	5549.5	184.5	8.0	7.7	0.0	0.0	Yes	Yes	9.9	2.0	11.8	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	1.3	1.0	7.5	4.0	3.2	No	Yes	0.0	3.5	3.2	5,710.1	5,548.2	179.7
2020	Jun	5710.1	5548.2	179.7	6.1	6.1	0.0	0.0	No	No	7.5	1.5	9.0	5.1	0.0	Yes	Yes	13.9	5.4	0.0	0.0	5710.1	5548.2	179.7	56.2	0.9	74.1	1.2	5,579.8	5,547.5	177.2	1.0	0.9	5.9	2.4	4.8	No	Yes	7.6	11.1	12.4	4,841.4	5,543.2	163.3
2020	Jul	4841.4	5543.2	163.3	5.3	5.3	0.0	0.0	No	No	6.5	1.3	7.8	4.3	2.6	No	Yes	14.4	19.4	0.0	0.0	4841.4	5543.2

Appendix B. Irrigation Company Historical Data

Utah Division of Water Rights
Distribution System Daily Records Summary

EAST FORK VIRGIN RIVER GLENDALE

COMMON DESCRIPTION: Diversion in river feeds pipe to sluice top exit
DIVERTING WORKS: Headgate at diversion dam to pipe to sluice basin
MEASURING DEVICE: 3` CIPOLETTI WEIR 10% split BFords
RECORDS RATING: Unrated
LOCATION: 358051.57 East, 4134186.13 North (NAD83 UTM Coordinates)

ACFT Monthly Summary of Mean daily discharge in CFS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
1991					482.	358.	227.	232.	266.	291.			1857.
1992					460.	313.	314.	336.	317.				1739.
1993				215.	476.	460.	467.	443.	459.	482.			3002.
1994						341.	276.	282.	299.	275.			1473.
1995				307.	475.	447.	443.	472.	411.	475.			3030.
1997				337.	464.	402.	215.	300.	383.	475.			2577.
1999					428.	284.	271.	387.	379.	317.			2067.
2000				390.	456.	328.	262.	272.	401.	416.			2527.
2001				479.	475.	347.	313.	324.	288.	336.			2561.
2002				267.	360.	265.	275.	235.	248.	383.			2033.
2003				302.	449.	293.	260.	302.	292.	342.			2240.
2004				322.	429.	319.	224.	266.	261.	307.			2128.
2005				446.	461.	446.	461.	461.	446.	461.		3179.	6358.
2006				365.	492.	462.	461.	405.	433.	492.			3109.
2007					397.	282.	259.	326.	265.	280.			1808.
2009				202.	433.	425.	273.	155.	250.	279.			2018.
2010				27.	343.	290.	267.	289.	292.	374.			1882.
2011				70.	625.	582.	555.	449.	476.	262.			3019.
2012				333.	573.	255.	198.	296.	483.	232.			2370.
2013				377.	320.	216.	455.	388.	295.	320.			2372.
2014				412.	619.	344.	313.	329.	336.	151.			2505.
2015				397.	414.	338.	296.	308.	277.	259.	0.		2289.
2016				449.	511.	346.	282.	305.	271.	328.			2491.
2017				0.	493.	553.	412.	357.	295.	123.			2234.
2018			53.	389.	330.	285.	224.	279.	266.	264.			2090.
2019				0.	220.	274.	403.	415.	375.	271.			1959.
2020				386.	401.	338.	320.	270.	266.	278.	17.		2275.
2021				367.	287.	285.	192.	256.	247.	210.			1845.
2022				211.	239.	242.	220.	124.					1036.
Mean			53.	294.	433.	349.	315.	319.	331.	322.	8.	3179.	2376.

Utah Division of Water Rights
Distribution System Daily Records Summary

EAST FORK VIRGIN RIVER ORDERVILLE IRRIGATION

COMMON DESCRIPTION: W Side of River N of Orderville, thur corral LWX
DIVERTING WORKS: Conc Div struct w side gate to pipe, still basin
MEASURING DEVICE: 10` CIPOLETTI Weir, Desilting basin
RECORDS RATING: Unrated
LOCATION: 356880.53 East, 4129395.96 North (NAD83 UTM Coordinates)

ACFT Monthly Summary of Mean daily discharge in CFS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
1963					236.	171.	151.	30.	154.				743.
1964				50.	335.	238.	198.	168.	162.				1151.
1965					338.	392.	267.	166.	219.				1382.
1966				146.	347.	248.	188.	192.	206.				1326.
1967					140.	316.	261.	312.	228.				1257.
1968				67.	366.	366.	235.	259.	245.				1538.
1969					490.	499.	494.	342.	287.				2113.
1974				349.	331.	238.	184.	175.	149.				1426.
1975					298.	372.	312.	219.	211.	124.			1535.
1976					391.	232.	182.	233.	234.	187.			1459.
1977				159.	267.	236.	219.	189.	183.	224.			1476.
1990					6.	25.	13.	26.	10.	7.			87.
1991					31.	183.	140.	142.	170.	185.			851.
1992					213.	207.	190.	154.	192.				957.
1993				134.	291.	282.	280.	268.	262.	273.			1790.
1994				193.	272.	226.	162.	156.	149.				1158.
1995				179.	279.	266.	258.	243.	221.	237.			1683.
1996				219.	249.	166.	158.	150.	227.	256.			1425.
1997				193.	265.	232.	149.	174.	217.	272.			1502.
1998				138.	279.	253.	246.	255.	263.	151.			1586.
1999					238.	187.	130.	179.	215.	178.			1126.
2000				229.	252.	170.	140.	134.	209.				1135.
2001				253.	256.	196.	205.	187.	172.	197.			1465.
2002				148.	232.	155.	140.	613.	149.	222.			1660.
2003				231.	295.	168.	159.	178.	166.	203.			1401.
2004				185.	245.	195.	128.	150.	148.	176.			1228.
2005				252.	260.	252.	260.	260.	252.	260.			1795.
2006				202.	272.	256.	269.	230.	244.	261.			1735.
2007				40.	241.	158.	144.	189.	221.	273.			1267.
2008				285.	361.	256.	134.	236.	157.	158.			1587.
2009				239.	356.	264.	155.	134.	148.	150.			1447.
2010					681.	402.	158.	229.	178.	380.			2028.
2011					500.	662.	525.	427.	368.	232.			2714.
2012				353.	427.	172.	165.	319.	409.	165.			2010.
2013				330.	588.	159.	259.	202.	229.	305.			2073.
2014				258.	344.	173.	185.	215.	203.	101.			1479.
2015				631.	565.	490.	224.	223.	287.	330.			2751.
2016				325.	442.	378.	203.	209.	194.	323.			2073.
2017				100.	1044.	552.	280.	275.	317.	178.			2746.
2018			148.	573.	387.	189.	269.	247.	285.	254.	250.		2603.
2019				0.	297.	615.	426.	342.	279.	86.			2045.
2020				422.	457.	245.	207.	179.	203.	274.	45.		2033.
2021			57.	440.	218.	167.	132.	135.	185.	536.	677.		2546.
2022				476.	419.	158.	141.	99.					1292.
Mean			103.	244.	336.	267.	212.	215.	214.	224.	324.		1606.

Utah Division of Water Rights
Distribution System Daily Records Summary

EAST FORK VIRGIN RIVER MT. CARMEL

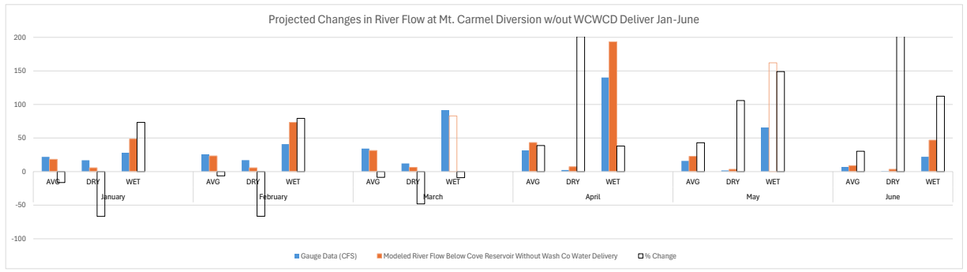
COMMON DESCRIPTION: 37 15 59 N/112 38 49 W
DIVERTING WORKS: CONCRETE AND ROCK DAM SCREW GATES, GRATED INTAKE
MEASURING DEVICE: 4 FT Contracted Rectanglar Weir
RECORDS RATING: Good
LOCATION: 353957.31 East, 4125713.44 North (NAD83 UTM Coordinates)

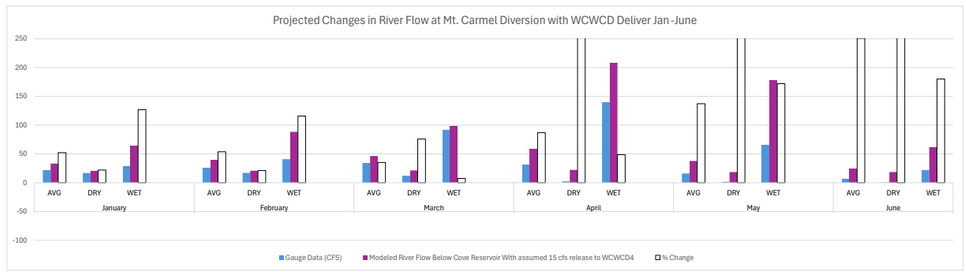
ACFT Monthly Summary of Mean daily discharge in CFS

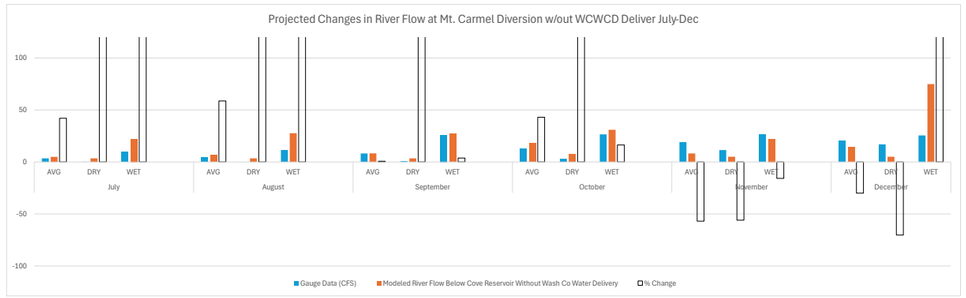
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
1991					354.	298.	211.	214.	235.	306.			1618.
1992				175.	359.	310.	285.	314.	322.				1764.
1993				227.	495.	482.	459.	384.	401.	457.			2905.
1994				287.	405.	333.	240.	224.	343.	234.			2066.
1997				308.	417.	318.	241.	272.	310.	414.			2280.
1998				196.	414.	366.	378.	383.	397.	221.			2355.
1999					334.	252.	195.	329.	325.	247.			1681.
2000				339.	384.	249.	236.	217.	275.	352.			2052.
2001				372.	377.	315.	309.	269.	236.	283.			2160.
2002				256.	333.	219.	210.	251.	221.	297.			1788.
2003				248.	356.	257.	228.	258.	244.	292.			1881.
2004				274.	363.	285.	675.	223.	259.	276.			2355.
2005				370.	382.	370.	382.	382.	370.	382.			2636.
2006				300.	405.	379.	398.	333.	360.	392.			2566.
2007				32.	324.	261.	214.	259.	245.	349.			1685.
2008				125.	316.	278.	237.	257.	210.	303.			1727.
2009				152.	334.	311.	275.	222.	220.	260.			1774.
2010					255.	381.	286.	354.	258.	248.			1782.
2011					260.	452.	453.	452.	432.	99.			2148.
2012				76.	436.	260.	219.	378.	320.	184.			1873.
2013				337.	463.	185.	269.	209.	163.	158.			1783.
2014				314.	443.	264.	238.	295.	273.	116.			1944.
2015				346.	456.	338.	235.	268.	247.	273.			2164.
2016				305.	340.	303.	185.	248.	427.	426.			2234.
2017				274.	536.	481.	410.	426.	409.	281.			2817.
2018				407.	362.	227.	273.	266.	273.	282.			2089.
2019				0.	373.	434.	377.	340.	339.	172.			2035.
2020				309.	484.	405.	328.	273.	306.	316.	0.		2421.
2021			26.	415.	356.	255.	217.	246.	252.		11.		1778.
2022				160.	281.	184.	178.	130.					933.
Mean			26.	254.	380.	315.	295.	289.	299.	282.	5.		2043.

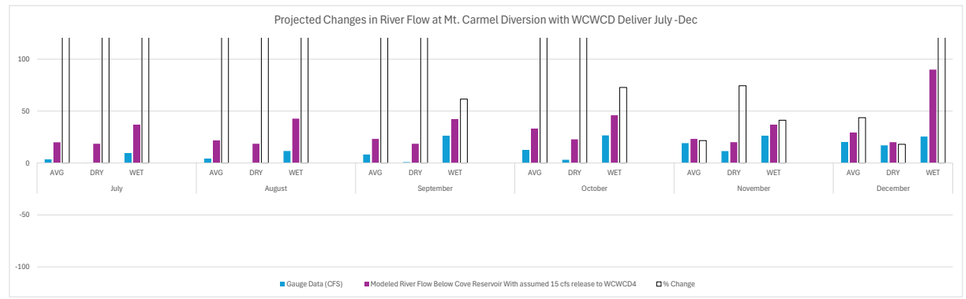
Appendix C. Flow Regime Comparisons Calcs

IMPACTS	January				February				March				April				May				June				July				August				September				October				November				December		
Mt. Carmel Gauge	AVG	DRY	WET		AVG	DRY	WET		AVG	DRY	WET		AVG	DRY	WET		AVG	DRY	WET		AVG	DRY	WET		AVG	DRY	WET		AVG	DRY	WET		AVG	DRY	WET		AVG	DRY	WET		AVG	DRY	WET		AVG	DRY	WET
Gauge Data (CFS)	21.9	16.9	28		25	17.1	40.9		34.3	12.1	91.2		31.2	2.4	140.1		15.9	1.7	65.1		6.8	0.7	22.1		3.5	0.2	9.5		4.2	0.1	11.6		8.2	0.8	26		12.6	3.1	26.6		19.1	11.5	26.3		20.4	17	25.5
Year		2001	1993			2002	1993			2002	1993			2002	1993			2002	1993			2002	1993			2002	1999			2002	1993			2002	1997			2002	1993			2002	1993			1999	1993
Modeled River Flow Below Cove Reservoir Without Wash Co Water Delivery	18.3	5.6	48.5		23.4	5.7	73.3		31.4	6.3	83.0		43.3	7.2	193.4		22.7	3.5	162.1		8.9	3.5	46.9		5.0	3.5	22.2		6.7	3.5	27.7		8.3	3.5	27.0		18.0	7.8	31.0		8.2	5.1	22.1		14.3	5.1	74.9
% Change	-16	-67	73		-6	-67	79		-9	-48	-9		39	201	38		43	106	149		30	400	112		42	1650	134		59	3400	139		1	338	4		43	151	16		-57	-56	-16		-30	-70	194
Modeled River Flow Below Cove Reservoir With assumed 15 cfs release to WCWCD[4]	33.3	20.6	63.5		38.4	20.7	88.3		46.4	21.3	98.0		58.3	22.2	208.4		37.7	18.5	177.1		23.9	18.5	61.9		20.0	18.5	37.2		21.7	18.5	42.7		23.3	18.5	42.0		33.0	22.8	46.0		23.2	20.1	37.1		29.3	20.1	89.9
% Change	52	22	127		54	21	116		35	76	7		87	826	49		137	988	172		251	2543	180		471	9150	292		416	18400	268		184	2213	61		162	635	73		22	74	41		44	18	253









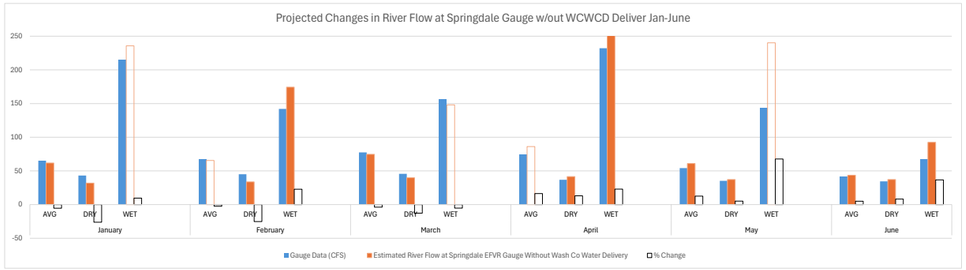
IMPACTS--MT CARMEL EFVR GAUGE

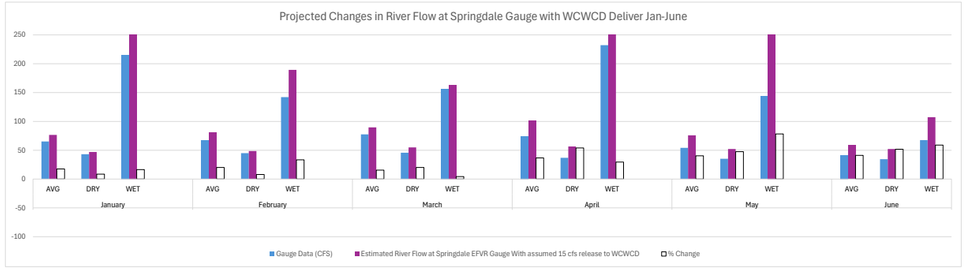
			Gauge Data(cfs)[5]	Year	Modeled River Flow Below Cove Reservoir Without Wash Co Water Delivery	% Change	Modeled River Flow Below Cove Reservoir With assumed 15 cfs release to WCWCD[4,7]	% Change
January--average year			21.9		18.3	-16	33.3	52
January--driest year			16.9	2001	5.6	-67	20.6	22
January--wettest year			28	1993	48.5	73	63.5	127
February--average year			25.0		23.4	-6	38.4	54
February--driest year			17.1	2002	5.7	-67	20.7	21
February--wettest year			40.9	1993	73.3	79	88.3	116
March--average year			34.3		31.4	-9	46.4	35
March--driest year			12.1	2002	6.3	-48	21.3	76
March--wettest year			91.2	1993	83.0	-9	98.0	7
April--average year			31.2		43.3	39	58.3	87
April--driest year			2.4	2002	7.2	201	22.2	826
April--wettest year			140.1	1993	193.4	38	208.4	49
May--average year			15.9		22.7	43	37.7	137
May--driest year			1.7	2002	3.5	106	18.5	988
May--wettest year			65.1	1993	162.1	149	177.1	172
June--average year			6.8		8.9	30	23.9	251
June--driest year			0.7	2002	3.5	400	18.5	2543
June--wettest year			22.1	1993	46.9	112	61.9	180
July--average year			3.5		5.0	42	20.0	471
July--driest year			0.2	2002	3.5	1650	18.5	9150
July--wettest year			9.5	1999	22.2	134	37.2	292
August--average year			4.2		6.7	59	21.7	416
August--driest year[6]			0.1	2002	3.5	3400	18.5	18400
August--wettest year			11.6	1993	27.7	139	42.7	268
September--average year			8.2		8.3	1	23.3	184
September--driest year			0.8	2002	3.5	338	18.5	2213
September--wettest year			26.0	1997	27.0	4	42.0	61
October--average year			12.6		18.0	43	33.0	162
October--driest year			3.1	2002	7.8	151	22.8	635
October--wettest year			26.6	1993	31.0	16	46.0	73
November--average year			19.1		8.2	-57	23.2	22
November--driest year			11.5	2002	5.1	-56	20.1	74
November--wettest year			26.3	1993	22.1	-16	37.1	41
December--average year			20.4		14.3	-30	29.3	44
December--driest year			17.0	1999	5.1	-70	20.1	18
December--wettest year			25.5	1993	74.9	194	89.9	253

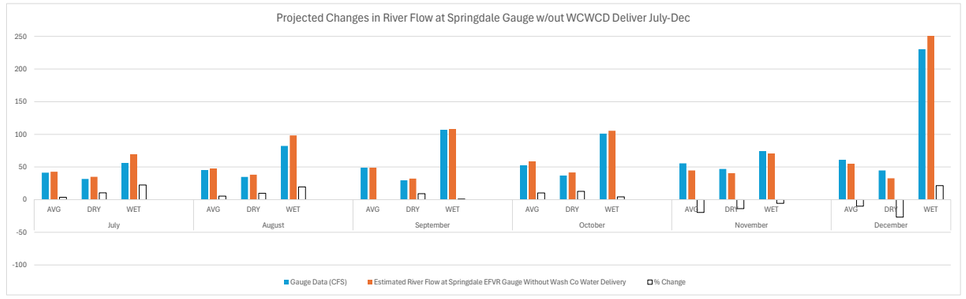
Notes

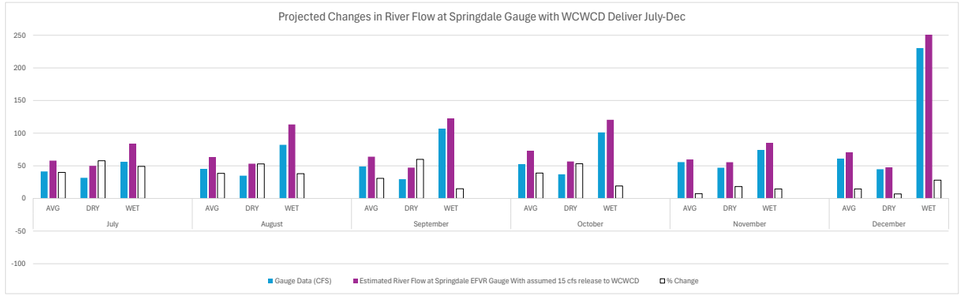
1. Average year: the mean CFS for all Januarys on record
2. Driest year: the mean CFS for driest January on record
3. Wettest year: the mean CFS for wettest January on record
4. Because the WCWCD delivery flow of 15 cfs was assumed independently for each scenario rather than being incorporated directly into the hydraulic model, the resulting river flow rates will be higher than those simulated. Since this additional 15 cfs was not included in the model calculations used to determine reservoir water surface elevations, the modeled elevations may underestimate the actual reservoir elevations that would occur under the assumed delivery conditions.
5. This analysis compares Average, Driest, and Wettest years recorded at three different gauging stations namely:
USGS Glendale Gauge 1966-2020
USGS Mt. Carmel Gauge 1992-2002
USGS Springdale Gauge 1991-2025
6. This valve was originally 0.0 cfs. It was changed to 0.1 cfs for calculation purposes.
7. Any releases to the WCWCD would adhere to the settlement agreement which specifies releases from the reservoir "shall not increase the flow measured at the U.S. Geological Survey (USGS) gage on the East Fork Virgin River near Springdale (USGS No. 09404900), by more than 25 cfs during any 7-day period and shall not exceed the long-term monthly average at the Springdale gage by more than 15 cfs."

IMPACTS Springdale EFVR Gauge	January				February				March				April				May				June				July				August				September				October				November				December		
	AVG	DRY	WET		AVG	DRY	WET		AVG	DRY	WET		AVG	DRY	WET		AVG	DRY	WET		AVG	DRY	WET		AVG	DRY	WET		AVG	DRY	WET		AVG	DRY	WET		AVG	DRY	WET		AVG	DRY	WET		AVG	DRY	WET
Gauge Data (CFS)	65.2	43.2	215.3		67.01559	45	142		77.52515	45.7	156.2		73.93694	36.8	232.1		54.08974	35.281	143.219		41.48074	34.4	67.56		41.373529	31.658	56.445		45.413824	34.806	82.206		48.913412	29.53	107.037		52.564559	36.952	101.103		55.605794	46.96	74.35		61.422118	44.706	230.419
Year		2003	2005			2015	2005			2002	2005			2002	2023			2002	2005			1996	2005			2002	2013			2009	2022			2002	2014			2003	2004			2002	2004			2002	2010
Estimated River Flow at Springdale EFVR Gauge Without Wash Co Water Delivery	61.6	31.9	235.8		65.4	33.6	174.4		74.6	39.9	148.0		86.1	41.6	285.4		60.9	37.1	240.2		43.5	37.2	92.4		42.8	35.0	69.2		47.9	38.2	98.3		49.0	32.2	108.0		58.0	41.6	105.5		44.7	40.5	70.2		55.3	32.8	279.8
% Change	-5	-26	10		-2	-25	23		-4	-13	-5		16	13	23		13	5	68		5	8	37		4	10	23		5	10	20		0	9	1		10	13	4		-20	-14	-6		-10	-27	21
Estimated River Flow at Springdale EFVR Gauge With assumed 15 cfs release to WCWCD	76.6	46.9	250.8		80.4	48.6	189.4		89.6	54.9	163.0		101.1	56.6	300.4		75.9	52.1	255.2		58.5	52.2	107.4		57.8	50.0	84.2		62.9	53.2	113.3		64.0	47.2	123.0		73.0	56.6	120.5		59.7	55.5	85.2		70.3	47.8	294.8
% Change	18	9	17		20	8	33		16	20	4		37	54	29		40	48	78		41	52	59		40	58	49		38	53	38		31	60	15		39	53	19		7	18	15		14	7	28









IMPACTS--SPRINGDALE EFVR GAUGE

			Gauge Data (cfs)	Year	Estimated River Flow at Springdale EFVR Gauge Without Wash Co Water Delivery[6]	% Change	Estimated River Flow at Springdale EFVR Gauge With assumed 15 cfs release to WCWCD[4,7]	% Change
January--average year			65.2		61.6	-5	76.6	18
January--driest year			43.2	2003	31.9	-26	46.9	9
January--wettest year			215.3	2005	235.8	10	250.8	17
February--average year			67.0		65.4	-2	80.4	20
February--driest year			45	2015	33.6	-25	48.6	8
February--wettest year			142	2005	174.4	23	189.4	33
March--average year			77.5		74.6	-4	89.6	16
March--driest year			45.7	2002	39.9	-13	54.9	20
March--wettest year			156.2	2005	148.0	-5	163.0	4
April--average year			73.9		86.1	16	101.1	37
April--driest year			36.8	2002	41.6	13	56.6	54
April--wettest year			232.1	2023	285.4	23	300.4	29
May--average year			54.1		60.9	13	75.9	40
May--driest year			35.3	2002	37.1	5	52.1	48
May--wettest year			143.2	2005	240.2	68	255.2	78
June--average year			41.5		43.5	5	58.5	41
June--driest year			34.4	1996	37.2	8	52.2	52
June--wettest year			67.6	2005	92.4	37	107.4	59
July--average year			41.4		42.8	4	57.8	40
July--driest year			31.7	2002	35.0	10	50.0	58
July--wettest year			56.4	2013	69.2	23	84.2	49
August--average year			45.4		47.9	5	62.9	38
August--driest year			34.8	2009	38.2	10	53.2	53
August--wettest year			82.2	2022	98.3	20	113.3	38
September--average year			48.9		49.0	0	64.0	31
September--driest year			29.5	2002	32.2	9	47.2	60
September--wettest year			107.0	2014	108.0	1	123.0	15
October--average year			52.6		58.0	10	73.0	39
October--driest year			37.0	2003	41.6	13	56.6	53
October--wettest year			101.1	2004	105.5	4	120.5	19
November--average year			55.6		44.7	-20	59.7	7
November--driest year			47.0	2002	40.5	-14	55.5	18
November--wettest year			74.4	2004	70.2	-6	85.2	15
December--average year			61.4		55.3	-10	70.3	14
December--driest year			44.7	2002	32.8	-27	47.8	7
December--wettest year			230.4	2010	279.8	21	294.8	28

Notes

1. Average year: the mean CFS for all Januarys on record
2. Driest year: the mean CFS for driest January on record
3. Wettest year: the mean CFS for wettest January on record
4. Because the WCWCD delivery flow of 15 cfs was assumed independently for each scenario rather than being incorporated directly into the hydraulic model, the resulting river flow rates will be higher than those simulated. Since this additional 15 cfs was not included in the model calculations used to determine reservoir water surface elevations, the modeled elevations may underestimate the actual reservoir elevations that would occur under the assumed delivery conditions.
5. This analysis compares Average, Driest, and Wettest years recorded at three different gauging stations namely:
USGS Glendale Gauge 1966-2020
USGS Mt. Carmel Gauge 1992-2002
USGS Springdale Gauge 1991-2025
6. This value was calculated by applying the difference between the Mt. Carmel EFVR gauge data and the model results to the Springdale EFVR gauge data. The Springdale gauge is located approximately 20 miles downstream of the Mt. Carmel gauge.
7. Any releases to the WCWCD would adhere to the settlement agreement which specifies releases from the reservoir "shall not increase the flow measured at the U.S. Geological Survey (USGS) gage on the East Fork Virgin River near Springdale (USGS No. 09404900), by more than 25 cfs during any 7-day period and shall not exceed the long-term monthly average at the Springdale gage by more than 15 cfs."

Appendix D. Model Output Without WCWD Delivery

Model Parameters

Miscellaneous Parameters			
	Start Volume	0	af
Spillway Elevation		5550	ft
	Conservation	500	af
Volume at Spillway Crest		6032	af
Minimum flow in river		3.5	cfs
	Seepage	0.125	in/day

Hydro Parameters			
Hydro Elevation		5358	ft
Max Flow to Hydro		18	cfs
Hydro Efficiency		75%	
	Price per kW	$0.040	/kW

Tributary Parameters	Streamstats Average	% increase
Glendale USGS	19.4	0%
Orderville	23.3	20%
Mt Carmel	25.9	13%
pre-GIC USGS	15.8	-19%

Cove Reservoir Vlookup Parameters						
Elevation	Area, ac	Volume, af	Elevation[1]	Area, ac[1]	Volume, af[1]	Elevation
0	0	0	5470	0	0	0
5470	0	0	5472	0.1	0.1	5470
5472	0.1	0.1	5474	0.4	0.5	5472
5474	0.4	0.5	5476	2	2.8	5474
5476	2	2.8	5478	4.4	9.3	5476
5478	4.4	9.3	5480	7.2	20.9	5478
5480	7.2	20.9	5482	11.3	39.4	5480
5482	11.3	39.4	5484	14.5	65.2	5482
5484	14.5	65.2	5486	18.6	98.3	5484
5486	18.6	98.3	5488	22.2	139.2	5486
5488	22.2	139.2	5490	25.7	187.1	5488
5490	25.7	187.1	5492	29.8	242.6	5490
5492	29.8	242.6	5494	33.6	306	5492
5494	33.6	306	5496	37.2	276.8	5494
5496	37.2	276.8	5498	41.7	455.7	5496
5498	41.7	455.7	5500	45.8	543.1	5498
5500	45.8	543.1	5502	49.9	638.8	5500
5502	49.9	638.8	5504	54	742.7	5502
5504	54	742.7	5506	58.3	855	5504
5506	58.3	855	5508	63	976.3	5506
5508	63	976.3	5510	67.9	1107.2	5508
5510	67.9	1107.2	5512	73.1	1248.2	5510
5512	73.1	1248.2	5514	78	1399.3	5512
5514	78	1399.3	5516	82.4	1559.7	5514
5516	82.4	1559.7	5518	87.3	1729.4	5516
5518	87.3	1729.4	5520	92.3	1909	5518
5520	92.3	1909	5522	97.7	2098.9	5520
5522	97.7	2098.9	5524	103.3	2299.9	5522
5524	103.3	2299.9	5526	109.7	2513	5524
5526	109.7	2513	5528	115.7	2738.3	5526
5528	115.7	2738.3	5530	121.5	2975.5	5528
5530	121.5	2975.5	5532	127.4	3224.4	5530
5532	127.4	3224.4	5534	133.1	3484.9	5532
5534	133.1	3484.9	5536	139.2	3757.1	5534
5536	139.2	3757.1	5538	145.7	4042	5536
5538	145.7	4042	5540	152.4	4340	5538
5540	152.4	4340	5542	159.5	4652	5540
5542	159.5	4652	5544	166	4977.5	5542
5544	166	4977.5	5546	172.2	5315.7	5544
5546	172.2	5315.7	5548	178.8	5666.7	5546
5548	178.8	5666.7	5550	186.6	6032	5548
5550	186.6	6032	5552	193.2	6411.8	5550
5552	193.2	6411.8	5554	200.7	6805.7	5552
5554	200.7	6805.7	5556	206	7212.4	5554
5556	206	7212.4	5558	211.3	7629.7	5556
5558	211.3	7629.7	5560	217	8058	5558
5560	217	8058	0	0	0	5560

Monthly Parameters				
	Irrigate?	Max Hydro	ET	Divert?
Jan	n	0	0.00	y
Feb	n	0	0.00	y
Mar	n	0	0.71	y
Apr	n	0	2.53	y
May	y	0	4.31	y
Jun	y	0	4.95	n
Jul	y	0	4.95	n
Aug	y	0	3.96	n
Sep	y	0	3.23	n
Oct	n	0	1.79	n
Nov	n	0	0.18	y
Dec	n	0	0.00	y

Diversion to Cove based on Reservoir Water Level		
5470	22.2	cfs
5560	12.6	cfs

Water Right Calcs											
Required	5.00	af/ac		Irr Hours per Day		24.0					<< model output
Efficiency	45%	<< calc'd									
				GIC	434.00	OIC	286.00	MCIC	404.00	WC	
Month	Irr Days	Rate, in	Req'd Rate, in	GIC, af	GIC, cfs	OIC, af	OIC, cfs	MCIC, af	MCIC, cfs	YIELD, af	YIELD, cfs
January	0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
February	0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
March	0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
April	0	0.05	0.1	4.1	0.0	2.7	0.0	3.8	0.0	0.0	0.0
May	31	5.82	13.1	472.1	7.7	311.1	5.1	439.5	7.1	0.0	0.0
June	30	5.66	12.7	459.1	7.7	302.6	5.1	427.4	7.2	0.0	0.0
July	31	7.87	17.7	638.4	10.4	420.7	6.8	594.3	9.7	0.0	0.0
August	31	4.16	9.3	337.5	5.5	222.4	3.6	314.1	5.1	0.0	0.0
September	30	3.19	7.2	258.8	4.3	170.5	2.9	240.9	4.0	0.0	0.0
October	0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
November	0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
December	0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Annual	153	26.75	60.00	2170.00	7.2	1430.00	4.7	2020.00	6.7	0.00	0.0

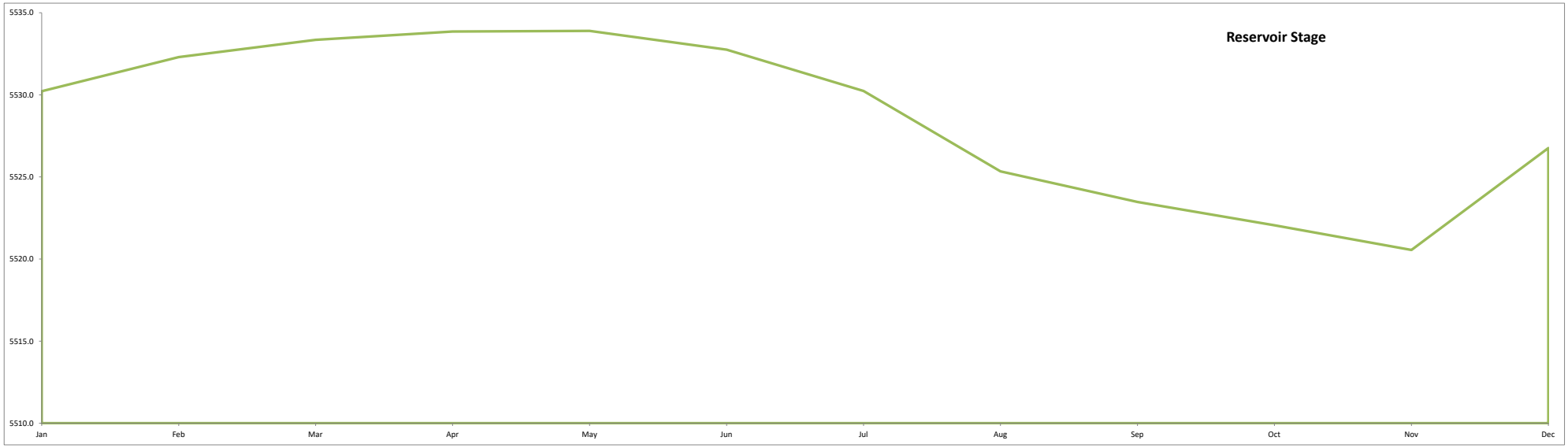
AF to CFS Calculator			
94,525,200.0	cf/yr	6.0	mo/yr
15,754,200.0	cf/irr mo	30	d/mo
525,140.0	cf/d	12.0	h/d
43,761.7	cf/h		
729.4	cf/m		
12.2	cfs		

5620.00

Average Annual Summary

Cove Reservoir Average Annual Simulation

	Reservoir at Beginning of Month			Pre-Glendale USGS Data	Glendale USGS Data	Orderville Tributary		Mt Carmel Tributary		Glendal Irr Co	Orderville Irr Co			Mt Carmel Irr Co			OIC + MCIC			Total Irr Co			WCWCD	Divert to Res'v	Losses		Supp to Irr Co	Supp to Irr Co	Final River	Res'v Flux	Change in River
	Reservoir Stage	Reservoir Volume	Reservoir Surface Area	Flow	Flow	Flow	Cumulative Flow	Flow	Cumulative Flow	Demand	Demand	Demand, from River	Demand, from Res'v	Demand	Demand, from River	Demand, from Res'v	Demand	Demand, from River	Demand, from Res'v	Demand	Prorated Demand, from River	Prorated Demand, from Res'v	Release, from Res'v	In	Seepage	Evaporation	Out	Out	Flow	Volume	Flow
	ft	ac-ft	ac	cfs	cfs	cfs		cfs		cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	ac-ft	cfs
Jan	5530.2	3,003.0	122.2	13.8	16.9	3.4	20.3	2.3	22.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	0.9	0.0	0.0	0.0	18.3	260.0	-4.2
Feb	5532.3	3,263.0	128.2	15.8	19.4	3.9	23.3	2.6	25.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	1.0	0.0	0.0	0.0	23.4	137.2	-2.5
Mar	5533.3	3,400.2	131.2	19.9	24.4	4.9	29.4	3.3	32.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	1.0	0.2	0.0	0.0	31.4	66.4	-1.3
Apr	5533.9	3,466.6	132.7	26.9	33.0	6.6	39.7	4.4	44.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	1.0	0.7	0.0	0.0	43.3	4.5	-0.7
May	5533.9	3,471.1	132.8	20.5	25.2	5.1	30.2	3.4	33.6	7.7	5.1	4.9	0.1	7.1	5.3	1.8	12.2	10.3	1.9	19.9	16.7	3.2	0.0	1.6	1.0	1.1	1.9	1.9	22.7	-148.4	-10.9
Jun	5532.8	3,322.8	129.6	10.4	12.8	2.6	15.3	1.7	17.0	7.7	5.1	4.6	0.5	7.2	4.6	2.6	12.3	9.1	3.1	20.0	14.9	5.1	0.0	0.0	0.9	1.3	3.1	3.1	8.9	-318.0	-8.2
Jul	5530.2	3,004.8	122.2	8.2	10.1	2.0	12.1	1.4	13.5	10.4	6.8	5.3	1.6	9.7	4.2	5.5	16.5	9.4	7.1	26.9	15.4	11.5	0.0	0.0	0.9	1.2	7.1	7.1	5.0	-562.5	-8.5
Aug	5525.3	2,442.3	107.6	8.0	9.8	2.0	11.8	1.3	13.1	5.5	3.6	3.4	0.2	5.1	3.9	1.2	8.7	7.3	1.4	14.2	11.9	2.4	0.0	0.0	0.9	0.9	1.4	1.4	6.7	-195.4	-6.4
Sep	5523.5	2,246.9	101.8	8.4	10.3	2.1	12.4	1.4	13.8	4.3	2.9	2.8	0.0	4.0	3.5	0.5	6.9	6.3	0.6	11.3	10.3	0.9	0.0	0.0	0.8	0.7	0.6	0.6	8.3	-126.3	-5.5
				10.5	12.9	2.6	15.5	1.7	17.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.4	0.0	0.0	18.0	-73.8	0.8
Nov	5520.6	1,962.0	93.8	11.6	14.2	2.9	17.1	1.9	19.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.6	0.9	0.0	0.0	0.0	8.2	636.0	-10.7
Dec	5526.8	2,598.0	112.0	12.7	15.6	3.1	18.8	2.1	20.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	0.9	0.0	0.0	0.0	14.3	405.0	-6.6
Average			**118**	**13.9**	**17.1**	**3.4**		**2.3**				**1.7**	**0.2**		**1.8**	**1.0**		**3.5**	**1.2**		**5.8**	**1.9**	**0.0**	**2.8**	**0.9**	**0.5**		**1.2**	**17.4**		
Total AF				**10056**	**12347**	**2482**		**1655**				**1265**	**151**		**1297**	**703**		**2562**	**854**		**4173**	**1391**	**0**	**2008**	**666**	**384**		**854**	**12580**		



Model Simulation

Date		Reservoir Start			Glendale USGS Data Backed to Glendale	to GIC					Glendale USGS Data	Orderville Tributary	River	to OIC				to COVE	Reservoir Int1			Seepage		Evaporation	Reservoir Int2			Mt Carmel Tributary	Seepage Return	River	to MCIC				WC Release	River		Reservoir End		
Yr	Mo	Volume	Elevation	Area	Ave Flow	From River		Supp	Pre Cove Full?	Full?	Ave Flow	Ave Flow	Ave Flow	River	Supp	Pre Cove Full?	Full?	Hydraulic Cap	to Fill Resv	Control	River	Volume	Elevation	Area					Volume	Elevation	Area	Ave Flow	Ave Flow	Ave Flow	River	Supp	Pre Cove Full?	Full?	Supp	Ave Flow	Sum Supp	Volume	Elevation	Area
		af	ft	ac	cfs	cfs	Max Supp	cfs			cfs	cfs	cfs	cfs	cfs			cfs	cfs	cfs	cfs	af	ft	ac	af	cfs	af	cfs	af	ft	ac	cfs	cfs	cfs	cfs	cfs			cfs	cfs	cfs	af	ft	ac
1967	Jan	500.0	5499.0	43.8	14.7	0.0	0.0	0.0	Yes	Yes	18.0	3.6	21.6	0.0	0.0	Yes	Yes	19.1	90.0	19.1	18.1	1614.1	5516.6	84.0	27.1	0.4	0.0	0.0	1,587.0	5,516.3	83.2	2.4	0.4	6.4	0.0	0.0	Yes	Yes	0.0	6.4	0.0	1,587.0	5,516.3	83.2
1967	Feb	1587.0	5516.3	83.2	16.1	0.0	0.0	0.0	Yes	Yes	19.8	4.0	23.8	0.0	0.0	Yes	Yes	17.3	80.0	17.3	17.3	2545.5	5526.3	110.6	32.2	0.6	0.0	0.0	2,513.2	5,526.0	109.7	2.7	0.6	9.8	0.0	0.0	Yes	Yes	0.0	9.8	0.0	2,513.2	5,526.0	109.7
1967	Mar	2513.2	5526.0	109.7	17.8	0.0	0.0	0.0	Yes	Yes	21.9	4.4	26.3	0.0	0.0	Yes	Yes	16.2	57.2	16.2	16.2	3510.9	5534.2	133.7	43.2	0.7	7.9	0.1	3,459.9	5,533.8	132.6	2.9	0.7	13.7	0.0	0.0	Yes	Yes	0.0	13.7	0.0	3,459.9	5,533.8	132.6
1967	Apr	3459.9	5533.8	132.6	19.5	0.0	0.0	0.0	Yes	Yes	23.9	4.8	28.7	0.0	0.0	Yes	Yes	15.4	43.2	15.4	15.4	4375.9	5540.2	153.2	47.9	0.8	32.3	0.5	4,295.7	5,539.7	151.4	3.2	0.8	17.3	0.0	0.0	Yes	Yes	0.0	17.3	0.0	4,295.7	5,539.7	151.4
1967	May	4295.7	5539.7	151.4	16.9	7.7	0.0	0.0	Yes	Yes	20.7	4.2	24.9	5.1	0.0	Yes	Yes	14.8	28.2	14.8	14.8	5203.6	5545.3	170.1	54.9	0.9	61.1	1.0	5,087.5	5,544.7	168.0	2.8	0.9	8.7	5.2	1.9	Yes	Yes	0.0	3.5	1.9	4,968.0	5,543.9	165.8
1967	Jun	4968.0	5543.9	165.8	15.2	7.7	0.0	0.0	Yes	Yes	18.7	3.8	22.5	5.1	0.0	Yes	Yes	14.3	17.9	0.0	0.0	4968.0	5543.9	165.8	51.8	0.9	68.4	1.1	4,847.8	5,543.2	163.4	2.5	0.9	20.8	7.2	0.0	Yes	Yes	0.0	13.6	0.0	4,847.8	5,543.2	163.4
1967	Jul	4847.8	5543.2	163.4	10.9	10.4	0.0	0.0	Yes	Yes	13.4	2.7	16.1	6.8	0.0	Yes	Yes	14.4	19.3	0.0	0.0	4847.8	5543.2	163.4	52.8	0.9	67.4	1.1	4,727.6	5,542.5	161.0	1.8	0.9	11.9	8.4	1.3	No	Yes	0.0	3.5	1.3	4,650.2	5,542.0	159.5
1967	Aug	4650.2	5542.0	159.5	12.6	5.5	0.0	0.0	Yes	Yes	15.5	3.1	18.6	3.6	0.0	Yes	Yes	14.5	22.5	0.0	0.0	4650.2	5542.0	159.5	51.5	0.8	52.6	0.9	4,546.0	5,541.3	157.1	2.1	0.8	17.9	5.1	0.0	Yes	Yes	0.0	12.8	0.0	4,546.0	5,541.3	157.1
1967	Sep	4546.0	5541.3	157.1	14.6	4.3	0.0	0.0	Yes	Yes	17.9	3.6	21.5	2.9	0.0	Yes	Yes	14.6	25.0	0.0	0.0	4546.0	5541.3	157.1	49.1	0.8	42.3	0.7	4,454.7	5,540.7	155.0	2.4	0.8	21.9	4.0	0.0	Yes	Yes	0.0	17.8	0.0	4,454.7	5,540.7	155.0
1967	Oct	4454.7	5540.7	155.0	11.8	0.0	0.0	0.0	Yes	Yes	14.5	2.9	17.4	0.0	0.0	Yes	Yes	14.7	25.7	0.0	0.0	4454.7	5540.7	155.0	50.1	0.8	23.1	0.4	4,381.5	5,540.3	153.3	1.9	0.8	20.2	0.0	0.0	Yes	Yes	0.0	20.2	0.0	4,381.5	5,540.3	153.3
1967	**Nov**	**4381.5**	**5540.3**	**153.3**	**12.9**	**0.0**	**0.0**	**0.0**	**Yes**	**Yes**	**15.8**	**3.2**	**19.0**	**0.0**	**0.0**	**Yes**	**Yes**	**14.7**	**27.7**	**14.7**	**14.7**	**5256.5**	**5545.6**	**171.1**	**53.5**	**0.9**	**2.6**	**0.0**	**5,200.5**	**5,545.3**	**170.1**	**2.1**	**0.9**	**7.3**	**0.0**	**0.0**	**Yes**	**Yes**	**0.0**	**7.3**	**0.0**	**5,200.5**	**5,545.3**	**170.1**
1967	Dec	5200.5	5545.3	170.1	13.9	7.7	0.0	0.0	Yes	Yes	17.1	3.4	20.5	5.1	0.0	Yes	Yes	14.2	13.5	13.5	13.5	6032.0	5550.0	186.6	60.1	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.3	1.0	10.3	0.0	0.0	Yes	Yes	0.0	10.3	0.0	5,971.7	5,549.7	185.3
1968	Jan	5971.7	5549.7	185.3	14.1	0.0	0.0	0.0	Yes	Yes	17.3	3.5	20.8	0.0	0.0	Yes	Yes	13.7	1.0	1.0	1.0	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.3	1.0	23.1	0.0	0.0	Yes	Yes	0.0	23.1	0.0	5,971.7	5,549.7	185.3
1968	Feb	5971.7	5549.7	185.3	17.9	0.0	0.0	0.0	Yes	Yes	22.0	4.4	26.4	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.9	1.0	29.3	0.0	0.0	Yes	Yes	0.0	29.3	0.0	5,977.6	5,549.7	185.4
1968	Mar	5977.6	5549.7	185.4	20.4	0.0	0.0	0.0	Yes	Yes	25.1	5.0	30.1	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	3.4	1.0	33.6	0.0	0.0	Yes	Yes	0.0	33.6	0.0	5,960.7	5,549.6	185.1
1968	Apr	5960.7	5549.6	185.1	21.5	0.0	0.0	0.0	Yes	Yes	26.4	5.3	31.7	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	3.5	1.0	35.0	0.0	0.0	Yes	Yes	0.0	35.0	0.0	5,934.3	5,549.5	184.5
1968	May	5934.3	5549.5	184.5	18.1	7.7	0.0	0.0	Yes	Yes	22.2	4.5	26.7	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,804.7	5,549.3	183.9	3.0	1.0	24.0	7.1	0.0	Yes	Yes	0.0	16.8	0.0	5,904.7	5,549.3	183.9
1968	Jun	5904.7	5549.3	183.9	12.8	7.7	0.0	0.0	Yes	Yes	15.7	3.2	18.9	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	2.1	1.0	16.8	7.2	0.0	Yes	Yes	0.0	9.7	0.0	5,771.4	5,548.6	181.0
1968	Jul	5771.4	5548.6	181.0	11.7	10.4	0.0	0.0	Yes	Yes	14.4	2.9	17.3	6.8	0.0	Yes	Yes	13.8	4.2	0.0	0.0	5771.4	5548.6	181.0	58.5	1.0	74.7	1.2	5,638.3	5,547.8	178.3	1.9	1.0	13.3	9.7	0.0	No	Yes	0.0	3.7	0.0	5,638.3	5,547.8	178.3
1968	Aug	5638.3	5547.8	178.3	14.6	5.5	0.0	0.0	Yes	Yes	17.9	3.6	21.5	3.6	0.0	Yes	Yes	13.9	6.4	0.0	0.0	5638.3	5547.8	178.3	57.6	0.9	58.8	1.0	5,521.9	5,547.2	176.1	2.4	0.9	21.2	5.1	0.0	Yes	Yes	0.0	16.1	0.0	5,521.9	5,547.2	176.1
1968	Sep	5521.9	5547.2	176.1	9.5	4.3	0.0	0.0	Yes	Yes	11.7	2.4	14.1	2.9	0.0	Yes	Yes	14.0	8.6	0.0	0.0	5521.9	5547.2	176.1	55.0	0.9	47.4	0.8	5,419.5	5,546.6	174.2	1.6	0.9	13.7	4.0	0.0	Yes	Yes	0.0	9.6	0.0	5,419.5	5,546.6	174.2
1968	Oct	5419.5	5546.6	174.2	10.8	0.0	0.0	0.0	Yes	Yes	13.3	2.7	16.0	0.0	0.0	Yes	Yes	14.0	10.0	0.0	0.0	5419.5	5546.6	174.2	56.2	0.9	26.0	0.4	5,337.2	5,546.1	172.6	1.8	0.9	18.7	0.0	0.0	Yes	Yes	0.0	18.7	0.0	5,337.2	5,546.1	172.6
1968	Nov	5337.2	5546.1	172.6	12.0	0.0	0.0	0.0	Yes	Yes	14.7	3.0	17.7	0.0	0.0	Yes	Yes	14.1	11.7	11.7	11.7	6032.0	5550.0	186.6	58.3	1.0	2.8	0.0	5,970.9	5,549.7	185.3	2.0	1.0	8.9	0.0	0.0	Yes	Yes	0.0	8.9	0.0	5,970.9	5,549.7	185.3
1968	Dec	5970.9	5549.7	185.3	12.1	0.0	0.0	0.0	Yes	Yes	14.8	3.0	17.8	0.0	0.0	Yes	Yes	13.7	1.0	1.0	1.0	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.0	1.0	19.7	0.0	0.0	Yes	Yes	0.0	19.7	0.0	5,971.7	5,549.7	185.3
1969	Jan	5971.7	5549.7	185.3	20.4	0.0	0.0	0.0	Yes	Yes	25.0	5.0	30.0	0.0	0.0	Yes	Yes	13.7	1.0	1.0	1.0	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	3.4	1.0	33.4	0.0	0.0	Yes	Yes	0.0	33.4	0.0	5,971.7	5,549.7	185.3
1969	Feb	5971.7	5549.7	185.3	17.8	0.0	0.0	0.0	Yes	Yes	21.8	4.4	26.2	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.9	1.0	29.0	0.0	0.0	Yes	Yes	0.0	29.0	0.0	5,977.6	5,549.7	185.4
1969	Mar	5977.6	5549.7	185.4	25.7	0.0	0.0	0.0	Yes	Yes	31.5	6.3	37.8	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	4.2	1.0	42.1	0.0	0.0	Yes	Yes	0.0	42.1	0.0	5,960.7	5,549.6	185.1
1969	Apr	5960.7	5549.6	185.1	107.5	0.0	0.0	0.0	Yes	Yes	132.0	26.5	158.5	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	17.7	1.0	176.0	0.0	0.0	Yes	Yes	0.0	176.0	0.0	5,934.3	5,549.5	184.5
1969	May	5934.3	5549.5	184.5	63.5	7.7	0.0	0.0	Yes	Yes	78.0	15.7	93.7	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	10.5	1.0	98.5	7.1	0.0	Yes	Yes	0.0	91.3	0.0	5,904.7	5,549.3	183.9
1969	Jun	5904.7	5549.3	183.9	26.8	7.7	0.0	0.0	Yes	Yes	32.9	6.6	39.5	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	4.4	1.0	39.8	7.2	0.0	Yes	Yes	0.0	32.6	0.0	5,771.4	5,548.6	181.0
1969	Jul	5771.4	5548.6	181.0	22.7	10.4	0.0	0.0	Yes	Yes	27.9	5.6	33.5	6.8	0.0	Yes	Yes	13.8	4.2	0.0	0.0	5771.4	5548.6	181.0	58.5	1.0	74.7	1.2	5,638.3	5,547.8	178.3	3.7	1.0	31.4	9.7	0.0	Yes	Yes	0.0	21.7	0.0	5,638.3	5,547.8	178.3
1969	Aug	5638.3	5547.8	178.3	16.9	5.5	0.0	0.0	Yes	Yes	20.8	4.2	25.0	3.6	0.0	Yes	Yes	13.9	6.4	0.0	0.0	5638.3	5547.8	178.3	57.6	0.9	58.8	1.0	5,521.9	5,547.2	176.1	2.8	0.9	25.1	5.1	0.0	Yes	Yes	0.0	20.0	0.0	5,521.9	5,547.2	176.1
1969	Sep	5521.9	5547.2	176.1	13.5	4.3	0.0	0.0	Yes	Yes	16.6	3.3	19.9	2.9	0.0	Yes	Yes	14.0	8.6	0.0	0.0	5521.9	5547.2	176.1	55.0	0.9	47.4	0.8	5,419.5	5,546.6	174.2	2.2	0.9	20.2	4.0	0.0	Yes	Yes	0.0	16.2	0.0	5,419.5	5,546.6	174.2
1969	Oct	5419.5	5546.6	174.2	15.0	0.0	0.0	0.0	Yes	Yes	18.4	3.7	22.1	0.0	0.0	Yes	Yes	14.0	10.0	0.0	0.0	5419.5	5546.6	174.2	56.2	0.9	26.0	0.4	5,337.2	5,546.1	172.6	2.5	0.9	25.5	0.0	0.0	Yes	Yes	0.0	25.5	0.0	5,337.2	5,546.1	172.6
1969	Nov	5337.2	5546.1	172.6	15.6	0.0	0.0	0.0	Yes	Yes	19.1	3.8	22.9	0.0	0.0	Yes	Yes	14.1	11.7	11.7	11.7	6032.0	5550.0	186.6	58.3	1.0	2.8	0.0	5,970.9	5,549.7	185.3	2.6	1.0	14.8	0.0	0.0	Yes	Yes	0.0	14.8	0.0	5,970.9	5,549.7	185.3
1969	Dec	5970.9	5549.7	185.3	14.1	0.0	0.0	0.0	Yes	Yes	17.3	3.5	20.8	0.0	0.0	Yes	Yes	13.7	1.0	1.0	1.0	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.3	1.0	23.1	0.0	0.0	Yes	Yes	0.0	23.1	0.0	5,971.7	5,549.7	185.3
1970	Jan	5971.7	5549.7	185.3	14.3	0.0	0.0	0.0	Yes	Yes	17.6	3.5	21.1	0.0	0.0	Yes	Yes	13.7	1.0	1.0	1.0	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.4	1.0	23.5	0.0	0.0	Yes	Yes	0.0	23.5	0.0	5,971.7	5,549.7	185.3
1970	Feb	5971.7	5549.7	185.3	16.0	0.0	0.0	0.0	Yes	Yes	19.6	3.9	23.5	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.6	1.0	26.1	0.0	0.0	Yes	Yes	0.0	26.1	0.0	5,977.6	5,549.7	185.4
1970	Mar	5977.6	5549.7	185.4	17.2	0.0	0.0	0.0	Yes	Yes	21.1	4.2	25.3	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	2.8	1.0	28.3	0.0	0.0	Yes	Yes	0.0	28.3	0.0	5,960.7	5,549.6	185.1
1970	Apr	5960.7	5549.6	185.1	13.3	0.0	0.0	0.0	Yes	Yes	16.3	3.3	19.6	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	2.2	1.0	21.5	0.0	0.0	Yes	Yes	0.0	21.5	0.0	5,934.3	5,549.5	184.5
1970	May	5934.3	5549.5	184.5	11.8	7.7	0.0	0.0	Yes	Yes	14.5	2.9	17.4	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	1.9	1.0	13.7	7.1	0.0	Yes	Yes	0.0	6.5	0.0	5,904.7	5,549.3	183.9
1970	Jun	5904.7	5549.3	183.9	9.6	7.7	0.0	0.0	Yes	Yes	11.8	2.4	14.2	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	1.6	1.0	11.6	7.2	0.0	No	Yes	0.0	4.5	0.0	5,771.4	5,548.6	181.0
1970	Jul	5771.4	5548.6	181.0	9.0	9.0	0.0	0.0	No	No	11.0	2.2	13.2	6.8	0.0	Yes	Yes	13.8	4.2	0.0	0.0	5771.4	5548.6	181.0	58.5	1.0	74.7	1.2	5,638.3	5,547.8	178.3	1.5	1.0	8.8	5.3	4.4	No	Yes	0.0	3.5	4.4	5,369.5	5,546.3	173.2
1970	Aug	5369.5	5546.3	173.2	8.9	5.5	0.0	0.0	Yes	Yes	10.9	2.2	13.1	3.6	0.0	Yes	Yes	14.1	10.8	0.0	0.0	5369.5	5546.3	173.2	55.9	0.9	57.2	0.9	5,256.4	5,545.6	171.1	1.5	0.9	11.8	5.1	0.0	Yes	Yes	0.0	6.7	0.0	5,256.4	5,545.6	171.1
1970	Sep	5256.4	5545.6	171.1	9.0	4.3	0.0	0.0	Yes	Yes	11.0	2.2	13.2	2.9	0.0	Yes	Yes	14.1	13.0	0.0	0.0	5256.4	5545.6	171.1	53.5	0.9	46.1	0.8	5,156.9	5,545.1	169.3	1.5	0.9	12.7	4.0	0.0	Yes	Yes	0.0	8.7	0.0	5,156.9	5,545.1	169.3
1970	Oct	5156.9	5545.1	169.3	10.6	0.0	0.0	0.0	Yes	Yes	13.0	2.6	15.6	0.0	0.0	Yes	Yes	14.2	14.2	0.0	0.0	5156.9	5545.1	169.3	54.7	0.9	25.3	0.4	5,077.0	5,544.6	167.8	1.7	0.9	18.2	0.0	0.0	Yes	Yes	0.0	18.2	0.0	5,077.0	5,544.6	167.8
1970	Nov	5077.0	5544.6	167.8	13.0	0.0	0.0	0.0	Yes	Yes	16.0	3.2	19.2	0.0	0.0	Yes	Yes	14.2	16.1	14.2	14.2	5924.5	5549.4	184.3	57.6	1.0	2.8	0.0	5,864.2	5,549.1	183.0	2.1	1.0	8.1	0.0	0.0	Yes	Yes	0.0	8.1	0.0	5,864.2	5,549.1	183.0
1970	Dec	5864.2	5549.1	183.0	12.9	0.0	0.0	0.0	Yes	Yes	15.9	3.2	19.1	0.0	0.0	Yes	Yes	13.8	2.7	2.7	2.7	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.1	1.0	19.5	0.0	0.0	Yes	Yes	0.0	19.5	0.0	5,971.7	5,549.7	185.3
1971	Jan	5971.7	5549.7	185.3	14.7	0.0	0.0	0.0	Yes	Yes	18.0	3.6	21.6	0.0	0.0	Yes	Yes	13.7	1.0	1.0	1.0	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.4	1.0	24.0	0.0	0.0	Yes	Yes	0.0	24.0	0.0	5,971.7	5,549.7	185.3
1971	Feb	5971.7	5549.7	185.3	13.8	0.0	0.0	0.0	Yes	Yes	17.0	3.4	20.4	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.3	1.0	22.6	0.0	0.0	Yes	Yes	0.0	22.6	0.0	5,977.6	5,549.7	185.4
1971	Mar	5977.6	5549.7	185.4	13.8	0.0	0.0	0.0	Yes	Yes	16.9	3.4	20.3	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	2.3	1.0	22.7	0.0	0.0	Yes	Yes	0.0	22.7	0.0	5,960.7	5,549.6	185.1
1971	Apr	5960.7	5549.6	185.1	11.2	0.0	0.0	0.0	Yes	Yes	13.7	2.8	16.5	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	1.8	1.0	18.1	0.0	0.0	Yes	Yes	0.0	18.1	0.0	5,934.3	5,549.5	184.5
1971	May	5934.3	5549.5	184.5	12.5	7.7	0.0	0.0	Yes	Yes	15.3	3.1	18.4	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	2.1	1.0	14.8	7.1	0.0	Yes	Yes	0.0	7.6	0.0	5,904.7	5,549.3	183.9
1971	Jun	5904.7	5549.3	183.9	9.0	7.7	0.0	0.0	Yes	Yes	11.0	2.2	13.2	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	1.5	1.0	10.6	7.1	0.1	No	Yes	0.0	3.5	0.1	5,764.5	5,548.5	180.9
1971	Jul	5764.5	5548.5	180.9	7.5	7.5	0.0	0.0	No	No	9.2	1.8	11.0	6.8	0.0	Yes	Yes	13.8	4.4	0.0	0.0	5764.5	5548.5	180.9	58.4	0.9	74.6	1.2	5,631.5	5,547.8	178.1	1.2	0.9	6.4	2.9	6.8	No	Yes	0.0	3.5	6.8	5,214.9	5,545.4	170.4
1971	Aug	5214.9	5545.4	170.4	8.6	5.5	0.0	0.0	Yes	Yes	10.6	2.1	12.7	3.6	0.0	Yes	Yes	14.2	13.3	0.0	0.0	5214.9	5545.4	170.4	55.0	0.9	56.2	0.9	5,103.6	5,544.7	168.3	1.4	0.9	11.4	5.1	0.0	Yes	Yes	0.0	6.3	0.0	5,103.6	5,544.7	168.3
1971	Sep	5103.6	5544.7	168.3	7.6	4.3	0.0	0.0	Yes	Yes	9.3	1.9	11.2	2.9	0.0	Yes	Yes	14.2	15.6	0.0	0.0	5103.6	5544.7	168.3	52.6	0.9	45.3	0.8	5,005.7	5,544.2	166.5	1.2	0.9	10.5	4.0	0.0	Yes	Yes	0.0	6.4	0.0	5,005.7	5,544.2	166.5
1971	Oct	5005.7	5544.2	166.5	10.7	0.0	0.0	0.0	Yes	Yes	13.1	2.6	15.7

Date		Reservoir Start			Glendale USGS Data Backed to Glendale	to GIC					Glendale USGS Data	Orderville Tributary	River	to OIC				to COVE				Reservoir Int1			Seepage		Evaporation		Reservoir Int2			Mt Carmel Tributary	Seepage Return	River	to MCIC				WC Release	River		Reservoir End		
Yr	Mo	Volume	Elevation	Area	Ave Flow	From River		Supp	Pre Cove Full?	Full?	Ave Flow	Ave Flow	Ave Flow	River	Supp	Pre Cove Full?	Full?	Hydraulic Cap	to Fill Resp	Control	River	Volume	Elevation	Area	af	cfs	af	cfs	Volume	Elevation	Area	Ave Flow	Ave Flow	Ave Flow	River	Supp	Pre Cove Full?	Full?	Supp	Ave Flow	Sum Supp	Volume	Elevation	Area
		af	ft	ac	cfs	cfs	Max Supp	cfs			cfs	cfs	cfs	cfs	cfs			cfs	cfs	cfs	cfs	af	ft	ac					af	ft	ac	cfs	cfs	cfs	cfs	cfs			cfs	cfs	af	ft	ac
1976	Dec	5311.2	5546.0	172.1	9.4	0.0	0.0	0.0	Yes	Yes	11.5	2.3	13.8	0.0	0.0	Yes	Yes	14.1	11.7	11.7	10.3	5945.3	5549.5	184.7	59.7	1.0	0.0	0.0	5,885.6	5,549.2	183.5	1.5	1.0	6.0	0.0	0.0	Yes	Yes	0.0	6.0	0.0	5,885.6	5,549.2	183.5
1977	Jan	5885.6	5549.2	183.5	9.6	0.0	0.0	0.0	Yes	Yes	11.8	2.4	14.2	0.0	0.0	Yes	Yes	13.8	2.4	2.4	2.4	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	1.6	1.0	14.4	0.0	0.0	Yes	Yes	0.0	14.4	0.0	5,971.7	5,549.7	185.3
1977	Feb	5971.7	5549.7	185.3	9.9	0.0	0.0	0.0	Yes	Yes	12.1	2.4	14.5	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	1.6	1.0	16.0	0.0	0.0	Yes	Yes	0.0	16.0	0.0	5,977.6	5,549.7	185.4
1977	Mar	5977.6	5549.7	185.4	9.4	0.0	0.0	0.0	Yes	Yes	11.5	2.3	13.8	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	1.5	1.0	15.4	0.0	0.0	Yes	Yes	0.0	15.4	0.0	5,960.7	5,549.6	185.1
1977	Apr	5960.7	5549.6	185.1	9.0	0.0	0.0	0.0	Yes	Yes	11.0	2.2	13.2	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	1.5	1.0	14.5	0.0	0.0	Yes	Yes	0.0	14.5	0.0	5,934.3	5,549.5	184.5
1977	May	5934.3	5549.5	184.5	10.1	7.7	0.0	0.0	Yes	Yes	12.4	2.5	14.9	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	1.7	1.0	10.9	7.1	0.0	Yes	Yes	0.0	3.7	0.0	5,904.7	5,549.3	183.9
1977	Jun	5904.7	5549.3	183.9	7.3	7.3	0.0	0.0	No	No	8.9	1.8	10.7	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	1.2	1.0	7.8	4.3	2.9	No	Yes	0.0	3.5	2.9	5,599.2	5,547.6	177.5
1977	Jul	5599.2	5547.6	177.5	6.6	6.6	0.0	0.0	No	No	8.1	1.6	9.7	6.2	0.7	No	No	13.9	0.0	0.0	0.0	5599.2	5547.6	177.5	59.8	1.0	73.2	1.2	5,498.7	5,546.9	175.1	1.1	0.9	5.5	2.0	7.7	No	Yes	0.0	8.3	10.7	5,498.7	5,546.9	165.6
1977	Aug	4957.4	5543.9	165.6	6.7	5.5	0.0	0.0	Yes	Yes	8.2	1.6	9.8	3.6	0.0	Yes	Yes	14.3	17.5	0.0	0.0	4957.4	5543.9	165.6	53.5	0.9	54.6	0.9	4,849.3	5,543.2	163.4	1.1	0.9	8.2	4.7	0.4	No	Yes	0.0	3.5	0.4	4,823.4	5,543.1	162.9
1977	Sep	4823.4	5543.1	162.9	7.0	4.3	0.0	0.0	Yes	Yes	8.6	1.7	10.4	2.9	0.0	Yes	Yes	14.4	20.3	0.0	0.0	4823.4	5543.1	162.9	50.9	0.9	43.9	0.7	4,728.6	5,542.5	161.0	1.2	0.9	9.5	4.0	0.0	Yes	Yes	0.0	5.4	0.0	4,728.6	5,542.5	161.0
1977	Oct	4728.6	5542.5	161.0	8.5	0.0	0.0	0.0	Yes	Yes	10.4	2.1	12.5	0.0	0.0	Yes	Yes	14.5	21.2	0.0	0.0	4728.6	5542.5	161.0	52.0	0.8	24.0	0.4	4,652.6	5,542.0	159.5	1.4	0.8	14.7	0.0	0.0	Yes	Yes	0.0	14.7	0.0	4,652.6	5,542.0	159.5
1977	Nov	4652.6	5542.0	159.5	9.6	0.0	0.0	0.0	Yes	Yes	11.8	2.4	14.2	0.0	0.0	Yes	Yes	14.5	23.2	14.5	10.7	5287.6	5545.8	171.7	53.7	0.9	2.6	0.0	5,231.4	5,545.5	170.7	1.6	0.9	6.0	0.0	0.0	Yes	Yes	0.0	6.0	0.0	5,231.4	5,545.5	170.7
1977	Dec	5231.4	5545.5	170.7	9.9	0.0	0.0	0.0	Yes	Yes	12.1	2.4	14.5	0.0	0.0	Yes	Yes	14.1	13.0	13.0	11.0	5909.7	5549.3	184.0	59.4	1.0	0.0	0.0	5,850.3	5,549.0	182.7	1.6	1.0	6.1	0.0	0.0	Yes	Yes	0.0	6.1	0.0	5,850.3	5,549.0	182.7
1978	Jan	5850.3	5549.0	182.7	11.6	0.0	0.0	0.0	Yes	Yes	14.2	2.9	17.1	0.0	0.0	Yes	Yes	13.8	3.0	3.0	3.0	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	1.9	1.0	17.0	0.0	0.0	Yes	Yes	0.0	17.0	0.0	5,971.7	5,549.7	185.3
1978	Feb	5971.7	5549.7	185.3	14.5	0.0	0.0	0.0	Yes	Yes	17.8	3.6	21.4	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.4	1.0	23.7	0.0	0.0	Yes	Yes	0.0	23.7	0.0	5,977.6	5,549.7	185.4
1978	Mar	5977.6	5549.7	185.4	27.9	0.0	0.0	0.0	Yes	Yes	34.3	6.9	41.2	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	4.6	1.0	45.9	0.0	0.0	Yes	Yes	0.0	45.9	0.0	5,960.7	5,549.6	185.1
1978	Apr	5960.7	5549.6	185.1	38.9	0.0	0.0	0.0	Yes	Yes	47.8	9.6	57.4	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	6.4	1.0	63.6	0.0	0.0	Yes	Yes	0.0	63.6	0.0	5,934.3	5,549.5	184.5
1978	May	5934.3	5549.5	184.5	25.1	7.7	0.0	0.0	Yes	Yes	30.8	6.2	37.0	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	4.1	1.0	35.5	7.1	0.0	Yes	Yes	0.0	28.3	0.0	5,904.7	5,549.3	183.9
1978	Jun	5904.7	5549.3	183.9	13.2	7.7	0.0	0.0	Yes	Yes	16.2	3.3	19.5	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	2.2	1.0	17.5	7.2	0.0	Yes	Yes	0.0	10.3	0.0	5,771.4	5,548.6	181.0
1978	Jul	5771.4	5548.6	181.0	10.2	10.2	0.0	0.0	No	No	12.5	2.5	15.0	6.8	0.0	Yes	Yes	13.8	4.2	0.0	0.0	5771.4	5548.6	181.0	58.5	1.0	74.7	1.2	5,638.3	5,547.8	178.3	1.7	1.0	10.8	7.3	2.4	No	Yes	0.0	2.4	2.4	5,492.8	5,547.0	175.5
1978	Aug	5492.6	5547.0	175.5	9.2	5.5	0.0	0.0	Yes	Yes	11.3	2.3	13.6	3.6	0.0	Yes	Yes	14.0	8.8	0.0	0.0	5492.6	5547.0	175.5	56.7	0.9	57.9	0.9	5,378.0	5,546.4	173.4	1.5	0.9	12.4	5.1	0.0	Yes	Yes	0.0	7.3	0.0	5,378.0	5,546.4	173.4
1978	Sep	5378.0	5546.4	173.4	9.2	4.3	0.0	0.0	Yes	Yes	11.3	2.3	13.6	2.9	0.0	Yes	Yes	14.1	11.0	0.0	0.0	5378.0	5546.4	173.4	54.2	0.9	46.7	0.8	5,277.2	5,545.8	171.5	1.5	0.9	13.1	4.0	0.0	Yes	Yes	0.0	9.1	0.0	5,277.2	5,545.8	171.5
1978	Oct	5277.2	5545.8	171.5	9.8	0.0	0.0	0.0	Yes	Yes	12.0	2.4	14.4	0.0	0.0	Yes	Yes	14.1	12.3	0.0	0.0	5277.2	5545.8	171.5	55.4	0.9	25.6	0.4	5,196.2	5,545.3	170.0	1.6	0.9	16.9	0.0	0.0	Yes	Yes	0.0	16.9	0.0	5,196.2	5,545.3	170.0
1978	Nov	5196.2	5545.3	170.0	15.9	0.0	0.0	0.0	Yes	Yes	19.5	3.9	23.4	0.0	0.0	Yes	Yes	14.2	14.0	14.0	14.0	6032.0	5550.0	186.6	58.3	1.0	2.8	0.0	5,970.9	5,549.7	185.3	2.6	1.0	13.0	0.0	0.0	Yes	Yes	0.0	13.0	0.0	5,970.9	5,549.7	185.3
1978	Dec	5970.9	5549.7	185.3	13.4	0.0	0.0	0.0	Yes	Yes	16.5	3.3	19.8	0.0	0.0	Yes	Yes	13.7	1.0	1.0	1.0	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.2	1.0	22.0	0.0	0.0	Yes	Yes	0.0	22.0	0.0	5,971.7	5,549.7	185.3
1979	Jan	5971.7	5549.7	185.3	14.3	0.0	0.0	0.0	Yes	Yes	17.6	3.5	21.1	0.0	0.0	Yes	Yes	13.7	1.0	1.0	1.0	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.4	1.0	23.5	0.0	0.0	Yes	Yes	0.0	23.5	0.0	5,971.7	5,549.7	185.3
1979	Feb	5971.7	5549.7	185.3	15.6	0.0	0.0	0.0	Yes	Yes	19.1	3.8	22.9	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.6	1.0	25.4	0.0	0.0	Yes	Yes	0.0	25.4	0.0	5,977.6	5,549.7	185.4
1979	Mar	5977.6	5549.7	185.4	26.5	0.0	0.0	0.0	Yes	Yes	32.5	6.5	39.0	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	4.4	1.0	43.5	0.0	0.0	Yes	Yes	0.0	43.5	0.0	5,960.7	5,549.6	185.1
1979	Apr	5960.7	5549.6	185.1	108.3	0.0	0.0	0.0	Yes	Yes	133.0	26.7	159.7	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	17.8	1.0	177.3	0.0	0.0	Yes	Yes	0.0	177.3	0.0	5,934.3	5,549.5	184.5
1979	May	5934.3	5549.5	184.5	83.9	7.7	0.0	0.0	Yes	Yes	103.0	20.7	123.7	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	13.8	1.0	131.8	7.1	0.0	Yes	Yes	0.0	124.7	0.0	5,904.7	5,549.3	183.9
1979	Jun	5904.7	5549.3	183.9	25.9	7.7	0.0	0.0	Yes	Yes	31.8	6.4	38.2	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	4.3	1.0	38.3	7.2	0.0	Yes	Yes	0.0	31.2	0.0	5,771.4	5,548.6	181.0
1979	Jul	5771.4	5548.6	181.0	15.3	10.4	0.0	0.0	Yes	Yes	18.8	3.8	22.6	6.8	0.0	Yes	Yes	13.8	4.2	0.0	0.0	5771.4	5548.6	181.0	58.5	1.0	74.7	1.2	5,638.3	5,547.8	178.3	2.5	1.0	19.2	9.7	0.0	Yes	Yes	0.0	9.5	0.0	5,638.3	5,547.8	178.3
1979	Aug	5638.3	5547.8	178.3	14.4	5.5	0.0	0.0	Yes	Yes	17.7	3.6	21.3	3.6	0.0	Yes	Yes	13.9	6.4	0.0	0.0	5638.3	5547.8	178.3	57.6	0.9	58.8	1.0	5,521.9	5,547.2	176.1	2.4	0.9	20.5	5.1	0.0	Yes	Yes	0.0	15.8	0.0	5,521.9	5,547.2	176.1
1979	Sep	5521.9	5547.2	176.1	12.0	4.3	0.0	0.0	Yes	Yes	14.7	3.0	17.7	2.9	0.0	Yes	Yes	14.0	8.6	0.0	0.0	5521.9	5547.2	176.1	55.0	0.9	47.4	0.8	5,419.5	5,546.6	174.2	2.0	0.9	17.7	4.0	0.0	Yes	Yes	0.0	13.6	0.0	5,419.5	5,546.6	174.2
1979	Oct	5419.5	5546.6	174.2	13.0	0.0	0.0	0.0	Yes	Yes	16.0	3.2	19.2	0.0	0.0	Yes	Yes	14.0	10.0	0.0	0.0	5419.5	5546.6	174.2	56.2	0.9	26.0	0.4	5,337.2	5,546.1	172.6	2.1	0.9	22.3	0.0	0.0	Yes	Yes	0.0	22.3	0.0	5,337.2	5,546.1	172.6
1979	Nov	5337.2	5546.1	172.6	14.1	0.0	0.0	0.0	Yes	Yes	17.3	3.5	20.8	0.0	0.0	Yes	Yes	14.1	11.7	11.7	11.7	6032.0	5550.0	186.6	58.3	1.0	2.8	0.0	5,970.9	5,549.7	185.3	2.3	1.0	12.4	0.0	0.0	Yes	Yes	0.0	12.4	0.0	5,970.9	5,549.7	185.3
1979	Dec	5970.9	5549.7	185.3	14.9	0.0	0.0	0.0	Yes	Yes	18.3	3.7	22.0	0.0	0.0	Yes	Yes	13.7	1.0	1.0	1.0	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.5	1.0	24.4	0.0	0.0	Yes	Yes	0.0	24.4	0.0	5,971.7	5,549.7	185.3
1980	Jan	5971.7	5549.7	185.3	21.3	0.0	0.0	0.0	Yes	Yes	26.2	5.3	31.5	0.0	0.0	Yes	Yes	13.7	1.0	1.0	1.0	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	3.5	1.0	35.0	0.0	0.0	Yes	Yes	0.0	35.0	0.0	5,971.7	5,549.7	185.3
1980	Feb	5971.7	5549.7	185.3	29.6	0.0	0.0	0.0	Yes	Yes	36.4	7.3	43.7	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	4.9	1.0	48.5	0.0	0.0	Yes	Yes	0.0	48.5	0.0	5,977.6	5,549.7	185.4
1980	Mar	5977.6	5549.7	185.4	34.9	0.0	0.0	0.0	Yes	Yes	42.9	8.6	51.5	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	5.7	1.0	57.4	0.0	0.0	Yes	Yes	0.0	57.4	0.0	5,960.7	5,549.6	185.1
1980	Apr	5960.7	5549.6	185.1	118.1	0.0	0.0	0.0	Yes	Yes	145.0	29.1	174.1	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	19.4	1.0	193.4	0.0	0.0	Yes	Yes	0.0	193.4	0.0	5,934.3	5,549.5	184.5
1980	May	5934.3	5549.5	184.5	106.7	7.7	0.0	0.0	Yes	Yes	131.0	26.3	157.3	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	17.6	1.0	169.2	7.1	0.0	Yes	Yes	0.0	162.1	0.0	5,904.7	5,549.3	183.9
1980	Jun	5904.7	5549.3	183.9	35.5	7.7	0.0	0.0	Yes	Yes	43.6	8.8	52.4	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	5.8	1.0	54.1	7.2	0.0	Yes	Yes	0.0	46.9	0.0	5,771.4	5,548.6	181.0
1980	Jul	5771.4	5548.6	181.0	22.8	10.4	0.0	0.0	Yes	Yes	28.0	5.6	33.6	6.8	0.0	Yes	Yes	13.8	4.2	0.0	0.0	5771.4	5548.6	181.0	58.5	1.0	74.7	1.2	5,638.3	5,547.8	178.3	3.8	1.0	31.5	9.7	0.0	Yes	Yes	0.0	21.8	0.0	5,638.3	5,547.8	178.3
1980	Aug	5638.3	5547.8	178.3	21.1	5.5	0.0	0.0	Yes	Yes	25.9	5.2	31.1	3.6	0.0	Yes	Yes	13.9	6.4	0.0	0.0	5638.3	5547.8	178.3	57.6	0.9	58.8	1.0	5,521.9	5,547.2	176.1	3.5	0.9	31.9	5.1	0.0	Yes	Yes	0.0	26.8	0.0	5,521.9	5,547.2	176.1
1980	Sep	5521.9	5547.2	176.1	24.7	4.3	0.0	0.0	Yes	Yes	29.7	5.9	35.6	2.9	0.0	Yes	Yes	14.0	8.6	0.0	0.0	5521.9	5547.2	176.1	55.0	0.9	47.4	0.8	5,419.5	5,546.6	174.2	3.3	0.9	33.0	4.0	0.0	Yes	Yes	0.0	27.0	0.0	5,419.5	5,546.6	174.2
1980	Oct	5419.5	5546.6	174.2	18.2	0.0	0.0	0.0	Yes	Yes	22.3	4.5	26.8	0.0	0.0	Yes	Yes	14.0	10.0	0.0	0.0	5419.5	5546.6	174.2	56.2	0.9	26.0	0.4	5,337.2	5,546.1	172.6	3.0	0.9	30.7	0.0	0.0	Yes	Yes	0.0	30.7	0.0	5,337.2	5,546.1	172.6
1980	Nov	5337.2	5546.1	172.6	17.7	0.0	0.0	0.0	Yes	Yes	21.7	4.4	26.1	0.0	0.0	Yes	Yes	14.1	11.7	11.7	11.7	6032.0	5550.0	186.6	58.3	1.0	2.8	0.0	5,970.9	5,549.7	185.3	2.9	1.0	18.3	0.0	0.0	Yes	Yes	0.0	18.3	0.0	5,970.9	5,549.7	185.3
1980	Dec	5970.9	5549.7	185.3	18.2	0.0	0.0	0.0	Yes	Yes	22.4	4.5	26.9	0.0	0.0	Yes	Yes	13.7	1.0	1.0	1.0	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	3.0	1.0	29.9	0.0	0.0	Yes	Yes	0.0	29.9	0.0	5,971.7	5,549.7	185.3
1981	Jan	5971.7	5549.7	185.3	17.8	0.0	0.0	0.0	Yes	Yes	21.8	4.4	26.2	0.0	0.0	Yes	Yes	13.7	1.0	1.0	1.0	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.9	1.0	29.1	0.0	0.0	Yes	Yes	0.0	29.1	0.0	5,971.7	5,549.7	185.3
1981	Feb	5971.7	5549.7	185.3	18.2	0.0	0.0	0.0	Yes	Yes	22.4	4.5	26.9	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	3.0	1.0	29.8	0.0	0.0	Yes	Yes	0.0	29.8	0.0	5,977.6	5,549.7	185.4
1981	Mar	5977.6	5549.7	185.4	21.3	0.0	0.0	0.0	Yes	Yes	26.2	5.3	31.5	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	3.5	1.0	35.1	0.0	0.0	Yes	Yes	0.0	35.1	0.0	5,960.7	5,549.6	185.1
1981	Apr	5960.7	5549.6	185.1	18.0	0.0	0.0	0.0	Yes	Yes	22.1	4.4	26.5	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	3.0	1.0	29.3	0.0	0.0	Yes	Yes	0.0	29.3	0.0	5,934.3	5,549.5	184.5
1981	May	5934.3	5549.5	184.5	14.7	7.7	0.0	0.0	Yes	Yes	18.1	3.6	21.7	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	2.4	1.0	18.5	7.1	0.0	Yes	Yes	0.0	11.3	0.0	5,904.7	5,549.3	183.9
1981	Jun	5904.7	5549.3	183.9	11.2	7.7	0.0	0.0	Yes	Yes	13.7	2.8	16.5	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	1.8	1.0	14.2	7.2	0.0	Yes	Yes	0.0	7.0	0.0	5,771.4	5,548.6	181.0
1981	Jul	5771.4	5548.6	181.0	9.5	9.5	0.0	0.0	No	No	11.7	2.4	14.1	6.8	0.0	Yes	Yes	13.8	4.2	0.0	0.0	5771.4	5548.6	181.0	58.5	1.0	74.7	1.2	5,638.3	5,547.8	178.3	1.6	1.0	9.7	6.2	3.4	No	Yes	0.0	3.5	3.4	5,427.0	5,546.0	174.3
1981	Aug	5427.0	5546.0	174.3	10.1	5.5	0.0	0.0	Yes	Yes	12.4	2.5	14.9	3.6	0.0	Yes	Yes	14.0	9.8	0.0	0.0	5427.0	5546.0	174.3	56.3	0.9	57.5	0.9	5,313.2	5,546.0	172.2	1.7	0.9	13.9	5.1	0.0	Yes	Yes	0.0	8.7	0.0	5,313.2	5,546.0	172.2
1981	Sep	5313.2	5546.0	172.2	10.7	4.3	0.0	0.0	Yes	Yes	13.1	2.6	15.7	2.9	0.0

Date		Reservoir Start			Glendale USGS Data Backed to Glendale	to GIC					Glendale USGS Data	Orderville Tributary	River	to OIC				to COVE				Reservoir Int1			Seepage		Evaporation		Reservoir Int2			Mt Carmel Tributary	Seepage Return	River	to MCIC				WC Release	River		Reservoir End		
Yr	Mo	Volume	Elevation	Area	Ave Flow	From River		Supp	Pre Cove Full?	Full?	Ave Flow	Ave Flow	Ave Flow	River	Supp	re Cove Full	Full?	Hydraulic Cap	to Fill Resv	Control	River	Volume	Elevation	Area	af	cfs	af	cfs	Volume	Elevation	Area	Ave Flow	Ave Flow	Ave Flow	River	Supp	Pre Cove Full?	Full?	Supp	Ave Flow	Sum Supp	Volume	Elevation	Area
		af	ft	ac	cfs	cfs	Max Supp	cfs			cfs	cfs	cfs	cfs	cfs			cfs	cfs	cfs	cfs	af	ft	ac					af	ft	ac	cfs	cfs	cfs	cfs	cfs			cfs	cfs	cfs	af	ft	ac
1986	Nov	4678.5	5542.2	160.0	15.5	0.0	0.0	0.0	Yes	Yes	19.0	3.8	22.8	0.0	0.0	Yes	Yes	14.5	22.7	14.5	14.5	5541.4	5547.3	176.4	55.1	0.9	2.6	0.0	5,483.6	5,547.0	175.4	2.5	0.9	11.8	0.0	0.0	Yes	Yes	0.0	11.8	0.0	5,483.6	5,547.0	175.4
1986	Dec	5483.6	5547.0	175.4	14.9	0.0	0.0	0.0	Yes	Yes	18.3	3.7	22.0	0.0	0.0	Yes	Yes	14.0	8.9	8.9	8.9	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.5	1.0	16.5	0.0	0.0	Yes	Yes	0.0	16.5	0.0	5,971.7	5,549.7	185.3
1987	Jan	5971.7	5549.7	185.3	14.3	0.0	0.0	0.0	Yes	Yes	17.5	3.5	21.0	0.0	0.0	Yes	Yes	13.7	1.0	1.0	1.0	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.3	1.0	23.4	0.0	0.0	Yes	Yes	0.0	23.4	0.0	5,971.7	5,549.7	185.3
1987	Feb	5971.7	5549.7	185.3	15.2	0.0	0.0	0.0	Yes	Yes	18.7	3.8	22.5	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.5	1.0	24.9	0.0	0.0	Yes	Yes	0.0	24.9	0.0	5,977.6	5,549.7	185.4
1987	Mar	5977.6	5549.7	185.4	18.8	0.0	0.0	0.0	Yes	Yes	23.1	4.6	27.7	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	3.1	1.0	30.9	0.0	0.0	Yes	Yes	0.0	30.9	0.0	5,960.7	5,549.6	185.1
1987	Apr	5960.7	5549.6	185.1	13.9	0.0	0.0	0.0	Yes	Yes	17.1	3.4	20.5	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	2.3	1.0	22.6	0.0	0.0	Yes	Yes	0.0	22.6	0.0	5,934.3	5,549.5	184.5
1987	May	5934.3	5549.5	184.5	8.3	7.7	0.0	0.0	Yes	Yes	10.2	2.1	12.3	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	1.4	1.0	7.0	4.4	2.7	No	Yes	0.0	3.5	2.7	5,738.8	5,548.4	180.3
1987	Jun	5738.8	5548.4	180.3	5.6	5.6	0.0	0.0	Yes	No	6.9	1.4	8.3	4.8	0.3	No	No	13.8	4.9	0.0	0.0	5738.8	5548.4	180.3	56.4	0.9	74.4	1.3	5,608.1	5,547.7	177.7	0.9	0.9	5.4	1.9	5.3	No	Yes	0.0	5.6	7.1	5,608.1	5,547.7	177.7
1987	Jul	5275.9	5545.8	171.5	6.7	6.7	0.0	0.0	No	No	8.3	1.7	9.9	6.4	0.4	No	Yes	14.1	12.3	0.0	0.0	5275.9	5545.8	171.5	55.4	0.9	70.7	1.2	5,149.8	5,545.0	169.2	1.1	0.9	5.5	2.0	7.7	No	Yes	0.0	3.5	8.1	4,652.2	5,542.0	159.5
1987	Aug	4652.2	5542.0	159.5	8.9	5.5	0.0	0.0	Yes	Yes	10.9	2.2	13.1	3.6	0.0	Yes	Yes	14.5	22.4	0.0	0.0	4652.2	5542.0	159.5	51.5	0.8	52.6	0.9	4,548.1	5,541.3	157.1	1.5	0.8	11.8	5.1	0.0	Yes	Yes	0.0	6.7	0.0	4,548.1	5,541.3	157.1
1987	Sep	4548.1	5541.3	157.1	5.2	4.3	0.0	0.0	Yes	Yes	6.4	1.3	7.7	2.9	0.0	Yes	Yes	14.6	24.9	0.0	0.0	4548.1	5541.3	157.1	49.1	0.8	42.3	0.7	4,456.7	5,540.7	155.1	0.9	0.8	6.5	3.0	1.1	No	Yes	0.0	3.5	1.1	4,393.7	5,540.3	153.6
1987	Oct	4393.7	5540.3	153.6	7.9	0.0	0.0	0.0	Yes	Yes	9.7	1.9	11.6	0.0	0.0	Yes	Yes	14.7	26.6	0.0	0.0	4393.7	5540.3	153.6	49.6	0.8	22.9	0.4	4,321.2	5,539.9	152.0	1.3	0.8	13.7	0.0	0.0	Yes	Yes	0.0	13.7	0.0	4,321.2	5,539.9	152.0
1987	Nov	4321.2	5539.9	152.0	14.3	0.0	0.0	0.0	Yes	Yes	17.5	3.5	21.0	0.0	0.0	Yes	Yes	14.7	28.8	14.7	14.7	5198.7	5545.3	170.1	53.1	0.9	2.6	0.0	5,143.0	5,545.0	169.0	2.3	0.9	9.5	0.0	0.0	Yes	Yes	0.0	9.5	0.0	5,143.0	5,545.0	169.0
1987	Dec	5143.0	5545.0	169.0	11.5	0.0	0.0	0.0	Yes	Yes	14.1	2.8	16.9	0.0	0.0	Yes	Yes	14.2	14.5	14.2	13.4	5969.0	5549.7	185.3	59.8	1.0	0.0	0.0	5,909.2	5,549.3	184.0	1.9	1.0	6.4	0.0	0.0	Yes	Yes	0.0	6.4	0.0	5,909.2	5,549.3	184.0
1988	Jan	5909.2	5549.3	184.0	11.8	0.0	0.0	0.0	Yes	Yes	14.5	2.9	17.4	0.0	0.0	Yes	Yes	13.7	2.0	2.0	2.0	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	1.9	1.0	18.3	0.0	0.0	Yes	Yes	0.0	18.3	0.0	5,971.7	5,549.7	185.3
1988	Feb	5971.7	5549.7	185.3	14.9	0.0	0.0	0.0	Yes	Yes	18.3	3.7	22.0	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.5	1.0	24.3	0.0	0.0	Yes	Yes	0.0	24.3	0.0	5,977.6	5,549.7	185.4
1988	Mar	5977.6	5549.7	185.4	14.8	0.0	0.0	0.0	Yes	Yes	18.2	3.7	21.9	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	2.4	1.0	24.4	0.0	0.0	Yes	Yes	0.0	24.4	0.0	5,960.7	5,549.6	185.1
1988	Apr	5960.7	5549.6	185.1	15.1	0.0	0.0	0.0	Yes	Yes	18.6	3.7	22.3	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	2.5	1.0	24.6	0.0	0.0	Yes	Yes	0.0	24.6	0.0	5,934.3	5,549.5	184.5
1988	May	5934.3	5549.5	184.5	12.8	7.7	0.0	0.0	Yes	Yes	15.7	3.2	18.9	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	2.1	1.0	15.3	7.1	0.0	Yes	Yes	0.0	8.1	0.0	5,904.7	5,549.3	183.9
1988	Jun	5904.7	5549.3	183.9	6.8	6.8	0.0	0.0	No	No	8.4	1.7	10.0	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	1.1	1.0	7.0	3.5	3.6	No	Yes	0.0	3.5	5.4	5,554.8	5,547.4	176.7
1988	Jul	5554.8	5547.4	176.7	5.9	5.9	0.0	0.0	No	No	7.2	1.5	8.7	5.2	1.7	No	Yes	13.9	7.8	0.0	0.0	5554.8	5547.4	176.7	57.1	0.9	72.9	1.2	5,424.8	5,546.6	174.3	1.0	0.9	5.4	1.9	7.8	No	Yes	0.0	3.5	9.4	4,844.3	5,543.2	163.3
1988	Aug	4844.3	5543.2	163.3	6.7	5.5	0.0	0.0	Yes	Yes	8.2	1.7	9.9	3.6	0.0	Yes	Yes	14.4	19.3	0.0	0.0	4844.3	5543.2	163.3	52.7	0.9	53.9	0.9	4,737.7	5,542.5	161.2	1.1	0.9	8.2	4.7	0.4	No	Yes	0.0	3.5	0.4	4,715.1	5,542.4	160.8
1988	Sep	4715.1	5542.4	160.8	5.2	4.3	0.0	0.0	Yes	Yes	6.4	1.3	7.7	2.9	0.0	Yes	Yes	14.5	22.1	0.0	0.0	4715.1	5542.4	160.8	50.2	0.8	43.3	0.7	4,621.6	5,541.8	158.8	0.9	0.8	6.6	3.1	1.0	Yes	Yes	0.0	3.5	1.0	4,563.0	5,541.4	157.5
1988	Oct	4563.0	5541.4	157.5	8.2	0.0	0.0	0.0	Yes	Yes	10.1	2.0	12.1	0.0	0.0	Yes	Yes	14.6	23.9	0.0	0.0	4563.0	5541.4	157.5	50.9	0.8	23.5	0.4	4,488.6	5,541.0	155.8	1.4	0.8	14.3	0.0	0.0	Yes	Yes	0.0	14.3	0.0	4,488.6	5,541.0	155.8
1988	Nov	4488.6	5541.0	155.8	9.6	0.0	0.0	0.0	Yes	Yes	11.8	2.4	14.2	0.0	0.0	Yes	Yes	14.6	25.9	14.6	10.7	5123.7	5544.9	168.7	52.7	0.9	2.5	0.0	5,068.4	5,544.5	167.7	1.6	0.9	6.0	0.0	0.0	Yes	Yes	0.0	6.0	0.0	5,068.4	5,544.5	167.7
1988	Dec	5068.4	5544.5	167.7	10.7	0.0	0.0	0.0	Yes	Yes	13.1	2.6	15.7	0.0	0.0	Yes	Yes	14.2	15.7	14.2	12.2	5820.6	5548.8	182.1	58.8	1.0	0.0	0.0	5,761.8	5,548.5	180.8	1.8	1.0	6.2	0.0	0.0	Yes	Yes	0.0	6.2	0.0	5,761.8	5,548.5	180.8
1989	Jan	5761.8	5548.5	180.8	11.4	0.0	0.0	0.0	Yes	Yes	14.0	2.8	16.8	0.0	0.0	Yes	Yes	13.8	4.4	4.4	4.4	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	1.9	1.0	15.3	0.0	0.0	Yes	Yes	0.0	15.3	0.0	5,971.7	5,549.7	185.3
1989	Feb	5971.7	5549.7	185.3	13.7	0.0	0.0	0.0	Yes	Yes	16.8	3.4	20.2	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.3	1.0	22.3	0.0	0.0	Yes	Yes	0.0	22.3	0.0	5,977.6	5,549.7	185.4
1989	Mar	5977.6	5549.7	185.4	16.8	0.0	0.0	0.0	Yes	Yes	20.6	4.1	24.7	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	2.8	1.0	27.6	0.0	0.0	Yes	Yes	0.0	27.6	0.0	5,960.7	5,549.6	185.1
1989	Apr	5960.7	5549.6	185.1	7.3	0.0	0.0	0.0	Yes	Yes	8.9	1.8	10.7	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	1.2	1.0	11.7	0.0	0.0	Yes	Yes	0.0	11.7	0.0	5,934.3	5,549.5	184.5
1989	May	5934.3	5549.5	184.5	5.2	5.2	0.0	0.0	No	No	6.4	1.3	7.7	4.2	0.0	No	Yes	13.7	1.6	1.6	0.0	5934.3	5549.5	184.5	59.6	1.0	66.3	1.1	5,808.5	5,548.8	181.8	0.9	1.0	5.3	1.8	5.3	No	Yes	0.0	3.5	6.2	5,426.0	5,546.6	174.3
1989	Jun	5426.0	5546.6	174.3	4.2	4.2	0.0	0.0	No	No	5.2	1.0	6.2	2.7	2.4	No	Yes	14.0	10.2	0.0	0.0	5426.0	5546.6	174.3	54.5	0.9	71.9	1.2	5,299.6	5,545.9	171.9	0.7	0.9	5.1	1.6	5.6	No	Yes	0.0	3.5	8.0	4,825.8	5,543.1	163.0
1989	Jul	4825.8	5543.1	163.0	4.6	4.6	0.0	0.0	No	No	5.6	1.1	6.7	3.2	3.6	No	Yes	14.4	19.6	0.0	0.0	4825.8	5543.1	163.0	52.6	0.9	67.2	1.1	4,705.9	5,542.3	160.6	0.8	0.9	5.1	1.6	8.1	No	Yes	0.0	3.5	11.7	3,988.0	5,537.6	144.1
1989	Aug	3988.0	5537.6	144.5	4.9	4.9	0.0	0.0	No	No	6.1	1.2	7.3	3.6	0.0	Yes	Yes	15.0	33.2	0.0	0.0	3988.0	5537.6	144.5	46.7	0.8	47.7	0.8	3,893.7	5,537.0	142.3	0.8	0.8	5.2	1.7	3.4	No	Yes	0.0	3.5	3.4	3,685.3	5,535.5	137.6
1989	Sep	3685.3	5535.5	137.6	4.2	4.2	0.0	0.0	No	No	5.1	1.0	6.1	2.6	0.2	No	Yes	15.2	39.4	0.0	0.0	3685.3	5535.5	137.6	43.0	0.7	37.0	0.6	3,605.2	5,534.9	135.8	0.7	0.7	4.9	1.4	2.6	No	Yes	0.0	3.5	2.9	3,433.7	5,533.6	132.0
1989	Oct	3433.7	5533.6	132.0	5.4	0.0	0.0	0.0	Yes	Yes	6.6	1.3	7.9	0.0	0.0	Yes	Yes	15.4	42.3	0.0	0.0	3433.7	5533.6	132.0	42.6	0.7	19.7	0.3	3,371.4	5,533.1	130.6	0.9	0.7	9.5	0.0	0.0	Yes	Yes	0.0	9.5	0.0	3,371.4	5,533.1	130.6
1989	Nov	3371.4	5533.1	130.6	6.8	0.0	0.0	0.0	Yes	Yes	8.4	1.7	10.1	0.0	0.0	Yes	Yes	15.5	44.7	15.5	6.6	3762.0	5536.0	139.3	43.5	0.7	2.1	0.0	3,716.4	5,535.7	138.3	1.1	0.7	5.4	0.0	0.0	Yes	Yes	0.0	5.4	0.0	3,716.4	5,535.7	138.3
1989	Dec	3716.4	5535.7	138.3	7.8	0.0	0.0	0.0	Yes	Yes	9.6	1.9	11.5	0.0	0.0	Yes	Yes	15.2	37.7	15.2	8.0	4208.6	5539.1	149.4	48.3	0.8	0.0	0.0	4,160.4	5,538.8	148.4	1.3	0.8	5.6	0.0	0.0	Yes	Yes	0.0	5.6	0.0	4,160.4	5,538.8	148.4
1990	Jan	4160.4	5538.8	148.4	7.9	0.0	0.0	0.0	Yes	Yes	9.8	2.0	11.7	0.0	0.0	Yes	Yes	14.9	30.4	14.9	8.2	4665.2	5542.1	159.8	51.6	0.8	0.0	0.0	4,613.6	5,541.8	158.6	1.3	0.8	5.6	0.0	0.0	Yes	Yes	0.0	5.6	0.0	4,613.6	5,541.8	158.6
1990	Feb	4613.6	5541.8	158.6	9.1	0.0	0.0	0.0	Yes	Yes	11.2	2.3	13.5	0.0	0.0	Yes	Yes	14.5	25.5	14.5	10.0	5166.3	5545.1	169.5	49.4	0.9	0.0	0.0	5,116.9	5,544.8	168.6	1.5	0.9	5.9	0.0	0.0	Yes	Yes	0.0	5.9	0.0	5,116.9	5,544.8	168.6
1990	Mar	5116.9	5544.8	168.6	11.1	0.0	0.0	0.0	Yes	Yes	13.6	2.7	16.3	0.0	0.0	Yes	Yes	14.2	14.9	14.2	12.8	5906.0	5549.3	183.9	59.4	1.0	10.9	0.2	5,835.7	5,548.9	182.4	1.8	1.0	6.3	0.0	0.0	Yes	Yes	0.0	6.3	0.0	5,835.7	5,548.9	182.4
1990	Apr	5835.7	5548.9	182.4	8.4	0.0	0.0	0.0	Yes	Yes	10.3	2.1	12.4	0.0	0.0	Yes	Yes	13.8	3.3	3.3	3.3	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	1.4	1.0	11.4	0.0	0.0	Yes	Yes	0.0	11.4	0.0	5,934.3	5,549.5	184.5
1990	May	5934.3	5549.5	184.5	5.4	5.4	0.0	0.0	No	No	6.6	1.3	7.9	4.4	0.7	No	Yes	13.7	1.6	1.6	0.0	5934.3	5549.5	184.5	59.6	1.0	66.3	1.1	5,808.5	5,548.8	181.8	0.9	1.0	5.3	1.8	5.3	No	Yes	0.0	3.5	6.0	5,441.6	5,546.7	174.6
1990	Jun	5441.6	5546.7	174.6	4.5	4.5	0.0	0.0	No	No	5.5	1.1	6.6	3.4	2.0	No	Yes	14.0	9.9	0.0	0.0	5441.6	5546.7	174.6	54.6	0.9	72.2	1.2	5,315.0	5,546.0	172.2	0.7	0.9	5.2	1.7	5.5	No	Yes	0.0	3.5	7.5	4,869.0	5,543.3	163.8
1990	Jul	4869.0	5543.3	163.8	4.7	4.7	0.0	0.0	No	No	5.7	1.1	6.9	3.4	3.5	No	Yes	14.4	18.9	0.0	0.0	4869.0	5543.3	163.8	52.9	0.9	67.6	1.1	4,748.6	5,542.6	161.4	0.8	0.9	5.1	1.6	8.0	No	Yes	0.0	3.5	11.5	4,040.8	5,538.0	145.7
1990	Aug	4040.8	5538.0	145.7	4.7	4.7	0.0	0.0	No	No	5.7	1.2	6.9	3.4	0.2	No	Yes	14.4	32.4	0.0	0.0	4040.8	5538.0	145.7	47.0	0.8	48.1	0.8	3,945.7	5,537.3	143.5	0.8	0.8	5.0	1.5	3.6	No	Yes	0.0	3.5	3.8	3,711.4	5,535.7	138.2
1990	Sep	3711.4	5535.7	138.2	5.3	4.3	0.0	0.0	Yes	Yes	6.5	1.3	7.8	2.9	0.0	Yes	Yes	15.2	39.0	0.0	0.0	3711.4	5535.7	138.2	43.2	0.7	37.2	0.6	3,631.0	5,535.1	136.4	0.9	0.7	6.5	3.0	1.0	No	Yes	0.0	3.5	1.0	3,570.9	5,534.6	135.0
1990	Oct	3570.9	5534.6	135.0	7.4	0.0	0.0	0.0	Yes	Yes	9.1	1.8	10.9	0.0	0.0	Yes	Yes	15.3	40.0	0.0	0.0	3570.9	5534.6	135.0	43.6	0.7	20.1	0.3	3,507.1	5,534.2	133.6	1.2	0.7	12.9	0.0	0.0	Yes	Yes	0.0	12.9	0.0	3,507.1	5,534.2	133.6
1990	Nov	3507.1	5534.2	133.6	7.8	0.0	0.0	0.0	Yes	Yes	9.6	1.9	11.5	0.0	0.0	Yes	Yes	15.4	42.4	15.4	8.0	3982.1	5537.6	144.3	45.1	0.8	2.2	0.0	3,934.8	5,537.2	143.3	1.3	0.8	5.5	0.0	0.0	Yes	Yes	0.0	5.5	0.0	3,934.8	5,537.2	143.3
1990	Dec	3934.8	5537.2	143.3	7.9	0.0	0.0	0.0	Yes	Yes	9.7	2.0	11.7	0.0	0.0	Yes	Yes	15.0	34.1	15.0	8.2	4438.9	5540.8	154.8	49.9	0.8	0.0	0.0	4,388.9	5,540.3	153.5	1.3	0.8	5.6	0.0	0.0	Yes	Yes	0.0	5.6	0.0	4,388.9	5,540.3	153.5
1991	Jan	4388.9	5540.3	153.5	7.7	0.0	0.0	0.0	Yes	Yes	9.4	1.9	11.3	0.0	0.0	Yes	Yes	14.7	26.7	14.7	7.8	4867.9	5543.3	163.8	52.9	0.9	0.0	0.0	4,815.0	5,543.0	162.8	1.3	0.9	5.6	0.0	0.0	Yes	Yes	0.0	5.6	0.0	4,815.0	5,543.0	162.8
1991	Feb	4815.0	5543.0	162.8	8.1	0.0	0.0	0.0	Yes	Yes	9.9	2.0	11.9	0.0	0.0	Yes	Yes	14.4	21.9	14.4	8.4	5281.0	5545.8	171.6	50.0	0.9	0.0	0.0	5,230.9	5,545.5	170.6	1.3	0.9	5.7	0.0	0.0	Yes	Yes	0.0	5.7	0.0	5,230.9	5,545.5	170.6
1991	Mar	5230.9	5545.5	170.6	11.6	0.0	0.0	0.0	Yes	Yes	14.3	2.9	17.2	0.0	0.0	Yes	Yes	14.1	13.0	13.0	13.0	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	1.9	1.0	7.0	0.0	0.0	Yes	Yes	0.0	7.0	0.0	5,960.7	5,549.6	185.1
1991	Apr	5960.7	5549.6	185.1	9.5	0.0	0.0	0.0	Yes	Yes	11.7	2.4	14.1	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	1.6	1.0	15.4	0.0	0.0	Yes	Yes	0.0	15.4	0.0	5,934.3	5,549.5	184.5
1991	May	5934.3	5549.5	184.5	6.6	6.6	0.0	0.0	No	No	8.2	1.6	9.8	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.2	6032.0	5549.9	186.1	60.1	1.0	66.9	1.1	5,882.9	5,549.2	183.4	1.1	1.0	5.6	2.1	5.1	No	Yes	0.0	3.5	5.1	5,570.7	5,547.5	177.0
1991	Jun	5570.7	5547.5	177.0	6.1	6.1	0.0	0.0	No	No	7.5	1.5	9.0	5.1	0.0	Yes	Yes	13.9	7.8	0.0	0.0	5570.7	5547.5	177.0	55.3	0.9	73.0	1.2	5,442.4	5,546.7	174.6	1.0	0.9	5.8	2.3	4.9	No	Yes	0.0	3.5	4.9	5,152.1	5,545.0	169.2
1991	Jul	5152.1	5545.0	169.2	4.5	4.5	0.0	0.0	No	No	5.6	1.1	6.7	3.2	3.7	No	Yes	14.2	14.3	0.0	0.0	5152.1	5545.0	169.2	54.6	0.9	69.8	1.1	5,027.6	5,544.3	166.9	0.7	0.9	5.1	1.6	8.0	No	Yes	0.0	3.5	11.7	4,307.7	5,539.8	151.7
1991	Aug	4307.7	5539.8	151.7	4.7	4.7	0.0	0.0	No	No	5.7	1.1	6.9	3.4	0.2	No	Yes	14.8	28.0	0.0	0.0	4307.7	5539.8	151.7	49.0	0.8	50.1	0.8	4,208.6	5,539.1	149.4	0.8

Date		Reservoir Start			Glendale USGS Data Backed to Glendale	to GIC					Glendale USGS Data	Orderville Tributary	River	to OIC				to COVE				Reservoir Int1			Seepage		Evaporation		Reservoir Int2			Mt Carmel Tributary	Seepage Return	River	to MCIC				WC Release	River		Reservoir End		
Yr	Mo	Volume	Elevation	Area	Ave Flow	From River		Supp	Pre Cove Full?	Full?	Ave Flow	Ave Flow	Ave Flow	River	Supp	re Cove Full	Full?	Hydraulic Cap	to Fill Resv	Control	River	Volume	Elevation	Area	af	cfs	af	cfs	Volume	Elevation	Area	Ave Flow	Ave Flow	Ave Flow	River	Supp	Pre Cove Full?	Full?	Supp	Ave Flow	Sum Supp	Volume	Elevation	Area
		af	ft	ac	cfs	cfs	Max Supp	cfs			cfs	cfs	cfs	cfs	cfs			cfs	cfs	cfs	cfs	af	ft	ac					af	ft	ac	cfs	cfs	cfs	cfs	cfs			cfs	cfs		af	ft	ac
1996	Oct	3705.5	5535.6	138.0	8.0	0.0	0.0	0.0	Yes	Yes	9.8	2.0	11.8	0.0	0.0	Yes	Yes	15.2	37.8	0.0	0.0	3705.5	5535.6	138.0	44.6	0.7	20.6	0.3	3,640.4	5,535.1	136.6	1.3	0.7	13.9	0.0	0.0	Yes	Yes	0.0	13.9	0.0	3,640.4	5,535.1	136.6
1996	Nov	3640.4	5533.1	136.6	12.1	0.0	0.0	0.0	Yes	Yes	14.9	3.0	17.9	0.0	0.0	Yes	Yes	15.3	40.2	15.3	14.4	4497.0	5541.0	156.0	48.7	0.8	2.3	0.0	4,445.9	5,540.7	154.8	2.0	0.8	6.3	0.0	0.0	Yes	Yes	0.0	6.3	0.0	4,445.9	5,540.7	154.8
1996	Dec	4445.9	5540.7	154.8	12.5	0.0	0.0	0.0	Yes	Yes	15.3	3.1	18.4	0.0	0.0	Yes	Yes	14.7	25.8	14.7	14.7	5347.5	5546.2	172.8	55.8	0.9	0.0	0.0	5,291.5	5,545.9	171.8	2.1	0.9	6.7	0.0	0.0	Yes	Yes	0.0	6.7	0.0	5,291.5	5,545.9	171.8
1997	Jan	5291.5	5545.9	171.8	16.0	0.0	0.0	0.0	Yes	Yes	19.6	3.9	23.5	0.0	0.0	Yes	Yes	14.1	12.0	12.0	12.0	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.6	1.0	15.1	0.0	0.0	Yes	Yes	0.0	15.1	0.0	5,971.7	5,549.7	185.3
1997	Feb	5971.7	5549.7	185.3	11.5	0.0	0.0	0.0	Yes	Yes	14.1	2.8	16.9	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	1.9	1.0	18.7	0.0	0.0	Yes	Yes	0.0	18.7	0.0	5,977.6	5,549.7	185.4
1997	Mar	5977.6	5549.7	185.4	13.6	0.0	0.0	0.0	Yes	Yes	16.7	3.4	20.1	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	2.2	1.0	22.4	0.0	0.0	Yes	Yes	0.0	22.4	0.0	5,960.7	5,549.6	185.1
1997	Apr	5960.7	5549.6	185.1	11.4	0.0	0.0	0.0	Yes	Yes	14.0	2.8	16.8	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	1.9	1.0	18.5	0.0	0.0	Yes	Yes	0.0	18.5	0.0	5,934.3	5,549.5	184.5
1997	May	5934.3	5549.5	184.5	7.3	7.3	0.0	0.0	No	No	9.0	1.8	10.8	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	1.2	1.0	6.4	2.9	4.3	No	Yes	0.0	4.3	0.0	5,904.7	5,549.3	183.9
1997	Jun	5641.9	5547.9	178.3	5.9	5.9	0.0	0.0	No	No	7.3	1.5	8.7	5.1	0.0	Yes	Yes	13.9	6.6	0.0	0.0	5641.9	5547.9	178.3	55.7	0.9	73.6	1.2	5,512.7	5,547.1	175.9	1.0	0.9	5.6	2.1	5.1	No	Yes	0.0	3.5	5.1	5,208.5	5,545.4	170.2
1997	Jul	5208.5	5545.4	170.2	4.3	4.3	0.0	0.0	No	No	5.2	1.1	6.3	2.8	4.1	No	Yes	14.2	13.4	0.0	0.0	5208.5	5545.4	170.2	55.0	0.9	70.2	1.1	5,083.3	5,544.6	167.9	0.7	0.9	5.1	1.6	8.1	No	Yes	0.0	3.5	12.1	4,337.4	5,540.0	152.3
1997	Aug	4337.4	5540.0	152.3	5.9	5.5	0.0	0.0	Yes	Yes	7.2	1.4	8.7	3.6	0.0	Yes	Yes	14.7	27.6	0.0	0.0	4337.4	5540.0	152.3	49.2	0.8	50.3	0.8	4,237.9	5,539.3	150.1	1.0	0.8	6.8	3.3	1.8	No	Yes	0.0	3.5	1.8	4,127.2	5,538.6	147.6
1997	Sep	4127.2	5538.6	147.6	9.9	4.3	0.0	0.0	Yes	Yes	12.2	2.5	14.7	2.9	0.0	Yes	Yes	14.9	32.0	0.0	0.0	4127.2	5538.6	147.6	46.1	0.8	39.7	0.7	4,041.4	5,538.0	145.7	1.6	0.8	14.2	4.0	0.0	Yes	Yes	0.0	10.1	0.0	4,041.4	5,538.0	145.7
1997	Oct	4041.4	5538.0	145.7	9.8	0.0	0.0	0.0	Yes	Yes	12.0	2.4	14.4	0.0	0.0	Yes	Yes	14.9	32.4	0.0	0.0	4041.4	5538.0	145.7	47.0	0.8	21.7	0.4	3,972.6	5,537.5	144.1	1.6	0.8	16.8	0.0	0.0	Yes	Yes	0.0	16.8	0.0	3,972.6	5,537.5	144.1
1997	Nov	3972.6	5537.5	144.1	10.1	0.0	0.0	0.0	Yes	Yes	12.4	2.5	14.9	0.0	0.0	Yes	Yes	15.0	34.6	15.0	11.4	4650.5	5542.0	159.5	49.8	0.8	2.4	0.0	4,598.3	5,541.7	158.3	1.7	0.8	6.0	0.0	0.0	Yes	Yes	0.0	6.0	0.0	4,598.3	5,541.7	158.3
1997	Dec	4598.3	5541.7	158.3	9.4	0.0	0.0	0.0	Yes	Yes	11.6	2.3	13.9	0.0	0.0	Yes	Yes	14.6	23.3	14.6	10.4	5239.7	5545.0	170.8	55.2	0.9	0.0	0.0	5,184.6	5,545.2	169.8	1.6	0.9	6.0	0.0	0.0	Yes	Yes	0.0	6.0	0.0	5,184.6	5,545.2	169.8
1998	Jan	5184.6	5545.2	169.8	10.6	0.0	0.0	0.0	Yes	Yes	13.0	2.6	15.6	0.0	0.0	Yes	Yes	14.2	13.8	13.8	12.1	5929.4	5549.4	184.4	59.5	1.0	0.0	0.0	5,869.8	5,549.1	183.1	1.7	1.0	6.2	0.0	0.0	Yes	Yes	0.0	6.2	0.0	5,869.8	5,549.1	183.1
1998	Feb	5869.8	5549.1	183.1	15.7	0.0	0.0	0.0	Yes	Yes	19.3	3.9	23.2	0.0	0.0	Yes	Yes	13.8	2.9	2.9	2.9	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.6	1.0	23.8	0.0	0.0	Yes	Yes	0.0	23.8	0.0	5,977.6	5,549.7	185.4
1998	Mar	5977.6	5549.7	185.4	17.3	0.0	0.0	0.0	Yes	Yes	21.2	4.3	25.5	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	2.8	1.0	28.4	0.0	0.0	Yes	Yes	0.0	28.4	0.0	5,960.7	5,549.6	185.1
1998	Apr	5960.7	5549.6	185.1	27.0	0.0	0.0	0.0	Yes	Yes	33.1	6.7	39.8	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	4.4	1.0	44.0	0.0	0.0	Yes	Yes	0.0	44.0	0.0	5,934.3	5,549.5	184.5
1998	May	5934.3	5549.5	184.5	24.8	7.7	0.0	0.0	Yes	Yes	30.4	6.1	36.5	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	4.1	1.0	34.9	7.1	0.0	Yes	Yes	0.0	27.8	0.0	5,904.7	5,549.3	183.9
1998	Jun	5904.7	5549.3	183.9	12.0	7.7	0.0	0.0	Yes	Yes	14.7	3.0	17.7	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.1	1.0	75.9	1.3	5,771.4	5,548.6	181.0	2.0	1.0	15.5	7.2	0.0	Yes	Yes	0.0	8.3	0.0	5,771.4	5,548.6	181.0
1998	Jul	5771.4	5548.6	181.0	8.2	8.2	0.0	0.0	No	No	10.1	2.0	12.1	6.8	0.0	Yes	Yes	13.8	4.2	0.0	0.0	5771.4	5548.6	181.0	58.5	1.0	74.7	1.2	5,638.3	5,547.8	178.3	1.4	1.0	7.6	4.1	5.6	No	Yes	0.0	3.5	5.6	5,295.6	5,545.9	171.8
1998	Aug	5295.6	5545.9	171.8	5.9	5.5	0.0	0.0	Yes	Yes	7.2	1.4	8.6	3.6	0.0	Yes	Yes	14.1	12.0	0.0	0.0	5295.6	5545.9	171.8	55.5	0.9	56.7	0.9	5,183.4	5,545.2	169.8	1.0	0.9	6.9	3.4	1.7	No	Yes	0.0	3.5	1.7	5,077.4	5,544.6	167.8
1998	Sep	5077.4	5544.6	167.8	14.1	4.3	0.0	0.0	Yes	Yes	17.3	3.5	20.8	2.9	0.0	Yes	Yes	14.2	16.0	0.0	0.0	5077.4	5544.6	167.8	52.4	0.9	45.2	0.8	4,979.8	5,544.0	166.0	2.3	0.9	21.1	4.0	0.0	Yes	Yes	0.0	17.1	0.0	4,979.8	5,544.0	166.0
1998	Oct	4979.8	5544.0	166.0	13.8	0.0	0.0	0.0	Yes	Yes	17.0	3.4	20.4	0.0	0.0	Yes	Yes	14.3	17.1	0.0	0.0	4979.8	5544.0	166.0	53.6	0.9	24.8	0.4	4,901.4	5,543.5	164.5	2.3	0.9	23.6	0.0	0.0	Yes	Yes	0.0	23.6	0.0	4,901.4	5,543.5	164.5
1998	Nov	4901.4	5543.5	164.5	15.7	0.0	0.0	0.0	Yes	Yes	19.3	3.9	23.2	0.0	0.0	Yes	Yes	14.4	19.0	14.4	14.4	5755.7	5548.5	180.7	56.5	0.9	2.7	0.0	5,696.5	5,548.2	179.4	2.6	0.9	12.4	0.0	0.0	Yes	Yes	0.0	12.4	0.0	5,696.5	5,548.2	179.4
1998	Dec	5696.5	5548.2	179.4	13.1	0.0	0.0	0.0	Yes	Yes	16.1	3.2	19.3	0.0	0.0	Yes	Yes	13.9	5.5	5.5	5.5	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.2	1.0	17.0	0.0	0.0	Yes	Yes	0.0	17.0	0.0	5,971.7	5,549.7	185.3
1999	Jan	5971.7	5549.7	185.3	12.9	0.0	0.0	0.0	Yes	Yes	15.9	3.2	19.1	0.0	0.0	Yes	Yes	13.7	1.0	1.0	1.0	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.1	1.0	21.2	0.0	0.0	Yes	Yes	0.0	21.2	0.0	5,971.7	5,549.7	185.3
1999	Feb	5971.7	5549.7	185.3	13.0	0.0	0.0	0.0	Yes	Yes	16.0	3.2	19.2	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.1	1.0	21.3	0.0	0.0	Yes	Yes	0.0	21.3	0.0	5,977.6	5,549.7	185.4
1999	Mar	5977.6	5549.7	185.4	9.4	0.0	0.0	0.0	Yes	Yes	11.5	2.3	13.8	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	1.5	1.0	15.4	0.0	0.0	Yes	Yes	0.0	15.4	0.0	5,960.7	5,549.6	185.1
1999	Apr	5960.7	5549.6	185.1	11.6	0.0	0.0	0.0	Yes	Yes	14.2	2.9	17.1	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	1.9	1.0	18.7	0.0	0.0	Yes	Yes	0.0	18.7	0.0	5,934.3	5,549.5	184.5
1999	May	5934.3	5549.5	184.5	9.0	7.7	0.0	0.0	Yes	Yes	11.1	2.2	13.3	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	1.5	1.0	9.2	5.7	1.5	No	Yes	0.0	3.5	1.5	5,812.7	5,548.8	181.9
1999	Jun	5812.7	5548.8	181.9	7.7	7.7	0.0	0.0	No	No	9.4	1.9	11.3	5.1	0.0	Yes	Yes	13.8	3.7	0.0	0.0	5812.7	5548.8	181.9	56.8	1.0	75.0	1.3	5,680.8	5,548.1	179.1	1.3	1.0	8.4	4.9	2.2	No	Yes	0.0	3.5	2.2	5,546.9	5,547.3	176.1
1999	Jul	5546.9	5547.3	176.5	8.1	8.1	0.0	0.0	No	No	10.0	2.0	12.0	6.8	0.0	Yes	Yes	14.0	7.9	0.0	0.0	5546.9	5547.3	176.5	57.0	0.9	72.8	1.2	5,417.1	5,546.6	174.1	1.3	0.9	7.4	3.9	5.7	No	Yes	0.0	3.5	5.7	5,064.8	5,544.5	167.6
1999	Aug	5064.8	5544.5	167.6	6.8	5.5	0.0	0.0	Yes	Yes	8.4	1.7	10.1	3.6	0.0	Yes	Yes	14.3	15.7	0.0	0.0	5064.8	5544.5	167.6	54.1	0.9	55.3	0.9	4,955.4	5,543.9	165.6	1.1	0.9	8.4	4.9	0.2	No	Yes	0.0	3.5	0.2	4,944.8	5,543.8	165.3
1999	Sep	4944.8	5543.8	165.3	6.8	4.3	0.0	0.0	Yes	Yes	8.4	1.7	10.1	2.9	0.0	Yes	Yes	14.3	18.3	0.0	0.0	4944.8	5543.8	165.3	51.7	0.9	44.5	0.7	4,848.7	5,543.2	163.4	1.1	0.9	9.2	4.0	0.0	Yes	Yes	0.0	5.2	0.0	4,848.7	5,543.2	163.4
1999	Oct	4848.7	5543.2	163.4	7.5	0.0	0.0	0.0	Yes	Yes	9.2	1.9	11.1	0.0	0.0	Yes	Yes	14.4	19.2	0.0	0.0	4848.7	5543.2	163.4	52.8	0.9	24.4	0.4	4,771.5	5,542.7	161.9	1.2	0.9	13.2	0.0	0.0	Yes	Yes	0.0	13.2	0.0	4,771.5	5,542.7	161.9
1999	Nov	4771.5	5542.7	161.9	8.3	0.0	0.0	0.0	Yes	Yes	10.2	2.1	12.3	0.0	0.0	Yes	Yes	14.4	21.2	14.4	8.8	5292.1	5545.9	171.8	53.7	0.9	2.6	0.0	5,236.0	5,545.5	170.7	1.4	0.9	5.8	0.0	0.0	Yes	Yes	0.0	5.8	0.0	5,236.0	5,545.5	170.7
1999	Dec	5236.0	5545.5	170.7	8.1	0.0	0.0	0.0	Yes	Yes	10.0	2.0	12.0	0.0	0.0	Yes	Yes	14.1	12.9	12.9	8.5	5759.2	5548.5	180.8	58.4	0.9	0.0	0.0	5,700.9	5,548.2	179.5	1.3	0.9	5.8	0.0	0.0	Yes	Yes	0.0	5.8	0.0	5,700.9	5,548.2	179.5
2000	Jan	5700.9	5548.2	179.5	9.9	0.0	0.0	0.0	Yes	Yes	12.2	2.5	14.7	0.0	0.0	Yes	Yes	13.9	5.4	5.4	5.4	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	1.6	1.0	11.9	0.0	0.0	Yes	Yes	0.0	11.9	0.0	5,971.7	5,549.7	185.3
2000	Feb	5971.7	5549.7	185.3	12.9	0.0	0.0	0.0	Yes	Yes	15.9	3.2	19.1	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.1	1.0	21.1	0.0	0.0	Yes	Yes	0.0	21.1	0.0	5,977.6	5,549.7	185.4
2000	Mar	5977.6	5549.7	185.4	17.4	0.0	0.0	0.0	Yes	Yes	21.4	4.3	25.7	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	2.9	1.0	28.7	0.0	0.0	Yes	Yes	0.0	28.7	0.0	5,960.7	5,549.6	185.1
2000	Apr	5960.7	5549.6	185.1	9.9	0.0	0.0	0.0	Yes	Yes	12.1	2.4	14.5	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	1.6	1.0	15.9	0.0	0.0	Yes	Yes	0.0	15.9	0.0	5,934.3	5,549.5	184.5
2000	May	5934.3	5549.5	184.5	6.1	6.1	0.0	0.0	No	No	7.5	1.5	9.1	5.1	0.0	Yes	Yes	13.7	1.6	1.6	0.5	5964.8	5549.6	185.2	59.8	1.0	66.5	1.1	5,838.5	5,548.9	182.5	1.0	1.0	9.3	5.2	2.0	No	Yes	0.0	3.5	5.2	5,521.0	5,547.2	176.1
2000	Jun	5521.0	5547.2	176.1	4.3	4.3	0.0	0.0	No	No	5.3	1.1	6.4	2.9	2.2	No	Yes	14.0	8.6	0.0	0.0	5521.0	5547.2	176.1	55.0	0.9	72.6	1.2	5,393.3	5,546.4	173.7	0.7	0.9	5.1	1.6	5.5	No	Yes	0.0	3.5	7.8	4,931.1	5,543.7	165.1
2000	Jul	4931.1	5543.7	165.1	3.9	3.9	0.0	0.0	No	No	4.8	1.0	5.8	2.3	4.6	No	Yes	14.3	17.9	0.0	0.0	4931.1	5543.7	165.1	53.3	0.9	68.1	1.1	4,809.7	5,543.0	162.6	0.6	0.9	5.0	1.5	8.2	No	Yes	0.0	3.5	12.7	4,026.9	5,537.9	145.4
2000	Aug	4026.9	5537.9	145.4	3.9	3.9	0.0	0.0	No	No	4.8	1.0	5.7	2.2	1.4	No	Yes	15.0	32.6	0.0	0.0	4026.9	5537.9	145.4	46.9	0.8	48.0	0.8	3,932.0	5,537.2	143.2	0.6	0.8	4.9	1.4	3.7	No	Yes	0.0	3.5	3.5	3,617.1	5,535.0	136.1
2000	Sep	3617.1	5535.0	136.1	4.3	4.3	0.0	0.0	No	No	5.3	1.1	6.3	2.8	0.0	No	Yes	15.3	40.6	0.0	0.0	3617.1	5535.0	136.1	42.5	0.7	36.6	0.6	3,537.9	5,534.4	134.3	0.7	0.7	4.9	1.4	2.6	No	Yes	0.0	3.5	2.7	3,380.2	5,533.2	130.8
2000	Oct	3380.2	5533.2	130.8	9.9	0.0	0.0	0.0	Yes	Yes	12.2	2.5	14.7	0.0	0.0	Yes	Yes	15.5	43.1	0.0	0.0	3380.2	5533.2	130.8	42.2	0.7	19.5	0.3	3,318.5	5,532.7	129.5	1.6	0.7	17.0	0.0	0.0	Yes	Yes	0.0	17.0	0.0	3,318.5	5,532.7	129.5
2000	Nov	3318.5	5532.7	129.5	11.2	0.0	0.0	0.0	Yes	Yes	13.7	2.8	16.5	0.0	0.0	Yes	Yes	15.5	45.6	15.5	13.0	4089.3	5538.3	146.8	45.9	0.8	2.2	0.0	4,041.2	5,538.0	145.7	1.8	0.8	6.1	0.0	0.0	Yes	Yes	0.0	6.1	0.0	4,041.2	5,538.0	145.7
2000	Dec	4041.2	5538.0	145.7	10.6	0.0	0.0	0.0	Yes	Yes	13.0	2.6	15.6	0.0	0.0	Yes	Yes	14.9	32.4	14.9	12.1	4786.1	5542.8	162.2	52.4	0.9	0.0	0.0	4,733.7	5,542.5	161.1	1.7	0.9	6.1	0.0	0.0	Yes	Yes	0.0	6.1	0.0	4,733.7	5,542.5	161.1
2001	Jan	4733.7	5542.5	161.1	10.0	0.0	0.0	0.0	Yes	Yes	12.3	2.5	14.8	0.0	0.0	Yes	Yes	14.5	21.1	14.5	11.3	5426.8	5546.6	174.3	56.3	0.9	0.0	0.0	5,370.5	5,546.3	173.2	1.6	0.9	6.1	0.0	0.0	Yes	Yes	0.0	6.1	0.0	5,370.5	5,546.3	173.2
2001	Feb	5370.5	5546.3	173.2	11.9	0.0	0.0	0.0	Yes	Yes	14.6	2.9	17.5	0.0	0.0	Yes	Yes	14.1	11.9	11.9	11.9	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.0	1.0	8.6	0.0	0.0	Yes	Yes	0.0	8.6	0.0	5,977.6	5,549.7	185.4
2001	Mar	5977.6	5549.7	185.4	14.3	0.0	0.0	0.0	Yes	Yes	17.6	3.5	21.1	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	2.4	1.0	23.6	0.0	0.0	Yes	Yes	0.0	23.6	0.0	5,960.7	5,549.6	185.1
2001	Apr	5960.7	5549.6	185.1	16.7	3.4	0.0	0.0	Yes	Yes	20.1	4.0	24.1	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	2.2	1.0	22.1	0.0	0.0	Yes	Yes	0.0	22.1	0.0	5,934.3	5,549.5	184.5
2001	May	5934.3	5549.5	184.5	7.8	7.7	0.0	0.0	Yes	Yes	9.5	1.9	11.5	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	1.3	1.0	7.1	3.6	3.6	No	Yes	0.0	3.5	3.6	5,684.6	5,548.1	179.2
2001	Jun	5684.6	5548.1	179.2	5.2	5.2	0.0	0.0	No	No	6.4	1.3	7.7	4.2	0.9	No	Yes	13.9	5.8	0.0	0.0	5684.6	5548.1	179.2	56.0	0.9	73.9	1.2	5,554.7	5,547.4	176.7	0.9	0.9	5.3	1.8	5.4	No	Yes	0.0	3.5	6.3	5,180.1	5,545.2	169.7
2001	Jul	5180.1	5545.2	169.7	4.4	4.4	0.0	0.0	No	No	5.5	1.1	6.6	3.1	3.8	No	Yes	14.2	13.9	0.0	0.0	5180.1	5545.2	169.7	54.8	0.9	70.0	1.

Date		Reservoir Start			Glendale USGS Data Backed to Glendale	to GIC					Glendale USGS Data	Orderville Tributary	River	to OIC				to COVE				Reservoir Int1			Seepage		Evaporation		Reservoir Int2			Mt Carmel Tributary	Seepage Return	River	to MCIC				WC Release	River		Reservoir End		
Yr	Mo	Volume	Elevation	Area	Ave Flow	From River		Supp	Pre Cove Full?	Full?	Ave Flow	Ave Flow	Ave Flow	River	Supp	re Cove Full	Full?	Hydraulic Cap	to Fill Resv	Control	River	Volume	Elevation	Area	af	cfs	af	cfs	Volume	Elevation	Area	Ave Flow	Ave Flow	Ave Flow	River	Supp	Pre Cove Full?	Full?	Supp	Ave Flow	Sum Supp	Volume	Elevation	Area
		af	ft	ac	cfs	cfs	Max Supp	cfs			cfs	cfs	cfs	cfs	cfs			cfs	cfs	cfs	cfs	af	ft	ac					af	ft	ac	cfs	cfs	cfs	cfs	cfs			cfs	cfs	cfs	af	ft	ac
2006	Sep	4686.9	5542.2	160.2	6.8	4.3	0.0	0.0	Yes	Yes	8.3	1.7	10.0	2.9	0.0	Yes	Yes	14.5	22.6	0.0	0.0	4686.9	5542.2	160.2	50.1	0.8	43.1	0.7	4,593.7	5,541.6	158.2	1.1	0.8	9.0	4.0	0.0	Yes	Yes	0.0	5.0	0.0	4,593.7	5,541.6	158.2
2006	Oct	4593.7	5541.6	158.2	12.4	0.0	0.0	0.0	Yes	Yes	15.2	3.1	18.3	0.0	0.0	Yes	Yes	14.6	23.4	0.0	0.0	4593.7	5541.6	158.2	51.1	0.8	23.6	0.4	4,519.0	5,541.1	156.5	2.0	0.8	21.1	0.0	0.0	Yes	Yes	0.0	21.1	0.0	4,519.0	5,541.1	156.5
2006	Nov	4519.0	5541.1	156.5	11.6	0.0	0.0	0.0	Yes	Yes	14.3	2.9	17.2	0.0	0.0	Yes	Yes	14.6	25.4	14.6	13.7	5332.7	5546.1	172.5	53.9	0.9	2.6	0.0	5,276.2	5,545.8	171.5	1.9	0.9	6.3	0.0	0.0	Yes	Yes	0.0	6.3	0.0	5,276.2	5,545.8	171.5
2006	Dec	5276.2	5545.8	171.5	11.0	0.0	0.0	0.0	Yes	Yes	13.5	2.7	16.2	0.0	0.0	Yes	Yes	14.1	12.3	12.3	12.3	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	1.8	1.0	6.7	0.0	0.0	Yes	Yes	0.0	6.7	0.0	5,971.7	5,549.7	185.3
2007	Jan	5971.7	5549.7	185.3	10.2	0.0	0.0	0.0	Yes	Yes	12.5	2.5	15.0	0.0	0.0	Yes	Yes	13.7	1.0	1.0	1.0	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	1.7	1.0	16.7	0.0	0.0	Yes	Yes	0.0	16.7	0.0	5,971.7	5,549.7	185.3
2007	Feb	5971.7	5549.7	185.3	11.6	0.0	0.0	0.0	Yes	Yes	14.2	2.9	17.1	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	1.9	1.0	18.9	0.0	0.0	Yes	Yes	0.0	18.9	0.0	5,977.6	5,549.7	185.4
2007	Mar	5977.6	5549.7	185.4	10.3	0.0	0.0	0.0	Yes	Yes	12.7	2.6	15.3	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	1.7	1.0	17.0	0.0	0.0	Yes	Yes	0.0	17.0	0.0	5,960.7	5,549.6	185.1
2007	Apr	5960.7	5549.6	185.1	9.2	0.0	0.0	0.0	Yes	Yes	11.3	2.3	13.6	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	1.5	1.0	14.9	0.0	0.0	Yes	Yes	0.0	14.9	0.0	5,934.3	5,549.5	184.5
2007	May	5934.3	5549.5	184.5	6.0	6.0	0.0	0.0	No	No	7.4	1.5	8.9	5.1	2.0	Yes	Yes	13.7	1.6	1.6	0.3	5954.5	5549.6	184.9	59.7	1.0	66.4	1.1	5,828.3	5,548.9	182.3	1.0	1.0	5.5	2.0	5.2	No	Yes	0.0	3.5	5.2	5,509.6	5,547.1	175.8
2007	Jun	5509.6	5547.1	175.8	4.2	4.2	0.0	0.0	No	No	5.2	1.0	6.2	2.7	2.3	No	Yes	14.0	8.8	0.0	0.0	5509.6	5547.1	175.8	55.0	0.9	72.5	1.2	5,382.1	5,546.4	173.4	0.7	0.9	5.1	1.6	5.6	No	Yes	0.0	3.5	7.9	4,911.9	5,543.6	164.7
2007	Jul	4911.9	5543.6	164.7	3.4	3.4	0.0	0.0	No	No	4.2	0.8	5.0	1.5	5.4	No	Yes	14.3	18.2	0.0	0.0	4911.9	5543.6	164.7	53.2	0.9	67.9	1.1	4,790.8	5,542.9	162.3	0.6	0.9	4.9	1.4	8.2	No	Yes	0.0	3.5	13.6	3,954.4	5,537.4	143.7
2007	Aug	3954.4	5537.4	143.7	3.7	3.7	0.0	0.0	No	No	4.5	0.9	5.4	1.9	1.7	No	Yes	15.0	33.8	0.0	0.0	3954.4	5537.4	143.7	46.4	0.8	47.4	0.8	3,860.6	5,536.7	141.6	0.6	0.8	4.9	1.4	3.7	No	Yes	0.0	3.5	5.4	3,526.3	5,534.3	134.0
2007	Sep	3526.3	5534.3	134.0	4.7	4.3	0.0	0.0	Yes	Yes	5.8	1.2	7.0	2.9	0.0	Yes	Yes	15.3	42.1	0.0	0.0	3526.3	5534.3	134.0	41.9	0.7	36.1	0.6	3,448.3	5,533.7	132.3	0.8	0.7	5.6	2.1	2.0	No	Yes	0.0	3.5	2.0	3,331.3	5,532.8	129.7
2007	Oct	3331.3	5532.8	129.7	6.8	0.0	0.0	0.0	Yes	Yes	8.4	1.7	10.1	0.0	0.0	Yes	Yes	15.5	43.9	0.0	0.0	3331.3	5532.8	129.7	41.9	0.7	19.4	0.3	3,270.0	5,532.4	128.4	1.1	0.7	11.9	0.0	0.0	Yes	Yes	0.0	11.9	0.0	3,270.0	5,532.4	128.4
2007	Nov	3270.0	5532.4	128.4	6.9	0.0	0.0	0.0	Yes	Yes	8.5	1.7	10.2	0.0	0.0	Yes	Yes	15.5	46.4	15.5	6.7	3667.8	5535.3	137.2	42.9	0.7	2.1	0.0	3,622.9	5,535.0	136.2	1.1	0.7	5.4	0.0	0.0	Yes	Yes	0.0	5.4	0.0	3,622.9	5,535.0	136.2
2007	Dec	3622.9	5535.0	136.2	10.3	0.0	0.0	0.0	Yes	Yes	12.7	2.6	15.3	0.0	0.0	Yes	Yes	15.3	39.2	15.3	11.8	4345.5	5540.0	152.5	49.3	0.8	4,296.3	5,539.7	151.4	1.7	0.8	6.0	0.0	0.0	Yes	Yes	0.0	6.0	0.0	4,296.3	5,539.7	151.4
2008	Jan	4296.3	5539.7	151.4	11.0	0.0	0.0	0.0	Yes	Yes	13.5	2.7	16.2	0.0	0.0	Yes	Yes	14.8	28.2	14.8	12.7	5078.0	5544.6	167.8	54.2	0.9	0.0	0.0	5,023.8	5,544.3	166.8	1.8	0.9	6.2	0.0	0.0	Yes	Yes	0.0	6.2	0.0	5,023.8	5,544.3	166.8
2008	Feb	5023.8	5544.3	166.8	12.3	0.0	0.0	0.0	Yes	Yes	15.1	3.0	18.1	0.0	0.0	Yes	Yes	14.3	18.2	14.3	14.3	5816.8	5548.8	182.0	53.1	1.0	0.0	0.0	5,763.7	5,548.5	180.9	2.0	1.0	6.8	0.0	0.0	Yes	Yes	0.0	6.8	0.0	5,763.7	5,548.5	180.9
2008	Mar	5763.7	5548.5	180.9	16.7	0.0	0.0	0.0	Yes	Yes	20.5	4.1	24.6	0.0	0.0	Yes	Yes	13.8	4.4	4.4	4.4	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	2.7	1.0	24.0	0.0	0.0	Yes	Yes	0.0	24.0	0.0	5,960.7	5,549.6	185.1
2008	Apr	5960.7	5549.6	185.1	11.8	0.0	0.0	0.0	Yes	Yes	14.5	2.9	17.4	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	1.9	1.0	19.1	0.0	0.0	Yes	Yes	0.0	19.1	0.0	5,934.3	5,549.5	184.5
2008	May	5934.3	5549.5	184.5	7.8	7.7	0.0	0.0	Yes	Yes	9.5	1.9	11.4	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	1.3	1.0	7.1	3.6	3.6	No	Yes	0.0	3.5	3.6	5,683.8	5,548.1	179.2
2008	Jun	5683.8	5548.1	179.2	5.4	5.4	0.0	0.0	No	No	6.6	1.3	7.9	4.4	0.7	No	Yes	13.9	5.9	0.0	0.0	5683.8	5548.1	179.2	56.0	0.9	73.9	1.2	5,553.9	5,547.4	176.7	0.9	0.9	5.3	1.8	5.4	No	Yes	0.0	3.5	6.0	5,196.0	5,545.3	170.0
2008	Jul	5196.0	5545.3	170.0	4.7	4.7	0.0	0.0	No	No	5.7	1.2	6.9	3.4	3.4	No	Yes	14.2	13.6	0.0	0.0	5196.0	5545.3	170.0	54.9	0.9	70.1	1.1	5,070.9	5,544.6	167.7	0.8	0.9	5.2	1.7	8.0	No	Yes	0.0	3.5	11.5	4,366.8	5,540.2	153.0
2008	Aug	4366.8	5540.2	153.0	4.1	4.1	0.0	0.0	No	No	5.1	1.0	6.1	2.6	3.0	No	Yes	14.7	27.1	0.0	0.0	4366.8	5540.2	153.0	49.4	0.8	50.5	0.8	4,266.9	5,539.5	150.8	0.7	0.8	5.0	1.5	3.6	No	Yes	0.0	3.5	4.7	3,980.8	5,537.6	144.3
2008	Sep	3980.8	5537.6	144.3	3.9	3.9	0.0	0.0	No	No	4.8	1.0	5.8	2.3	0.6	No	Yes	15.0	34.5	0.0	0.0	3980.8	5537.6	144.3	45.1	0.8	38.8	0.7	3,896.9	5,537.0	142.4	0.6	0.8	4.9	1.4	2.6	No	Yes	0.0	3.5	3.2	3,706.8	5,535.6	138.1
2008	Oct	3706.8	5535.6	138.1	5.9	0.0	0.0	0.0	Yes	Yes	7.2	1.5	8.7	0.0	0.0	Yes	Yes	15.2	37.8	0.0	0.0	3706.8	5535.6	138.1	44.6	0.7	20.6	0.3	3,641.6	5,535.2	136.6	1.0	0.7	10.4	0.0	0.0	Yes	Yes	0.0	10.4	0.0	3,641.6	5,535.2	136.6
2008	Nov	3641.6	5535.2	136.6	7.8	0.0	0.0	0.0	Yes	Yes	9.6	1.9	11.5	0.0	0.0	Yes	Yes	15.3	40.2	15.3	8.0	4116.5	5538.5	147.4	46.1	0.8	2.2	0.0	4,068.3	5,538.2	146.3	1.3	0.8	5.6	0.0	0.0	Yes	Yes	0.0	5.6	0.0	4,068.3	5,538.2	146.3
2008	Dec	4068.3	5538.2	146.3	8.9	0.0	0.0	0.0	Yes	Yes	10.9	2.2	13.1	0.0	0.0	Yes	Yes	14.9	31.9	14.9	9.6	4658.0	5542.0	159.6	51.5	0.8	0.0	0.0	4,606.5	5,541.7	158.5	1.5	0.8	5.8	0.0	0.0	Yes	Yes	0.0	5.8	0.0	4,606.5	5,541.7	158.5
2009	Jan	4606.5	5541.7	158.5	11.8	0.0	0.0	0.0	Yes	Yes	14.5	2.9	17.4	0.0	0.0	Yes	Yes	14.6	23.2	14.6	13.9	5462.1	5546.8	175.0	56.5	0.9	0.0	0.0	5,405.6	5,546.5	173.9	1.9	0.9	6.4	0.0	0.0	Yes	Yes	0.0	6.4	0.0	5,405.6	5,546.5	173.9
2009	Feb	5405.6	5546.5	173.9	12.9	0.0	0.0	0.0	Yes	Yes	15.8	3.2	19.0	0.0	0.0	Yes	Yes	14.0	11.3	11.3	11.3	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.1	1.0	10.8	0.0	0.0	Yes	Yes	0.0	10.8	0.0	5,977.6	5,549.7	185.4
2009	Mar	5977.6	5549.7	185.4	14.1	0.0	0.0	0.0	Yes	Yes	17.3	3.5	20.8	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	2.3	1.0	23.2	0.0	0.0	Yes	Yes	0.0	23.2	0.0	5,960.7	5,549.6	185.1
2009	Apr	5960.7	5549.6	185.1	12.2	0.0	0.0	0.0	Yes	Yes	15.0	3.0	18.0	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	2.0	1.0	19.8	0.0	0.0	Yes	Yes	0.0	19.8	0.0	5,934.3	5,549.5	184.5
2009	May	5934.3	5549.5	184.5	7.7	7.7	0.0	0.0	Yes	Yes	9.5	1.9	11.4	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	1.3	1.0	7.0	3.5	3.7	No	Yes	0.0	3.5	3.7	5,678.1	5,548.1	179.2
2009	Jun	5678.1	5548.1	179.0	5.8	5.8	0.0	0.0	No	No	7.1	1.4	8.5	5.0	0.1	No	Yes	13.9	5.9	0.0	0.0	5678.1	5548.1	179.0	56.0	0.9	73.9	1.2	5,548.3	5,547.3	176.6	0.9	0.9	5.4	1.9	5.3	No	Yes	0.0	3.5	5.4	5,228.4	5,545.5	170.6
2009	Jul	5228.4	5545.5	170.6	4.2	4.2	0.0	0.0	No	No	5.2	1.0	6.3	2.8	4.1	No	Yes	14.1	13.1	0.0	0.0	5228.4	5545.5	170.6	55.1	0.9	70.4	1.1	5,102.9	5,544.7	168.3	0.7	0.9	5.1	1.6	8.1	No	Yes	0.0	3.5	12.2	4,355.5	5,540.1	152.8
2009	Aug	4355.5	5540.1	152.8	3.9	3.9	0.0	0.0	No	No	4.7	1.0	5.7	2.2	1.4	No	Yes	14.7	27.3	0.0	0.0	4355.5	5540.1	152.8	49.3	0.8	50.4	0.8	4,255.8	5,539.4	150.5	0.8	0.8	4.9	1.4	3.7	No	Yes	0.0	3.5	5.1	3,942.5	5,537.3	143.4
2009	Sep	3942.5	5537.3	143.4	4.1	4.1	0.0	0.0	No	No	5.1	1.0	6.1	2.6	0.3	No	Yes	15.0	35.1	0.0	0.0	3942.5	5537.3	143.4	44.8	0.8	38.6	0.6	3,859.0	5,536.7	141.5	0.7	0.8	4.9	1.4	2.6	No	Yes	0.0	3.5	2.9	3,687.7	5,535.5	137.6
2009	Oct	3687.7	5535.5	137.6	5.4	0.0	0.0	0.0	Yes	Yes	6.6	1.3	7.9	0.0	0.0	Yes	Yes	15.2	38.1	0.0	0.0	3687.7	5535.5	137.6	44.4	0.7	20.5	0.3	3,622.8	5,535.0	136.2	0.9	0.7	9.5	0.0	0.0	Yes	Yes	0.0	9.5	0.0	3,622.8	5,535.0	136.2
2009	Nov	3622.8	5535.0	136.2	7.4	0.0	0.0	0.0	Yes	Yes	9.0	1.8	10.9	0.0	0.0	Yes	Yes	15.3	40.5	15.3	7.4	4060.5	5538.1	146.1	45.7	0.8	2.2	0.0	4,012.7	5,537.8	145.0	1.2	0.8	5.5	0.0	0.0	Yes	Yes	0.0	5.5	0.0	4,012.7	5,537.8	145.0
2009	Dec	4012.7	5537.8	145.0	9.9	0.0	0.0	0.0	Yes	Yes	12.1	2.4	14.5	0.0	0.0	Yes	Yes	15.0	32.8	15.0	11.0	4691.1	5542.2	160.3	51.8	0.8	0.0	0.0	4,639.3	5,541.9	159.2	1.6	0.8	6.0	0.0	0.0	Yes	Yes	0.0	6.0	0.0	4,639.3	5,541.9	159.2
2010	Jan	4639.3	5541.9	159.2	12.1	0.0	0.0	0.0	Yes	Yes	14.8	3.0	17.8	0.0	0.0	Yes	Yes	14.5	22.7	14.5	14.3	5517.0	5547.1	176.0	56.8	0.9	0.0	0.0	5,460.2	5,546.8	174.9	2.0	0.9	6.4	0.0	0.0	Yes	Yes	0.0	6.4	0.0	5,460.2	5,546.8	174.9
2010	Feb	5460.2	5546.8	174.9	13.9	0.0	0.0	0.0	Yes	Yes	17.1	3.4	20.5	0.0	0.0	Yes	Yes	14.0	10.3	10.3	10.3	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.3	1.0	13.5	0.0	0.0	Yes	Yes	0.0	13.5	0.0	5,977.6	5,549.7	185.4
2010	Mar	5977.6	5549.7	185.4	18.4	0.0	0.0	0.0	Yes	Yes	22.6	4.5	27.1	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	3.0	1.0	30.3	0.0	0.0	Yes	Yes	0.0	30.3	0.0	5,960.7	5,549.6	185.1
2010	Apr	5960.7	5549.6	185.1	21.7	0.0	0.0	0.0	Yes	Yes	26.6	5.3	31.9	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	3.6	1.0	35.3	0.0	0.0	Yes	Yes	0.0	35.3	0.0	5,934.3	5,549.5	184.5
2010	May	5934.3	5549.5	184.5	14.1	7.7	0.0	0.0	Yes	Yes	17.3	3.5	20.8	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	2.3	1.0	17.4	7.1	0.0	Yes	Yes	0.0	10.3	0.0	5,904.7	5,549.3	183.9
2010	Jun	5904.7	5549.3	183.9	7.7	7.7	0.0	0.0	Yes	Yes	9.5	1.9	11.4	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	1.3	1.0	8.6	5.1	2.1	No	Yes	0.0	3.5	2.1	5,644.5	5,547.9	178.4
2010	Jul	5644.5	5547.9	178.4	5.3	5.3	0.0	0.0	No	No	6.5	1.3	7.8	4.3	2.6	No	Yes	13.9	6.3	0.0	0.0	5644.5	5547.9	178.4	57.6	0.9	73.6	1.2	5,513.3	5,547.1	175.9	0.9	0.9	5.3	1.8	7.9	No	Yes	0.0	3.5	10.4	4,872.7	5,543.4	163.9
2010	Aug	4872.7	5543.4	163.9	5.2	5.2	0.0	0.0	No	No	6.4	1.3	7.7	3.6	0.0	No	Yes	14.4	18.9	0.0	0.0	4872.7	5543.4	163.9	52.9	0.9	54.1	0.9	4,765.6	5,542.7	161.8	0.9	0.9	5.7	2.2	2.9	No	Yes	0.0	3.5	2.9	4,589.7	5,541.6	158.1
2010	Sep	4589.7	5541.6	158.1	4.5	4.3	0.0	0.0	Yes	Yes	5.5	1.1	6.6	2.9	0.0	Yes	Yes	14.6	24.2	0.0	0.0	4589.7	5541.6	158.1	49.4	0.8	42.6	0.7	4,497.8	5,541.0	156.0	0.7	0.8	5.3	1.8	2.3	No	Yes	0.0	3.5	2.3	4,362.1	5,540.1	152.9
2010	Oct	4362.1	5540.1	152.9	9.0	0.0	0.0	0.0	Yes	Yes	11.0	2.2	13.2	0.0	0.0	Yes	Yes	14.7	27.2	0.0	0.0	4362.1	5540.1	152.9	49.4	0.8	22.8	0.4	4,289.9	5,539.7	151.3	1.5	0.8	15.5	0.0	0.0	Yes	Yes	0.0	15.5	0.0	4,289.9	5,539.7	151.3
2010	Nov	4289.9	5539.7	151.3	8.6	0.0	0.0	0.0	Yes	Yes	10.6	2.1	12.7	0.0	0.0	Yes	Yes	14.8	29.3	14.8	9.2	4839.2	5543.1	163.2	51.0	0.9	2.4	0.0	4,785.7	5,542.8	162.2	1.4	0.9	5.8	0.0	0.0	Yes	Yes	0.0	5.8	0.0	4,785.7	5,542.8	162.2
2010	Dec	4785.7	5542.8	162.2	53.9	0.0	0.0	0.0	Yes	Yes	66.2	13.3	79.5	0.0	0.0	Yes	Yes	14.4	20.3	14.4	14.4	5673.1	5548.0	178.9	57.8	0.9	0.0	0.0	5,615.3	5,547.7	177.8	8.9	0.9	74.9	0.0	0.0	Yes	Yes	0.0	74.9	0.0	5,615.3	5,547.7	177.8
2011	Jan	5615.3	5547.7	177.8	23.5	0.0	0.0	0.0	Yes	Yes	28.8	5.8	34.6	0.0	0.0	Yes	Yes	13.9	6.8	6.8	6.8	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	3.9	1.0	32.7	0.0	0.0	Yes	Yes	0.0	32.7	0.0	5,971.7	5,549.7	185.3
2011	Feb	5971.7	5549.7	185.3	15.9	0.0	0.0	0.0	Yes	Yes	19.5	3.9	23.4	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.6	1.0	25.9	0.0	0.0	Yes	Yes	0.0	25.9	0.0	5,977.6	5,549.7	185.4
2011	Mar	5977.6	5549.7	185.4	32.1	0.0	0.0	0.0	Yes	Yes	39.4	7.9	47.3	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	5.3	1.0	52.7	0.0	0.0	Yes	Yes	0.0	52.7	0.0	5,960.7	5,549.6	185.1
2011	Apr	5960.7	5549.6	185.1	81.4	0.0	0.0	0.0	Yes	Yes	100.0	20.1	120.1	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	13.4	1.0	133.3	0.0	0.0	Yes	Yes	0.0	133.3	0.0	5,934.3	5,549.5	184.5
2011	May	5934.3	5549.5	184.5	56.8	7.7	0.0	0.0	Yes	Yes	69.7	14.0	83.7	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	9.3	1.0	87.4	7.1	0.0	Yes	Yes	0.0	80.2	0.0	5,904.7	5,549.3	183.9
2011	Jun	5904.7	5549.3	183.9	18.3	7.7	0.0	0.0	Yes	Yes	22.5	4.5	27.0	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	3.0

Date		Reservoir Start			Glendale USGS Data Backed to Glendale	to GIC					Glendale USGS Data	Orderville Tributary	River	to OIC				to COVE				Reservoir Int1			Seepage		Evaporation		Reservoir Int2			Mt Carmel Tributary	Seepage Return	River	to MCIC				WC Release	River		Reservoir End		
Yr	Mo	Volume	Elevation	Area	Ave Flow	From River		Supp	Pre Cove Full?	Full?	Ave Flow	Ave Flow	Ave Flow	River	Supp	re Cove Full	Full?	Hydraulic Cap	to Fill Resv	Control	River	Volume	Elevation	Area					Volume	Elevation	Area	Ave Flow	Ave Flow	Ave Flow	River	Supp	Pre Cove Full?	Full?	Supp	Ave Flow	Sum Supp	Volume	Elevation	Area
		af	ft	ac	cfs	cfs	Max Supp	cfs			cfs	cfs	cfs	cfs	cfs			cfs	cfs	cfs	cfs	af	ft	ac	af	cfs	af	cfs	af	ft	ac	cfs	cfs	cfs	cfs	cfs			cfs	af	ft	ac
2016	Aug	4679.5	5542.2	160.0	7.1	5.5	0.0	0.0	Yes	Yes	8.7	1.7	10.4	3.6	0.0	Yes	Yes	14.5	22.0	0.0	0.0	4679.5	5542.2	160.0	51.7	0.8	52.8	0.9	4,575.0	5,541.5	157.7	1.2	0.8	8.8	5.1	0.0	No	Yes	0.0	3.7	0.0	4,575.0	5,541.5	157.7
2016	Sep	4575.0	5541.5	157.7	9.0	4.3	0.0	0.0	Yes	Yes	11.0	2.2	13.2	2.9	0.0	Yes	Yes	14.6	24.5	0.0	0.0	4575.0	5541.5	157.7	49.3	0.8	42.5	0.7	4,483.3	5,540.9	155.7	1.5	0.8	12.6	4.0	0.0	Yes	Yes	0.0	8.6	0.0	4,483.3	5,540.9	155.7
2016	Oct	4483.3	5540.9	155.7	8.3	0.0	0.0	0.0	Yes	Yes	10.2	2.1	12.3	0.0	0.0	Yes	Yes	14.6	25.2	0.0	0.0	4483.3	5540.9	155.7	50.3	0.8	23.2	0.4	4,409.8	5,540.4	154.0	1.4	0.8	14.4	0.0	0.0	Yes	Yes	0.0	14.4	0.0	4,409.8	5,540.4	154.0
2016	Nov	4409.8	5540.4	154.0	7.3	0.0	0.0	0.0	Yes	Yes	8.9	1.8	10.7	0.0	0.0	Yes	Yes	14.7	27.3	14.7	7.2	4838.3	5543.1	163.2	51.0	0.9	2.4	0.0	4,784.8	5,542.8	162.2	1.2	0.9	5.6	0.0	0.0	Yes	Yes	0.0	5.6	0.0	4,784.8	5,542.8	162.2
2016	Dec	4784.8	5542.8	162.2	13.5	0.0	0.0	0.0	Yes	Yes	16.6	3.3	19.9	0.0	0.0	Yes	Yes	14.4	20.3	14.4	14.4	5672.3	5548.0	178.9	57.8	0.9	0.0	0.0	5,614.5	5,547.7	177.8	2.2	0.9	8.7	0.0	0.0	Yes	Yes	0.0	8.7	0.0	5,614.5	5,547.7	177.8
2017	Jan	5614.5	5547.7	177.8	33.1	0.0	0.0	0.0	Yes	Yes	40.7	8.2	48.9	0.0	0.0	Yes	Yes	13.9	6.8	6.8	6.8	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	5.5	1.0	48.5	0.0	0.0	Yes	Yes	0.0	48.5	0.0	5,971.7	5,549.7	185.3
2017	Feb	5971.7	5549.7	185.3	44.8	0.0	0.0	0.0	Yes	Yes	55.0	11.1	66.1	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	7.4	1.0	73.3	0.0	0.0	Yes	Yes	0.0	73.3	0.0	5,977.6	5,549.7	185.4
2017	Mar	5977.6	5549.7	185.4	33.1	0.0	0.0	0.0	Yes	Yes	40.7	8.2	48.9	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	5.5	1.0	54.4	0.0	0.0	Yes	Yes	0.0	54.4	0.0	5,960.7	5,549.6	185.1
2017	Apr	5960.7	5549.6	185.1	16.4	0.0	0.0	0.0	Yes	Yes	20.1	4.0	24.1	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	2.7	1.0	26.6	0.0	0.0	Yes	Yes	0.0	26.6	0.0	5,934.3	5,549.5	184.5
2017	May	5934.3	5549.5	184.5	10.5	7.7	0.0	0.0	Yes	Yes	12.9	2.6	15.5	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	1.7	1.0	11.6	7.1	0.0	Yes	Yes	0.0	4.4	0.0	5,904.7	5,549.3	183.9
2017	Jun	5904.7	5549.3	183.9	7.8	7.7	0.0	0.0	Yes	Yes	9.5	1.9	11.4	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	1.3	1.0	8.6	5.1	2.1	No	Yes	0.0	3.5	2.1	5,647.7	5,547.9	178.4
2017	Jul	5647.7	5547.9	178.4	7.1	7.1	0.0	0.0	No	No	8.7	1.7	10.4	6.8	0.0	Yes	Yes	13.9	6.3	0.0	0.0	5647.7	5547.9	178.4	57.6	0.9	73.6	1.2	5,516.5	5,547.1	176.0	1.2	0.9	5.7	2.2	7.5	No	Yes	0.0	3.5	7.5	5,054.8	5,544.5	167.4
2017	Aug	5054.8	5544.5	167.4	6.1	5.5	0.0	0.0	Yes	Yes	7.4	1.5	8.9	3.6	0.0	Yes	Yes	14.3	15.9	0.0	0.0	5054.8	5544.5	167.4	54.1	0.9	55.2	0.9	4,945.5	5,543.8	165.4	1.0	0.9	7.2	3.7	1.4	No	Yes	0.0	3.5	1.4	4,857.7	5,543.3	163.6
2017	Sep	4857.7	5543.3	163.6	8.9	4.3	0.0	0.0	Yes	Yes	10.9	2.2	13.1	2.9	0.0	Yes	Yes	14.4	19.7	0.0	0.0	4857.7	5543.3	163.6	51.1	0.9	44.0	0.7	4,762.5	5,542.7	161.7	1.5	0.9	12.5	4.0	0.0	Yes	Yes	0.0	8.5	0.0	4,762.5	5,542.7	161.7
2017	Oct	4762.5	5542.7	161.7	9.3	0.0	0.0	0.0	Yes	Yes	11.4	2.3	13.7	0.0	0.0	Yes	Yes	14.4	20.6	0.0	0.0	4762.5	5542.7	161.7	52.2	0.8	24.1	0.4	4,686.2	5,542.2	160.2	1.5	0.8	16.1	0.0	0.0	Yes	Yes	0.0	16.1	0.0	4,686.2	5,542.2	160.2
2017	Nov	4686.2	5542.2	160.2	9.9	0.0	0.0	0.0	Yes	Yes	12.1	2.4	14.5	0.0	0.0	Yes	Yes	14.5	22.6	14.5	11.0	5342.7	5546.2	172.7	54.0	0.9	2.6	0.0	5,286.1	5,545.8	171.7	1.6	0.9	6.0	0.0	0.0	Yes	Yes	0.0	6.0	0.0	5,286.1	5,545.8	171.7
2017	Dec	5286.1	5545.8	171.7	11.2	0.0	0.0	0.0	Yes	Yes	13.8	2.8	16.6	0.0	0.0	Yes	Yes	14.1	12.1	12.1	12.1	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	1.8	1.0	7.3	0.0	0.0	Yes	Yes	0.0	7.3	0.0	5,971.7	5,549.7	185.3
2018	Jan	5971.7	5549.7	185.3	12.1	0.0	0.0	0.0	Yes	Yes	14.8	3.0	17.8	0.0	0.0	Yes	Yes	13.7	1.0	1.0	1.0	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.0	1.0	19.8	0.0	0.0	Yes	Yes	0.0	19.8	0.0	5,971.7	5,549.7	185.3
2018	Feb	5971.7	5549.7	185.3	16.1	0.0	0.0	0.0	Yes	Yes	19.8	4.0	23.8	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	2.7	1.0	26.3	0.0	0.0	Yes	Yes	0.0	26.3	0.0	5,977.6	5,549.7	185.4
2018	Mar	5977.6	5549.7	185.4	10.1	0.0	0.0	0.0	Yes	Yes	12.4	2.5	14.9	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	1.7	1.0	16.6	0.0	0.0	Yes	Yes	0.0	16.6	0.0	5,960.7	5,549.6	185.1
2018	Apr	5960.7	5549.6	185.1	7.4	0.0	0.0	0.0	Yes	Yes	9.1	1.8	11.0	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	1.2	1.0	12.0	0.0	0.0	Yes	Yes	0.0	12.0	0.0	5,934.3	5,549.5	184.5
2018	May	5934.3	5549.5	184.5	4.7	4.7	0.0	0.0	No	No	5.8	1.2	7.0	3.5	1.6	No	Yes	13.7	1.6	1.6	0.0	5934.3	5549.5	184.5	59.6	1.0	66.3	1.1	5,808.5	5,548.8	181.8	0.8	1.0	5.2	1.7	5.4	No	Yes	0.0	3.5	7.0	5,377.5	5,546.4	173.4
2018	Jun	5377.5	5546.4	173.4	6.0	6.0	0.0	0.0	No	No	7.3	1.5	8.8	5.1	0.0	Yes	Yes	14.1	11.0	0.0	0.0	5377.5	5546.4	173.4	54.2	0.9	71.5	1.2	5,251.9	5,545.6	171.0	1.0	0.9	5.6	2.1	5.1	No	Yes	0.0	3.5	5.1	4,948.5	5,543.8	165.4
2018	Jul	4948.5	5543.8	165.4	4.6	4.6	0.0	0.0	No	No	5.6	1.1	6.7	3.2	3.6	No	Yes	14.3	17.6	0.0	0.0	4948.5	5543.8	165.4	53.4	0.9	68.2	1.1	4,826.8	5,543.1	163.0	0.8	0.9	5.1	1.6	8.0	No	Yes	0.0	3.5	11.6	4,110.6	5,538.5	147.2
2018	Aug	4110.6	5538.5	147.2	4.4	4.4	0.0	0.0	No	No	5.4	1.1	6.4	2.9	0.7	No	Yes	14.9	31.2	0.0	0.0	4110.6	5538.5	147.2	47.5	0.8	48.6	0.8	4,014.4	5,537.8	145.1	0.7	0.8	5.0	1.5	3.6	No	Yes	0.0	3.5	4.3	3,749.4	5,535.9	139.0
2018	Sep	3749.4	5535.9	139.0	7.7	4.3	0.0	0.0	Yes	Yes	9.5	1.9	11.4	2.9	0.0	Yes	Yes	15.2	38.4	0.0	0.0	3749.4	5535.9	139.0	43.4	0.7	37.4	0.6	3,668.6	5,535.3	137.2	1.3	0.7	10.5	4.0	0.0	Yes	Yes	0.0	6.4	0.0	3,668.6	5,535.3	137.2
2018	Oct	3668.6	5535.3	137.2	9.9	0.0	0.0	0.0	Yes	Yes	12.1	2.4	14.5	0.0	0.0	Yes	Yes	15.2	38.4	0.0	0.0	3668.6	5535.3	137.2	44.3	0.7	20.5	0.3	3,603.8	5,534.9	135.8	1.6	0.7	16.9	0.0	0.0	Yes	Yes	0.0	16.9	0.0	3,603.8	5,534.9	135.8
2018	Nov	3603.8	5534.9	135.8	11.2	0.0	0.0	0.0	Yes	Yes	13.7	2.8	16.5	0.0	0.0	Yes	Yes	15.3	40.8	15.3	13.0	4374.6	5540.2	153.2	47.9	0.8	2.3	0.0	4,324.4	5,539.9	152.1	1.8	0.8	6.1	0.0	0.0	Yes	Yes	0.0	6.1	0.0	4,324.4	5,539.9	152.1
2018	Dec	4324.4	5539.9	152.1	12.9	0.0	0.0	0.0	Yes	Yes	15.8	3.2	19.0	0.0	0.0	Yes	Yes	14.7	27.8	14.7	14.7	5231.0	5545.5	170.6	55.1	0.9	0.0	0.0	5,175.9	5,545.2	169.6	2.1	0.9	7.2	0.0	0.0	Yes	Yes	0.0	7.2	0.0	5,175.9	5,545.2	169.6
2019	Jan	5175.9	5545.2	169.6	12.5	0.0	0.0	0.0	Yes	Yes	15.3	3.1	18.4	0.0	0.0	Yes	Yes	14.2	13.9	13.9	13.9	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.1	1.0	7.5	0.0	0.0	Yes	Yes	0.0	7.5	0.0	5,971.7	5,549.7	185.3
2019	Feb	5971.7	5549.7	185.3	28.7	0.0	0.0	0.0	Yes	Yes	35.2	7.1	42.3	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	4.7	1.0	46.9	0.0	0.0	Yes	Yes	0.0	46.9	0.0	5,977.6	5,549.7	185.4
2019	Mar	5977.6	5549.7	185.4	43.7	0.0	0.0	0.0	Yes	Yes	53.7	10.8	64.5	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	7.2	1.0	71.8	0.0	0.0	Yes	Yes	0.0	71.8	0.0	5,960.7	5,549.6	185.1
2019	Apr	5960.7	5549.6	185.1	27.4	0.0	0.0	0.0	Yes	Yes	33.7	6.8	40.5	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	4.5	1.0	44.8	0.0	0.0	Yes	Yes	0.0	44.8	0.0	5,934.3	5,549.5	184.5
2019	May	5934.3	5549.5	184.5	18.6	7.7	0.0	0.0	Yes	Yes	22.8	4.6	27.4	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	3.1	1.0	24.8	7.1	0.0	Yes	Yes	0.0	17.6	0.0	5,904.7	5,549.3	183.9
2019	Jun	5904.7	5549.3	183.9	10.9	7.7	0.0	0.0	Yes	Yes	13.4	2.7	16.1	5.1	0.0	Yes	Yes	13.7	2.1	0.0	0.0	5904.7	5549.3	183.9	57.5	1.0	75.9	1.3	5,771.4	5,548.6	181.0	1.8	1.0	13.8	7.2	0.0	Yes	Yes	0.0	6.6	0.0	5,771.4	5,548.6	181.0
2019	Jul	5771.4	5548.6	181.0	8.6	8.6	0.0	0.0	No	No	10.5	2.1	12.6	6.8	0.0	Yes	Yes	13.8	4.2	0.0	0.0	5771.4	5548.6	181.0	58.5	1.0	74.7	1.2	5,638.3	5,547.8	178.3	1.4	1.0	8.1	4.6	5.0	No	Yes	0.0	3.5	5.0	5,328.5	5,546.1	172.4
2019	Aug	5328.5	5546.1	172.4	8.0	5.5	0.0	0.0	Yes	Yes	9.8	2.0	11.8	3.6	0.0	Yes	Yes	14.1	11.4	0.0	0.0	5328.5	5546.1	172.4	55.7	0.9	56.9	0.9	5,215.9	5,545.4	170.4	1.3	0.9	10.4	5.1	0.0	Yes	Yes	0.0	5.3	0.0	5,215.9	5,545.4	170.4
2019	Sep	5215.9	5545.4	170.4	10.4	4.3	0.0	0.0	Yes	Yes	12.8	2.6	15.4	2.9	0.0	Yes	Yes	14.2	13.7	0.0	0.0	5215.9	5545.4	170.4	53.2	0.9	45.9	0.8	5,116.8	5,544.8	168.6	1.7	0.9	15.1	4.0	0.0	Yes	Yes	0.0	11.1	0.0	5,116.8	5,544.8	168.6
2019	Oct	5116.8	5544.8	168.6	14.0	0.0	0.0	0.0	Yes	Yes	17.2	3.5	20.7	0.0	0.0	Yes	Yes	14.2	14.9	0.0	0.0	5116.8	5544.8	168.6	54.4	0.9	25.1	0.4	5,037.2	5,544.4	167.1	2.3	0.9	23.8	0.0	0.0	Yes	Yes	0.0	23.8	0.0	5,037.2	5,544.4	167.1
2019	Nov	5037.2	5544.4	167.1	17.3	0.0	0.0	0.0	Yes	Yes	21.2	4.3	25.5	0.0	0.0	Yes	Yes	14.3	16.7	14.3	14.3	5886.3	5549.2	183.5	57.3	1.0	2.8	0.0	5,826.2	5,548.9	182.2	2.8	1.0	15.0	0.0	0.0	Yes	Yes	0.0	15.0	0.0	5,826.2	5,548.9	182.2
2019	Dec	5826.2	5548.9	182.2	15.9	0.0	0.0	0.0	Yes	Yes	19.5	3.9	23.4	0.0	0.0	Yes	Yes	13.8	3.3	3.3	3.3	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.6	1.0	23.7	0.0	0.0	Yes	Yes	0.0	23.7	0.0	5,971.7	5,549.7	185.3
2020	Jan	5971.7	5549.7	185.3	16.0	0.0	0.0	0.0	Yes	Yes	19.6	3.9	23.5	0.0	0.0	Yes	Yes	13.7	1.0	1.0	1.0	6032.0	5550.0	186.6	60.3	1.0	0.0	0.0	5,971.7	5,549.7	185.3	2.6	1.0	26.2	0.0	0.0	Yes	Yes	0.0	26.2	0.0	5,971.7	5,549.7	185.3
2020	Feb	5971.7	5549.7	185.3	19.5	0.0	0.0	0.0	Yes	Yes	24.0	4.8	28.8	0.0	0.0	Yes	Yes	13.7	1.1	1.1	1.1	6032.0	5550.0	186.6	54.4	1.0	0.0	0.0	5,977.6	5,549.7	185.4	3.2	1.0	31.9	0.0	0.0	Yes	Yes	0.0	31.9	0.0	5,977.6	5,549.7	185.4
2020	Mar	5977.6	5549.7	185.4	17.1	0.0	0.0	0.0	Yes	Yes	21.0	4.2	25.2	0.0	0.0	Yes	Yes	13.7	0.9	0.9	0.9	6032.0	5550.0	186.6	60.3	1.0	11.0	0.2	5,960.7	5,549.6	185.1	2.8	1.0	28.1	0.0	0.0	Yes	Yes	0.0	28.1	0.0	5,960.7	5,549.6	185.1
2020	Apr	5960.7	5549.6	185.1	11.3	0.0	0.0	0.0	Yes	Yes	13.9	2.8	16.7	0.0	0.0	Yes	Yes	13.7	1.2	1.2	1.2	6032.0	5550.0	186.6	58.3	1.0	39.3	0.7	5,934.3	5,549.5	184.5	1.9	1.0	18.3	0.0	0.0	Yes	Yes	0.0	18.3	0.0	5,934.3	5,549.5	184.5
2020	May	5934.3	5549.5	184.5	8.0	7.7	0.0	0.0	Yes	Yes	9.9	2.0	11.8	5.1	0.0	Yes	Yes	13.7	1.6	1.6	1.6	6032.0	5550.0	186.6	60.3	1.0	67.0	1.1	5,904.7	5,549.3	183.9	1.3	1.0	7.5	4.0	3.2	No	Yes	0.0	3.5	3.2	5,710.1	5,548.2	179.7
2020	Jun	5710.1	5548.2	179.7	6.1	6.1	0.0	0.0	No	No	7.5	1.5	9.0	5.1	0.0	Yes	Yes	13.9	5.4	0.0	0.0	5710.1	5548.2	179.7	56.2	0.9	74.1	1.2	5,579.8	5,547.5	177.2	1.0	0.9	5.9	2.4	4.8	No	Yes	0.0	3.5	4.8	5,292.7	5,545.9	171.8
2020	Jul	5292.7	5545.9	171.8	5.3	5.3	0.0	0.0	No	No	6.5	1.3	7.8	4.3	2.6	No	Yes	14.1	12.0	0.0	0.0	5292.7	5545.9	171.8	55.5	0.9	70.9	1.2	5,166.4	5,545.1	169.5	0.9	0.9	5.3	1.8	7.9	No	Yes	0.0	3.5	10.5	4,523.6	5,541.2	156.6
2020	Aug	4523.6	5541.2	156.6	5.8	5.5	0.0	0.0	Yes	Yes	7.2	1.4	8.6	3.6	0.0	Yes	Yes	14.6	24.5	0.0	0.0	4523.6	5541.2	156.6	50.6	0.8	51.7	0.8	4,421.3	5,540.5	154.3	1.0	0.8	6.8	3.3	1.9	No	Yes	0.0	3.5	1.9	4,307.1	5,539.8	151.7
2020	Sep	4307.1	5539.8	151.7	8.0	4.3	0.0	0.0	Yes	Yes	9.8	2.0	11.8	2.9	0.0	Yes	Yes	14.8	29.0	0.0	0.0	4307.1	5539.8	151.7	47.4	0.8	40.8	0.7	4,218.9	5,539.2	149.7	1.3	0.8	11.0	4.0	0.0	Yes	Yes	0.0	7.0	0.0	4,218.9	5,539.2	149.7
2020	Oct	4218.9	5539.2	149.7	11.7	0.0	0.0	0.0	Yes	Yes	14.4	2.9	17.3	0.0	0.0	Yes	Yes	14.8	29.5	0.0	0.0	4218.9	5539.2	149.7	48.3	0.8	22.3	0.4	4,148.2	5,538.7	148.1	1.9	0.8	20.0	0.0	0.0	Yes	Yes	0.0	20.0	0.0	4,148.2	5,538.7	148.1
2020	Nov	4148.2	5538.7	148.1	13.1	0.0	0.0	0.0	Yes	Yes	16.1	3.2	19.3	0.0	0.0	Yes	Yes	14.9	31.7	14.9	14.9	5033.1	5544.3	167.0	52.2	0.9	2.5	0.0	4,978.4	5,544.0	166.0	2.2	0.9	7.5	0.0	0.0	Yes	Yes	0.0	7.5	0.0	4,978.4	5,544.0	166.0
2020	Dec	4978.4	5544.0	166.0	4.1	0.0	0.0	0.0	Yes	Yes	5.0	1.0	6.0	0.0	0.0	Yes	Yes	14.3	17.1	14.3	2.5	5132.4	5544.9	168.8	54.5	0.9	0.0	0.0	5,077.9	5,544.6	167.8	0.7	0.9	5.1	0.0	0.0	Yes	Yes	0.0	5.1	0.0	5,077.9	5,544.6	167.8

AQUATIC RESOURCE DELINEATION REPORT

Cove–East Fork Virgin River Watershed Project

March 2026

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Prepared For:

United States Department of Agriculture
Natural Resources Conservation Service

Kane County Water Conservancy District

Washington County Water Conservancy District

EXECUTIVE SUMMARY

An aquatic resource delineation study has been conducted for the Cove–East Fork Virgin River Watershed Project in accordance with the 1987 U.S. Army Corps of Engineers (USACE) Wetland Delineation Manual and Regional Supplement to the USACE Wetland Delineation Manual: Arid West Region (USACE 2008).

Within the approximately 719.2-acre survey area, a total of 22 aquatic features were identified, comprising of two isolated, manmade wetlands (0.76-acre total), 17 stream and/or riverine features (4.7187 acres/12,784 linear feet) and three seasonal ponds. The total area of aquatic resources within the survey area amounts to 5.35 acres. Out of the 17 stream and riverine features identified, five were ephemeral, four were intermittent, and eight were perennial, including three sections of the East Fork of the Virgin River. The overall condition of the aquatic features varies; several streams exhibited clear Ordinary High-Water Marks (OHWMs), with some segments showing evidence of recent flows while others lacked surficial connectivity due to anthropogenic alterations. The two wetlands identified were manmade and isolated and, per prior consultation with USACE, are not considered jurisdictional under Section 404 of the Clean Water Act (CWA). It is anticipated that total temporary disturbance would be limited to approximately 0.253 acre and the total permanent disturbance would be limited to 0.021 acre within the OHWM of potentially jurisdictional streams.

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ACRONYMS

asl	above sea level
BMP	Best Management Practice
CWA	Clean Water Act
DBH	diameter at breast height
EFVR	East Fork Virgin River
FAC	facultative
FACU	facultative upland
FACW	facultative wetland
KCWCD	Kane County Water Conservancy District
MP	milepost
NRCS	Natural Resources Conservation Service
NWI	National Wetland Inventory
OHWM	Ordinary High-Water Mark
OBL	obligate
ROW	right-of-way
UPL	upland
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
WCWCD	Washington County Water Conservancy District
Wetland 1	W1
Wetland 2	W2
WOTUS	Waters of the United States

CHAPTER 1 INTRODUCTION

1.1 Contact Information

The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), with assistance from the Kane County Water Conservancy District (KCWCD) and Washington County Water Conservancy District (WCWCD), as the project co-sponsors, are considering proposed improvements within the East Fork Virgin River (EFVR) Watershed. Alpha Engineering Company contracted Eocene Environmental Group, Inc. (Eocene) to analyze the proposed project for potential impacts to wetlands and potentially jurisdictional Waters of the United States (WOTUS).

Table 1: Project Contact Information

Role	Company	Name	Address	Phone Number
Project Sponsor	KCWCD	Mike Noel	725 East Kaneplex Drive Kanab, Utah 84741	(435) 616-5603
Project Sponsor	WCWCD	George Elliott	533 East Waterworks Drive St. George, Utah 84770	(435) 922-8118
Lead Federal Agency	NRCS	Anders Fillerup	125 State Street #4010 Salt Lake City, Utah 84138	(385) 245-7709
Engineering Consultant	Alpha Engineering Company	Glen Carnahan	43 South 100 East Suite 100 St. George, Utah 84770	(435) 628-6500
Environmental Consultant	Eocene Environmental Group, Inc.	Emily Paris	1745 South Alma School Road #220 Mesa, Arizona 85210	(775) 296-0819

1.2 Survey Area Description

The survey area is an approximately 719.2-acre polygon surrounding all areas where ground or surface disturbance would occur from project implementation. The survey area is larger than the area of disturbance to account for changes to project details, and therefore, not all identified aquatic features would be impacted. Current proposed improvements being considered include the construction of a new, approximately 6,055-acre-foot capacity reservoir (Cove Reservoir) with principal and auxiliary spillways; the replacement of an approximately 1.7-mile section of existing pipeline in the Glendale irrigation system; addition of earthen and rock fill dam and a 3.2-mile access road; installing approximately 4.5 miles of new pipeline in the Mt. Carmel area; and the creation of a 4.1-acre outdoor recreation area with a boat ramp, picnic facilities, a pavilion, restrooms, overnight and primitive camping sites, and recreation vehicle sites. The proposed project also includes the use of three existing borrow pits (Tait, Lamb, and Esplin) for construction material (e.g., rip rap, gravel, etc.). The total area of disturbance is approximately 375.1 acres. See **Appendix B** for figures of the project.

1.3 Purpose

The purpose of this report is to identify and describe aquatic resources. This report facilitates efforts to do the following:

1. Avoid or minimize impacts to aquatic resources during the design process.

2. Document aquatic resource boundary determinations for review by regulatory authorities.

3. Provide early indications of known sensitive species and historic/cultural properties within the survey area.

4. Provide background information.

The purpose of the proposed project is to enhance the efficiency and reliability of the current agricultural water management in Long Valley, part of the EFVR sub-watershed, while complying with the Zion National Park Water Rights Settlement Agreement of 1996 (United States, Utah, Washington District, & Kane District, 1996). Effective irrigation systems and water management strategies would support farm profitability amid constraints posed by scarce and costly water resources.

The secondary purposes of the proposed project are public recreation and to increase irrigation and Municipal & Industrial water supply to communities in Washington County. The water demand in the WCWCD service area is projected to increase as summer agricultural water shortages continue, and more municipal water providers join and receive water from the WCWCD system.

CHAPTER 2 LOCATION

The proposed project is located adjacent to US-89 and the EFVR near Mt. Carmel, Glendale, and Orderville, in Kane County, Utah, located within Township 40 South, Range 7 West, Sections 23, 26, and 27; Township 41 South, Range 7 West, Sections 5, 6, 8, 9, 17, 18, and 19; and Township 40 South, Range 6 West, Section 35 of the Salt Lake Baseline and Meridian on the Orderville, Glendale, and Mt. Carmel, Utah, 7.5-minute U.S. Geological Survey topographic quadrangles. Please see the **Vicinity Map** in **Appendix B**. Project features would be installed on Utah School and Institutional Trust Lands Administration and private lands as shown on the **Land Ownership Map** in **Appendix B**.

The Tait and Lamb pits are located east of US-89 on private land, and the Esplin pit is located along County Road 3000 approximately 3 miles east of Glendale. The proposed Cove Reservoir area can be accessed from Cove Road off US-89 between milepost (MP) 84.9 and MP 85, and the Glendale Pipeline can be accessed via multiple private roads west of US-89 between MP 87.9 and MP 89.4. The Mt. Carmel Irrigation Improvement Area can be accessed at various locations adjacent to either side of US-89 between MPs 84.5 and 82.5. The Lamb borrow pit is accessed east of US-89 from a dirt road at MP 81.4. The Tait borrow pit can be accessed via Tait Lane, east of Mt. Carmel and US-89. Access to the Esplin Pit can be made by traveling eastbound on County Road 3000 for approximately 3 miles and stopping just northwest of the split in the road where County Road 3035 is located. Access to Glendale Bench Road is located east of US-89 at MP 90. Access to all aquatic features is located on land under the jurisdiction of the Bureau of Land Management Kanab Field Office, Utah School and Institutional Trust Lands Administration, or private ownership.

CHAPTER 3 METHODS

3.1 Delineation Survey Methods

A focused evaluation of potentially jurisdictional WOTUS and any other aquatic features (including wetlands) located within the survey area was performed between October 8, 2018, and October 10, 2018, and follow-up field visits to evaluate additional borrow pits were conducted on April 24, 2019, and September 20, 2019. A survey of the Mt. Carmel Irrigation Improvement Area was conducted on October 24, 2021.

The methods used to delineate potentially jurisdictional WOTUS and locate any other aquatic features (including wetlands) within the survey area were based on the best available resources at the time of survey, including the USACE **Jurisdictional Determination Form Instructional Guidebook** (USACE 2007), **A Field Guide to the Identification of the Ordinary High Water Mark in the Arid West Region of the Western United States** (Lichvar and McColley 2008), USACE **Wetland Delineation Manual** (USACE 1987), and the **Interim Regional Supplement to the USACE Wetland Delineation Manual: Arid West Region**.

Additionally, this report considers rulemaking as of the revision date (2025), which includes the revised definition of WOTUS as of March 12, 2025 (33 Code of Federal Regulations [CFR] Part 328), considering the Supreme Court's 2023 decision in **Sackett v. Environmental Protection Agency.**

Eocene used two methods to identify wetlands and waters:

1. Locations with previously mapped wetlands and waters were identified in the field and investigated.

2. The survey area was traversed and inspected for signs of wetlands and waters (e.g., changes in vegetation, depression holding water, or channels) and investigated.

Ordinary High-Water Mark (OHWM) data was collected for 15 stream and riverine features within the survey area. Eocene's Aquatic Resource Specialist observed two wetlands; therefore, two wetland delineations were performed. OHWM and photo locations are indicated on the **Aquatic Resource Delineation Map** in **Appendix A**. The data sheets used to collect wetland and OHWM data can be found in **Appendices D and E.** Methods for evaluating the presence of wetlands and other waters employed during the routine determination are described in detail below.

3.1.1 Existing Data

Existing data were reviewed before conducting a field assessment. Information reviewed included the following:

- Recent aerial photography
- U.S. Fish and Wildlife Service (USFWS) National Water Inventory (NWI) (USFWS 2021)
- USDA–NRCS soil maps (NRCS 2022)

3.1.2 Definitions

The survey area was evaluated for the presence or absence of indicators of the three wetland parameters described in the USACE **Manual** (USACE 1987) and the **Arid West Regional Supplement** (USACE 2008): 1) hydrophytic vegetation, 2) wetland hydrology, and 3) hydric soils.

Section 328.3 of the Federal CFR defines wetlands as follows:

> **Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.**

According to the USACE **Manual**, for areas not considered "problem areas" or "atypical situations," the following applies:

> **…evidence of a minimum of one positive wetland indicator from each parameter (hydrology, soil, and vegetation) must be found in order to make a positive wetland determination.**

Data on vegetation, hydrology, and soils collected at sample points during the site visit was reported on a Wetland Determination Data Form–Arid West Region forms (**Appendix D**). Once an area was determined to be a potential jurisdictional wetland, its boundaries were delineated using GPS and mapped on a topographic aerial map. Indicators described in the Arid West Regional Supplement were used to make wetland determinations at each sample point in the survey area and are summarized below.

Vegetation

This report discusses botanical species with both their scientific and common names. Plant species identified within the survey area were assigned a wetland status according to the USACE National Wetland Plant List (USACE, 2023). This wetland classification system is based on the expected frequency of species occurrence in wetlands, identified in **Table 2**.

Table 2: Wetland Indicator Status Ratings Used in the National Wetland Plant List

Wetland Indicator Status Rating	Definition
Obligate (OBL)	Almost always occur in wetlands
Facultative Wetland (FACW)	Usually occur in wetlands, but may occur in non-wetlands
Facultative (FAC)	Occur in wetlands and non-wetlands
Facultative Upland (FACU)	Usually occur in non-wetlands, but may occur in wetlands
Upland (UPL)	Almost never occurs in wetlands

The **Arid West Regional Supplement** requires a three-step process to determine if hydrophytic vegetation is present. The procedure first requires the delineator to apply the 50/20 Rule (Indicator 1) described in the manual. To apply the 50/20 Rule, dominant species are chosen independently from each stratum of the community including four strata: tree, sapling/shrub, herbaceous, and woody vine[1]. In general, dominant species are determined for each vegetation stratum from a sampling plot of an appropriate size surrounding the sample point. Dominant species are generally the most abundant species that individually or collectively account for more than 50 percent of total vegetative cover in the stratum, plus any other species that, by itself, accounts for at least 20 percent of the total cover. If greater than 50 percent of the dominant species have an OBL, FACW, or FAC status, the sample point meets the hydrophytic vegetation criterion.

If the sample point fails the application of Indicator 1, and both hydric soil and wetland hydrology are absent, then the sample point does not meet the hydrophytic vegetation criterion unless the site is a problematic wetland situation. However, if the sample point fails Indicator 1 but hydric soils and wetland hydrology are both present, the delineator must apply Indicator 2.

Indicator 2 is the Prevalence Index, which is a weighted average of the wetland indicator status for all plant species within the sampling plot. Each indicator status is given a numeric code: OBL=1, FACW=2, FAC=3, FACU=4, and UPL=5. Application of Indicator 2 requires the delineator to estimate the percent cover of each species in every stratum of the community and sum the cover estimates for any species that are present in more than one stratum. The delineator must then organize all species into groups according to their wetland indicator status and calculate the Prevalence Index using the following formula, where "A" equals total percent cover.

$$PI = \frac{A_{OBL} + 2A_{FACW} + 3A_{FAC} + 4A_{FACU} + 5A_{UPL}}{A_{OBL} + A_{FACW} + A_{FAC} + A_{FACU} + A_{UPL}}$$

The Prevalence Index will yield a number between one and five. If the Prevalence Index is equal to or less than three, the sample point meets the hydrophytic vegetation criterion. However, if the community is greater than three, the delineator must proceed to Indicator 3.

Application of Indicator 3 assesses the presence of morphological adaptations. If more than 50 percent of the individuals of a FACU species have morphological adaptations for life in wetlands, that species is considered to be a hydrophyte, and its indicator status should be reassigned to FAC. If such observations are made, the delineator must recalculate Indicators 1 and 2 using a FAC indicator status for this species. The sample point meets the hydrophytic vegetation criterion if either test is satisfied.

This three-step process was utilized to determine if sample points within the survey area met the hydrophytic vegetation criterion.

[1] The tree stratum includes woody plants, excluding woody vines, approximately 20 feet or more in height and 3 inches or larger in diameter at breast height (DBH). The sapling/shrub stratum includes woody plants, excluding woody vines, less than 3 inches DBH, regardless of height. The herb stratum includes all herbaceous (non-woody) plants, including herbaceous vines regardless of size and woody plants, except woody vines, less than approximately 3 feet in height. The woody vine stratum includes all woody vines regardless of height (USACE 2008).

Hydrology

At the time of the field surveys, the USACE jurisdictional wetland hydrology criterion was satisfied if an area is inundated or saturated long enough to create anoxic soil conditions during the growing season (i.e., a minimum of 14 days in the Arid West Region). Evidence of wetland hydrology can include primary indicators, such as visible inundation or saturation, drift deposits, oxidized root channels, salt crusts; or secondary indicators such as the FAC-neutral test, the presence of a shallow aquitard, or frost-heave hummocks. The Arid West Regional Supplement contains 18 primary hydrology indicators and nine secondary hydrology indicators (USACE 2008). Only one primary indicator is required to meet the wetland hydrology criterion. If secondary indicators are used, at least two secondary indicators must be present to conclude that an area has wetland hydrology.

The presence or absence of the primary or secondary indicators described in the Arid West Regional Supplement was utilized to determine if sample points within the delineation survey area met the wetland hydrology criteria.

Hydric Soils

The NRCS (Vasilas et al. 2010) defines hydric soil as follows:

> **A hydric soil is a soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part.**

Soils formed over long periods of time under wetland (anaerobic) conditions often possess characteristics that indicate they meet the definition of hydric soils. Hydric soils can have a hydrogen sulfide odor (i.e., rotten egg), low chroma matrix color (designated 0, 1, or 2), presence of redox concentrations, gleyed or depleted matrix, or high organic matter content.

Specific indicators that can be used to determine whether a soil is hydric for the purpose of wetland delineation are provided in the NRCS **Field Indicators of Hydric Soils in the United States** (Vasilas et al. 2010). The **Arid West Regional Supplement** provides a list of 19 hydric soil indicators that are known to occur in the Arid West Region (USACE 2008). Where possible, soil samples were collected and described according to the methodology provided in the **Arid West Regional Supplement**. Soil chroma and values were determined by utilizing a standard Munsell soil chart (Munsell 2009).

Hydric soils were determined to be present if any of the soil samples met one or more of the 19 hydric soil indicators described in the 2008 **Arid West Regional Supplement**.

3.1.3 Other Waters of the United States

Identification of the OHWM followed the USACE Regulatory Guidance Letter Number 05-05, OHWM Identification (USACE 2005). The extent of the OHWM was determined using a combination of aerial imagery and field assessment. OHWM data gathered in the field was identified by a break between upland and aquatic characteristics, as identified in the 2008 **Arid West Regional Supplement**. Topographic information from ArcGIS software Esri ArcMap 10.4.1 was used to extend the break throughout the entire feature.

Channel lengths approximated the centerline of main channel flow. Widths and depths were measured from cross-channel measurements conducted in the field, general field observations, and post-field calculations. Delineation of the OHWM of all washes was conducted using handheld sub-meter GPS, in combination with available aerial imagery, to provide an accurate representation of the OHWM at the time of survey. All OHWM data collected at sample points during the site visit were recorded on Arid West Ephemeral and Intermittent Streams OHWM Datasheets (**Appendix E**).

CHAPTER 4 EXISTING CONDITIONS

4.1 Landscape Setting

In October 2018, Eocene conducted an initial aquatic resource impact assessment within the survey area (defined in Chapter 1.1) to identify potential impacts to wetlands and other potentially jurisdictional WOTUS, pursuant to Section 404 of the CWA. Supplementary visits were also conducted on April 24, 2019, September 20, 2019, and October 24, 2021. The survey area for the proposed project is approximately 719.2 acres in size.

Field surveys occurred in October 2018, April and September 2019, and October 2021. October conditions followed a major rainfall event, with saturated soil and debris deposits observed. The timing reflects both post-monsoon and early fall conditions, providing insight into both dry and wet hydrologic states. Surveyors noted some artificial irrigation infrastructure and evidence of historical sheet flow and ponding.

The entire 719.2-acre survey area was field verified except for extremely steep or unstable sections where direct access posed safety risks. These areas (upper reaches of canyons) were observed visually from above. Borrow pits and pipeline alignments were also physically assessed. Unmapped or removed aquatic features were investigated and dismissed based on field conditions.

4.1.1 Topography

The topography of the region is characterized by steep slopes, cliff faces, and various rock formations, and is situated in a distinctive geological area surrounded by the Coral Pink Sand Dunes State Park to the south, Zion National Park to the west, Cedar Breaks National Monument to the northwest, the Grand Staircase-Escalante National Monument to the east, and Bryce Canyon National Park to the northeast. Most of the proposed project extends along the Sevier Fault; Triassic and Jurassic rock formations are exposed in the region across the anticline, including the Glen Canyon Group of Moenave Formation, Kayenta Formation, and Navajo Sandstone. There are also Cretaceous rock formations west of the Sevier Fault in the survey area, including the Wahweap and Straight Cliffs formations, Dakota Sandstone and Cedar Mountain Formation, and the Jurassic Carmel Formation. Elevations in the survey area range from 5,230 feet above sea level (asl) near Lamb pit to approximately 6,300 feet asl in the vicinity of the Esplin borrow pit.

4.1.2 Geological Features

The survey area is located within the Grand Staircase subdivision of the Colorado Plateau physiographic region of southwestern Utah, immediately south of the Basin and Range–Colorado Plateau Transition Zone (Woods et al. 2001). The Grand Staircase subdivision is characterized by a series of slopes, cliffs, and terraces that extend from the Grand Canyon in Arizona, culminating in the High Plateaus of southern Utah. This region is further characterized by many unique linear cliffs that are distinctly colored and display several different geologic ages. Major drainage systems in the survey area include the EFVR and Muddy Creek as well as numerous unnamed intermittent and ephemeral streams, springs, and dry washes.

4.1.3 Major Water Bodies

The general location of potential wetlands and potentially jurisdictional WOTUS was identified using NWI data provided by the USFWS (USFWS 2022). **Table 3** lists the feature types that intersect with the survey area as reported by the NWI. Features shown to intersect the survey area include 16 intermittent stream systems and one wetland approximately 60 feet from the survey area.

Table 3: National Wetland Inventory Feature Types Within and Near the Survey Area

NWI Wetland ID	NWI Feature Type	Feature Type NWI*	Mapped Area (Acres)
1	Riverine	R4SBA	3.97
2	Riverine	R4SBA	1.25
3	Riverine	R4SBA	2.31
4	Riverine	R4SBA	1.23
5	Riverine	R4SBC	5.13
6	Riverine	R4SBJ	30.08
7	Riverine (Perennial; EFVR)	R3UBG	5.12
8	Riverine	R5UBFx	0.91
9	Riverine	R5UBFx	0.16
10	Riverine	R4SBJx	0.64
11	Riverine	R4SBC	4.05
12	Riverine	R4SBC	1.98
13	Riverine	R4SBJ	5.76
14	Freshwater Emergent Wetland	PEM1Fx	0.42
15	Riverine	R4SBJ	1.83
16	Riverine	R4SBJ	0.93
17	Riverine	R4SBC	129.15

*Wetlands and Deepwater Habitats Classification (Cowardin et al. 1979). **System––**P: Palustrine; R: Riverine. **Subsystem––**3: Upper Perennial; 4: Intermittent **Class––**AB: Aquatic Bed; EM: Emergent; SB: Streambed; UB: Unconsolidated Bottom; **Subclass––**1: Persistent; **Modifiers––**C: Seasonally Flooded; F: Semi permanently Flooded; G: Intermittently Exposed; J: Intermittently Flooded; **Special Modifiers––**h: Diked/Impounded; x: Excavated

4.1.4 Surface Water Flow

The proposed project is located within the Upper Virgin River Watershed, with the EFVR intersecting the project limits. Within the project limits, the EFVR is considered perennial, and flowing water was observed during field reconnaissance. Water in the EFVR is derived from runoff via rainfall and snowmelt, and from groundwater entering via seeps and springs. The water from snowmelt makes up the largest percentage of streamflow and usually causes the highest monthly flows to occur in March through May while most low-flow periods occur from June through October (Glancy and Van Denburgh 1969). Water collected within or upstream of the Cove Reservoir and Glendale Pipeline components of the survey area eventually drains into the EFVR.

4.1.5 Community Types

Dominant ecological systems in the survey area include inter-mountain basins big sagebrush, Colorado plateau pinyon-juniper woodland, introduced upland vegetation-shrub, shrub land, inter-mountain basins greasewood flat, rocky mountain lower montane riparian woodland and shrub land, Mogollon chaparral, disturbed/successional–shrub regeneration, and pasture/hay (USGS 2018). Species observed within or adjacent to the survey area were characteristic of these ecosystems and included a mix of native and non-native trees, shrubs, forbs, and grasses.

4.1.6 Existing Vegetation

Vegetation found in the survey area consists of greasewood-salt scrub and transitions into sagebrush-perennial grassland habitat and, eventually, into pinyon-juniper woodland in the higher elevations. The proposed project includes the use of three existing borrow pits (Tait, Lamb, and Esplin). The Esplin pit consists of a mix of pinyon juniper woodland and sagebrush communities. The area of the proposed new pipeline is found in proximity to the EFVR, and portions of this section of the project cross though agricultural fields and along a riparian environment with tamarisk (tamarix sp.), Russian olive (Elaeagnus angustifolia), and cottonwood trees (Populus fremontii).

Dominant native vegetation observed within the survey area included two-needle pinyon pine (Pinus edulis), Utah juniper (Juniperus osteosperma), sagebrush (Artemesia tridentata), salt bush (Atriplex confertifolia), greasewood (Sarcobatus vermiculatus), narrowleaf willow (Salix exigua), cattail (Typhus latifolia), blue bunch wheatgrass (Pseudoroegneria spicata), western wheatgrass (Pascopyrum smithii), and bottlebrush squirreltail (Elymus elymoides).

4.1.7 Current Land Use

The survey area associated with the reservoir is primarily utilized for livestock grazing and recreation, including hiking and off-highway vehicle use. East and south of the survey area are

agricultural fields located on privately owned lands. Much of the survey area associated with the Glendale Pipeline replacement is located along an existing access road. North of this alignment are steep, forested hills, while south is mainly agricultural fields and private residences. Portions of the pipeline traverse through some of these agricultural fields.

4.1.9 Soils

USDA–NRCS soil surveys indicate 12 native soil types in the survey area (NRCS 2022). **Table 4** lists the soil types and whether they meet the NRCS hydric soils criteria. No soil types within the survey area are listed as an NRCS hydric soil type. NRCS custom resource reports, including a description and map for all soils contained within the survey area listed below, are in **Appendix B.**

Table 4: Native Soil Types in the Survey Area

Map Unit Name	Acres in Survey Area	Percent of Survey Area	NRCS Hydric Soil
Catdraw family-Orderville-Quezcan family complex, 15- to 35-percent slopes	0.2	0.1	No
Catdraw-Quezcan-Vessilla complex, 35- to 60-percent slopes	6.5	2.0	No
Elpedro-Plumasano-Teromote family-Flatnose complex, 0- to 8-percent slopes	1.7	0.5	No
Naplene-Teromote-Arboles-Oxyaquic Ustifluvents complex, 2- to 8-percent slopes	27.0	8.3	No
Pinepoint-Waumac-Royosa complex, 0- to 4-percent slopes	6.8	2.1	No
Pinepoint-Paria-Parkwash complex, 2- to 8-percent slopes	18.0	5.5	No
Quezcan, deep-Sideshow-Orderville complex, 15- to 35-percent slopes	42.5	13.0	No
Sili-Sideshow-Gypsic Haplustepts complex, 2- to 15-percent slopes	169.0	51.8	No
Tonalea family-Barnac complex, 15- to 65-percent slopes	21.9	6.7	No
Welring-Arabrab-Rock outcrop complex, Carmel Formation, 4- to 35-percent slopes	0.2	0.1	No

Map Unit Name	Acres in Survey Area	Percent of Survey Area	NRCS Hydric Soil
Wetoe family-Flugle-Royosa family-Lava flows complex, 2- to 60-percent slopes	11.9	3.7	No
Zigzag family-Badland-Quezcan complex, 35- to 90-percent slopes	20.5	6.3	No

4.2 Aquatic Resources

4.2.1 Overview

Based on our desktop review and field surveys conducted between October 8, 2018, and October 10, 2018, on April 24, 2019, on September 20, 2019, and on October 24, 2021, it has been determined that that two wetlands, 17 stream or riverine features, and three ponds exist within the approximately 719.2-acre survey area, with 0.20 acre identified as wetlands (**Table 5**) 4.72 acres identified as streams or riverine, and 0.43 acre identified as seasonal ponds (**Table 6**)—totaling 5.35 acres surveyed. Wetland 1 (W1), Wetland 2 (W2), and Streams 1–6, 8–9, and 11 were sampled during the October 2018 visit. Ponds 1 and 3 were also evaluated during these initial visits. Pond 2, Streams 6, 7, 10, and portions of the EFVR were evaluated during the October 2021 visit. All potentially jurisdictional features identified were located within the survey areas associated with the Cove Reservoir, Glendale Pipeline, and the Mt. Carmel Improvement Area portions of the survey area.

Three borrow pits, Esplin (**Appendix A, Sheet 21**), Tait (**Appendix A**, **Sheet 20**), and Lamb (**Appendix A**, **Sheet 19**), were all investigated, and a portion of the EFVR enters the southwest corner of the Lamb pit but not within the disturbance area of the Project (**Appendix A, Sheet 19**). No aquatic features were identified at the Esplin or Tait pits. During our field review, it was also noted that prior anthropogenic disturbances had altered several streams that were identified by the NWI, and these streams no longer exist or no longer exhibit connectivity to other aquatic features downstream. These disturbances included roads, residential developments, and sediment ponds/cattle ponds. Sediment ponds discovered during field surveys were investigated for wetland characteristics; however, none exhibited the required vegetation, hydrology, or soils to be considered wetlands. Representative photos of all potential aquatic resources observed within the survey area are included in **Appendix C**.

Wetlands

W1 is a small, approximately 0.03-acre, artificial pond located approximately 200 feet south of the existing Cove Road, south of the proposed reservoir location (**Appendix A**, **Sheet 7**). Upon field review, W1 was observed to contain a monoculture of cattail (Typha latifolia), a wetland obligate species, and included other hydrophytic vegetation justifying the classification of a wetland (**Appendix C**, **Photo 10**). Investigations of hydrologic and soil conditions resulted in the positive identification of wetland indicators, confirming its status as a wetland, with inundation visible on aerial imagery and abundant redox depressions throughout the soil sample at the site

(**Appendix C**, **Photos 42 to 44**). Underground irrigation hoses were observed around the pond; it appears that it was artificially fed in the past. No outlet or connectivity to other aquatic features was observed, and this appears to be an artificially created isolated wetland feature. The boundaries of the wetland were well defined using the survey methods described in Chapter 3, and surrounding vegetation directly adjacent to W1 consisted of upland dominant species.

W2 is an approximately 0.73-acre, manmade pond located within the right-of-way (ROW) for the Glendale Pipeline portion of the survey area and is adjacent to privately owned agricultural pastures (**Appendix A**, **Sheet 16**). Approximately 0.17 acre of it intersects the survey area. Field review showed the wetland to contain primarily narrowleaf willow (Salix exigua), a facultative wetland species, with a mix of unknown grass species at the herbaceous stratum (**Appendix C**, **Photo 26**). Due to the time of year field surveys were conducted, species identification and thus wetland indicator statuses for these grasses were not attainable. However, because the willow was abundant and noticeably dominant throughout the pond at the sapling/shrub stratum, application of the Dominance Test (more than 50 percent of dominant plant species across all strata are rated OBL, FACW, or FAC) confirmed that hydrophytic vegetation was present. Investigations of the hydrologic and soil conditions also confirmed its status as a wetland, with surface soil cracks present throughout the pond basin and redox depressions throughout the soil sample (**Appendix C**, **Photos 45–46**). No inlet, outlet, or connectivity to other aquatic features was observed, and this appears to be an artificially created isolated wetland feature. Boundaries of the wetland were well defined using the survey methods described in Chapter 3, and surrounding vegetation directly adjacent to W2 consisted of upland dominant species.

Table 5: Delineated Wetland Features

ID	Latitude	Longitude	Wetland Type	Wetland Type NWI*	Acres
W1	37.269568	-112.65711	Isolated Wetland	PABFh	0.03
W2	37.303818	-112.614124	Isolated Wetland	PABFh/PEM1Fh	0.17

*Wetlands and Deepwater Habitats Classification **System––**P: Palustrine; **Class––**AB: Aquatic Bed; EM: Emergent; **Modifiers––**F: Semi permanently Flooded; **Special Modifiers––**h: Diked/Impounded (Cowardin et al. 1979).

Streams or Riverines

Stream 1 is a large ephemeral drainage that bisects the survey area in a southeasterly direction crossing through where the proposed reservoir would be constructed (**Appendix A**, **Sheets 1, 2, 6, and 7**). Sediment and flow carried within this drainage are collected from terrain northwest of the survey area and eventually lead south and out of the survey area, debouching into the EFVR. The northeast portion of Stream 1 within the survey area is situated at the bottom of an approximately 25–30-foot-deep canyon. Here the OHWM was well defined, with large debris and deposition evident of significant flow from the heavy precipitation experienced in the area

days prior to survey. The channel was relatively clear, with some vegetation and sediment consisting of a mix of boulders and clay (**Appendix C**, **Photos 1–7, 11, and 14**). Further downstream, the width of the OHWM and channel characteristics remain the same, and the terrain opens into a large valley. No flowing water was observed although there were numerous areas of pooling and the active floodplain was deeply saturated, making walking the stream difficult to impossible. Stream 1A is a smaller intermittent stream tributary to Stream 1, which carries precipitation and snowmelts directly adjacent and north of the proposed reservoir and access road location (**Appendix A**, **Sheet 6**). This stream has a well-defined channel and deposition at the OHWM (**Appendix C**, **Photos 13 and 14**). No flowing water was observed within this stream at the time of field surveys.

Within the survey area, Stream 1 and Stream 1A encompass approximately 2.71 acres, and their average widths are 12 feet and 3.5 feet respectively.

Stream 2 is an ephemeral drainage that bisects the reservoir portion of the survey area in a southerly direction along the eastern boundary of where the proposed reservoir would be located (**Appendix A**, **Sheets 3 and 7**). Sediment and flow carried within this drainage are collected from terrain northeast of the survey area, leading to the confluence with Stream 1 and eventually to the EFVR downstream (**Appendix C**, **Photo 6**). The upper reaches of Stream 2 are characterized by 50–60-foot-deep slot canyon walls and a narrow channel with some upland vegetation observed growing in the active floodplain and along canyon walls (**Appendix C**, **Photo 18**). Channels were not walked on foot in this area during field surveys because of safety concerns due to the unstable cliff walls; however, the conditions of the channel could be easily viewed from above the edge of the canyon. Downstream, Stream 2 opens up into an open valley landscape where widths of the active floodplain are similar to its upstream segment, but there is more terracing, banks are less steep, and more significant vegetation is present within the channel and floodplain (**Appendix C**, **Photos 19–20**). Stream 2A (**Appendix C**, **Photos 16 and 17**) is a tributary ephemeral drainage that feeds into the upper reach of Stream 2 within the survey area upstream where the proposed reservoir would occur (**Appendix A**, **Sheet 3**). This tributary is formed by sheet flow and runoff north of the survey area that is diverted into a set of two non-functional sediment ponds (**Appendix C**, **Photo 15**) that then spill into an approximately 50-foot canyon and confluence with Stream 2. Saturation was evident throughout Stream 2 and Stream 2A, though no flowing water was observed.

Within the survey area, Stream 2 and Stream 2A encompass approximately 1.37 acres, and their average widths are 17 feet and 24 feet respectively.

Stream 3 and Stream 3A (Stream 3A is tributary to Stream 3) comprise an ephemeral stream system located at the southwest boundary of where the proposed reservoir boundaries are located and run in a generally easterly direction (**Appendix A**, **Sheet 6**). Sediment and flow carried within this small drainage are collected from upland terrain west of the survey area, but the stream does not maintain definition or connectivity downstream. Upstream, Stream 3 and Stream 3A exhibited a clear channel, banks, and a well-defined OHWM (**Appendix C**, **Photos 21 and 23**). Below the confluence of Stream 3 and Stream 3A, this ephemeral stream reaches an existing dirt road downhill where the OHWM is delineated, and all definitions of a channel and OHWM disappear (**Appendix C**, **Photo 22**). Prior to creation of the road, Stream 3 may have had surficial connectivity with Stream 1. Currently flow and sediment carried in the upper reaches of Stream 3 dissipate into sheet flow roughly following the alignment of the road and likely only

reach Stream 1 during heavy or extended precipitation or snowmelt events. No flowing water was observed during field surveys.

Within the survey area, Stream 3 and Stream 3A encompass approximately 0.06 acre, and their average widths are 3 feet and 2 feet respectively.

Stream 4 is an intermittent stream located west of W2 that runs in a southerly direction and bisects the ROW for the Glendale Pipeline portion of the survey area (**Appendix A**, **Sheet 16**). Flow and sediment carried within this stream are collected from mountains directly north of the survey area. The stream had flowing water in its approximately 3-foot-wide channel during the time of surveys and showed evidence of recent heavier flow indicated by downed vegetation and large debris deposition at the OHWM (**Appendix C**, **Photos 27 and 28**). Vegetation surrounding Stream 4 was a mix of upland and riparian species, including cottonwood (Populus spp.), two-needle pinyon pine (Pinus edulis), Utah juniper (Juniperus osteosperma), and oak (Quercus sp.). Stream 4 was one of only two streams that had flowing water in the survey area despite the occurrence of heavy rain a few days prior to field surveys. Flow is likely maintained within this stream much of the year, at least seasonally, and because of its proximity and connectivity to the EFVR, located approximately 0.2 mile south, Stream 4 likely has jurisdictional status as a WOTUS.

Within the survey area, Stream 4 encompasses approximately 0.004 acre, and the average width is 11 feet.

Stream 5 is an intermittent stream located west of W2 and Stream 4 and runs in a southerly direction bisecting the ROW for the Glendale Pipeline portion of the survey area (**Appendix A**, **Sheet 16**). Flow and sediment carried within this stream are collected from mountains directly north of the survey area. Like Stream 4, Stream 5 had flowing water in its channel during the time of surveys and showed evidence of recent flood events as indicated by downed, matted vegetation and debris deposition at the OHWM (**Appendix C**, **Photos 29 and 30**). Vegetation was observed within the channel of the intermittent stream, which consisted of smaller herbaceous species and grasses. Vegetation surrounding the stream consisted of a mix of upland and riparian species including oak, cottonwood, and cattail. Flow is likely maintained within this stream much of the year, though likely less than Stream 4 as the channel contained vegetation and was significantly smaller. Because of observation in the field of flowing water, a clear OHWM, and the connectivity to the EFVR approximately 0.2 mile south, Stream 5 likely has jurisdictional status as a WOTUS.

Within the survey area, Stream 5 encompasses approximately 0.012 acre, and the average width is 5 feet.

Stream 6 is a perennial stream located east of US-89 within the Mt. Carmel Irrigation Improvement Area of the survey area (**Appendix A**, **Sheets 9–10**), and flowing water was present. It appears to follow the natural alignment of Stream 1 to the north but in this area has been heavily affected by anthropogenic influences as it appears to have been dug out and bermed to aid in irrigating the adjacent agricultural lands. Stream 6 flows southeast and drains into the EFVR just outside of the survey area. Flowing water was present within the OHWM during the field survey. The substrate for Stream 6 was mud and organic matter and was surrounded by riparian vegetation and grass (**Appendix C**, **Photos 34–35**).

Within the survey area, Stream 6 encompasses approximately 0.059 acre, and the average width is 7.75 feet.

Stream 7 is a perennial stream located east of US-89 within the Mt. Carmel Improvement Area of the survey area (**Appendix A**, **Sheet 13**), and flowing water was present. It enters the survey area via a pipe culvert and appears to follow the natural alignment of an ephemeral wash northwest of US-89, which is fed by active irrigation. Within the survey area, Stream 7 has been heavily affected by anthropogenic influences as it appears to have been dug out and bermed to aid in irrigating the adjacent agricultural lands. Stream 7 flows southeast and drains into the EFVR. The substrate for Stream 7 was fine mud to cobbles and organic matter and was surrounded by riparian vegetation and grasses (**Appendix C**, **Photo 36**).

Within the survey area, Stream 7 encompasses approximately 0.011 acre, and the average width is 7.5 feet.

Stream 8 is a perennial stream located in the eastern portion of the Mt. Carmel Improvement Area of the survey area (**Appendix A**, **Sheet 9**), and flowing water was present. It appears to convey runoff from active irrigation and the adjacent mountains and unpaved roads. Stream 8 exits the survey area via a pipe culvert and loses definition after exiting the culvert; however, flows from Stream 8 do continue into the EFVR. The substrate for Stream 8 was sand to cobbles and was surrounded by upland vegetation and cottonwoods (**Appendix C**, **Photo 37**).

Within the survey area, Stream 8 encompasses approximately 0.004 acre, and the average width is 3.75 feet.

Stream 9 is a perennial stream located west of US-89 within the Mt. Carmel Irrigation Improvement Area of the survey area (**Appendix A**, **Sheet 12**), and flowing water was present. It appears to convey runoff from active irrigation and the adjacent mountains to the north. The substrate for Stream 9 is sand to cobble and is surrounded by upland vegetation. Stream 9 flows southeast and exits the survey area via a pipe culvert. Flows from Stream 9 cease just north of US-89 and turn into sheet flow at the highway (**Appendix C**, **Photo 38**).

Within the survey area, Stream 9 encompasses approximately 0.004 acre, and the average width is 4 feet.

Stream 10 is a perennial stream located in the eastern portion of Mt. Carmel Irrigation Improvement Area of the survey area (**Appendix A**, **Sheet 13**). It appears to convey runoff from the plateau to the east. The substrate for Stream 10 is fine sand to cobble and is surrounded by upland vegetation. The channel was wet with areas of flowing water at the time of the surveys. A metal pipe carries the irrigation canal waters above Stream 10 and back into the irrigation canal across the stream. Stream 10 flows west and drains into the EFVR (**Appendix C**, **Photo 39**).

Within the survey area, Stream 10 encompasses approximately 0.019 acre, and the average width is 10.35 feet.

Stream 11 is an intermittent stream located west of US-89 and north of Cove Road and Pond 1 within the survey area (**Appendix A, Sheet 4 and 8**). NWI classifies this feature as a riverine (R4SBC). Multiple erosional features converge within proximity of Stream 11 forming sheet flow which leads to the naturally occurring OHWM downstream towards Cove Road. The average

sediment texture within the low-flow channel is fine silt, and vegetation within the channel is absent. Mud cracks, ripples, and drift/debris were observed within the channel. The banks of the channel include early to mid-herbaceous vegetation along steep walled banks. Stream 11 loses OHWM definition downstream as it fans out amongst the surrounding landscape. Below this point of obscurity, a retention pond exists downstream of Stream 11.

Within the survey area, Stream 11 encompasses approximately 0.176 acre, and the average width is 15.36 feet.

The EFVR is classified by the NWI as an upper perennial riverine feature and is formed from precipitation and snowmelt collected from mountains and valleys north of Glendale. Within the survey area, riparian vegetation was abundant, including mixed stands of cottonwood, tamarisk, Russian olive, and willow. The EFVR crosses the survey area three times (**Appendix A, Sheets 10, 13, 19)**.

The north section of the EFVR (EFVR North) then crosses the survey area between Orderville and Mt. Carmel, approximately 1,500 feet southeast of US-89 (**Appendix A**, **Sheet 10**). The proposed Mt. Carmel pipeline may impact this section of the EFVR. Just after the river enters the survey area, there is a concrete dam restricting flows. Additionally, debris has accumulated below the dam and includes garbage and natural materials. Here the river is approximately 13 feet wide and encompasses 0.117 acre (**Appendix C**, **Photo 40**).

Another section of the EFVR (EFVR South) within the survey area occurs at the Pinyon Pine Drive bridge, approximately 850 feet southeast of US-89 (**Appendix A**, **Sheet 13**). Here the river is approximately 10 feet wide and encompasses 0.023 acre (**Appendix C**, **Photo 41**). The proposed Mt. Carmel pipeline may impact this section of the EFVR.

The final crossing of the EFVR (EFVR Lambs) within the survey area occurs within the Lamb pit (Appendix A, Sheet 19). Disturbance is not expected to occur within the section of the Lamb pit, and therefore, no impacts to the EFVR are anticipated.

Irrigation Canals

The Mt Carmel Irrigation Ditch is an existing open ditch conveyance system that parallels portions of Stream 6, Stream 7, Stream 8, Stream 9, and Stream 10, running along the lower slopes near the EFVR. The ditch functions as a man-made water delivery channel, likely used to divert and distribute surface water for agricultural or local land-use needs. Its alignment generally follows the natural topography, staying close to existing streams and water pipelines, and it passes through areas identified for proposed grading, access routes, and pipeline installations. Within the survey area, the Mt. Carmel Irrigation Ditch encompasses approximately 3.376 acres

Ponds

Pond 1 is an ephemeral feature intersected by a NWI identified riverine (R4SBC) (**Appendix A, Sheet 8**). Pond 1 is not identified as an aquatic feature by the NWI or NHD. The pond is located north of Cove Road approximately .05 mile and approximately 0.2 mile northwest of US-89. Based on aerial imagery, the pond appears to retain water periodically, likely during heavy flooding events and collects water via agricultural runoff and the steep mountains surrounding the feature. No vegetation exists within the pond. Upland vegetation borders the pond and

remains consistent with the surrounding landscape. Due to the lack of hydrophytic vegetation and other wetland indicators, an in-depth evaluation of the pond was not conducted during the field assessment.

Within the survey area, Pond 1 encompasses approximately 0.18 acre.

Pond 2 is identified by the NWI as a Freshwater Pond (PUBFx). This feature abuts Muddy Canyon Road, approximately 0.4 mile northwest of US-89, and has been constructed along the east border of an existing agricultural field. This feature appears to be manmade and is utilized as a detention basin. Based on aerial imagery, vegetation does not appear to exist within or near the pond. Upland vegetation exists to the east of the pond across Muddy Canyon Road and to the west of the agricultural field. Due to the lack of hydrophytic vegetation and other wetland indicators, an in-depth evaluation of the pond was not conducted during the field assessment.

Within the survey area, Pond 2 encompasses approximately 0.12 acre.

Pond 3 is identified by the NWI as a Freshwater Pond (PABFh). This feature lies east of Tait Lane and an existing agricultural field with a NWI identified riverine (R5UBFx) flowing between Pond 3 and the field. Based on NWI data, there is no surface connectivity between the riverine and Pond 3. Based on aerial imagery, Pond 3 likely collects stormwater runoff from the surrounding mountains and acts as a detention basin for the nearby agricultural fields. Due to the lack of hydrophytic vegetation and other wetland indicators, an in-depth evaluation of the pond was not conducted during the field assessment. Within the survey area, Pond 3 encompasses approximately 0.12 acre.

Table 6: Potentially Jurisdictional Aquatic Features Within the Survey Area

Feature Name	Wetland Type	Latitude	Longitude	Distinct Banks/ Channelization	Connection to Water Body	Average Width (Feet)	Length (Feet)	Potential Disturbance (Acres)
EFVR North	Perennial	37.266034	-112.64719	Yes	Yes	13	498	0.117
EFVR South	Perennial	37.257743	-112.65519	Yes	Yes	13	111	0.023
EFVR Lambs	Perennial	37.228235	-112.67547	Yes	Yes	13	520	0
Stream 1	Ephemeral	37.274125	-112.66397	Yes	Yes	12	5,712	1.972
Stream 1A	Intermittent	37.274738	-112.6632	Yes	Yes	3.5	305	0.021
Stream 2	Ephemeral	37.275276	-112.65728	Yes	No	17	2,989	1.010
Stream 2A	Ephemeral	37.278002	-112.65601	Yes	No	24	29	0.029
Stream 3	Ephemeral	37.272271	-112.66806	Yes	No	3	597	0.043
Stream 3A	Ephemeral	37.271862	-112.66882	Yes	Yes	2	33	0.002

Feature Name	Wetland Type	Latitude	Longitude	Distinct Banks/ Channelization	Connection to Water Body	Average Width (Feet)	Length (Feet)	Potential Disturbance (Acres)
Stream 4	Intermittent	37.303455	-112.61455	Yes	Yes	11	32	0.004
Stream 5	Intermittent	37.301543	-112.616465	Yes	Yes	5	39	0.012
Stream 6	Perennial	37.262565	-112.651434	Yes	Yes	7.75	738	0.059
Stream 7	Perennial	37.257852	-112.658135	Yes	Yes	7.5	105	0.011
Stream 8	Perennial	37.258596	-112.65212	Yes	Yes	3.75	52	0.004
Stream 9	Perennial	37.256111	-112.659587	Yes	No	4	45	0.004
Stream 10	Perennial	37.254452	-112.653813	Yes	Yes	10.35	110	0.019
Stream 11	Intermittent	37.274707	-112.653335	Yes	No	15.36	536	0.176
Mt. Carmel Irrigation Ditch	Intermittent	37.259118	-112.65626	Yes	Yes	5	29,415	3.376

Feature Name	Wetland Type	Latitude	Longitude	Distinct Banks/ Channelization	Connection to Water Body	Average Width (Feet)	Length (Feet)	Potential Disturbance (Acres)
Pond 1	Ephemeral	37.27245	-112.6531	Yes	No	78	88	0.187
Pond 2	Freshwater Pond	37.24767	-112.6732	Yes	No	65	140	0.12
Pond 3	Freshwater Pond	37.25132	-112.655	Yes	No	241	152	0.12

4.2.2 Impacts

The proposed project is expected to temporarily impact 0.253 acre and permanently impact 0.021 acre of potentially jurisdictional intermittent and perennial streams, including the EFVR, and 3.056 acres or 9,360 linear feet of non-jurisdictional ephemeral streams. Additionally, the proposed project is expected to impact the existing Mt. Carmel Irrigation Ditch, W2, and ponds 1 through 3. However, after coordination with the USACE project lead at the time, Hollis Jencks, following initial review of October 2018 survey results, it was determined that all four of these features are isolated features and would not be considered jurisdictional or be included in the overall impact calculation for the proposed project.

Therefore, the total possible temporary and permanent impacts to potentially jurisdictional WOTUS delineated within the survey area may be approximately 0.274 acre. Impacts to each potential WOTUS are summarized in **Table 7**.

Although the designs of the Cove Reservoir alternative have not been finalized, most project features are not expected to deviate significantly from their currently proposed locations. Permanent impacts would occur to potentially jurisdictional WOTUS where the reservoir, dam, access road, spillways, recreational features (designs yet to be determined), and pipelines would be constructed. All WOTUS within the boundaries of the proposed reservoir would be disturbed during construction and would be permanently inundated once the dam is complete and the reservoir is filled. Access road construction would also necessitate cut-and-fill slope in steeper terrain resulting in permanent impacts outside of the 16-foot travel surface. Impacts to intermittent streams during construction of the access road would also occur should bridges or culverts be constructed or fill be installed at stream crossings.

All impacts associated with the Glendale Pipeline portion of the survey area during pipeline replacement, including impacts to W2, would be temporary. Temporary impacts to WOTUS will occur during construction of the reservoir portion of the proposed project and include disturbance within temporary ROWs for the construction of the spillways and access road. Staging of material and equipment during construction is anticipated to take place within the reservoir basin and would not require additional temporary disturbance. No impacts within the OHWM of the EFVR are anticipated as part of the Glendale Pipeline portion of the survey area.

All impacts associated with the Mt. Carmel Irrigation Improvement Area portion of the survey area during pipeline replacement would be temporary. The impacts would occur during pipeline installation. The EFVR may be impacted by the construction of the new water pipeline, but that has yet to be determined as the proposed pipeline may be constructed outside of the OHWM in addition to being hung on the bridge to avoid impacts to the EFVR.

Development of the one borrow pit, Esplin, would result in a total new surface disturbance of approximately 13.72 acres; however, no WOTUS are found within the boundaries of the pit, and none would be impacted by the use or development of the three collective borrow pits. Temporarily disturbed areas would be returned to pre-construction conditions following construction activities. Best management practices (BMPs) would be employed to minimize long-term surface disturbance.

Table 7: Impacts to Potentially Jurisdictional Wetlands and Other Waters of the United States

ID	Acres within Survey Area	Temporary Impacts (Acres)	Permanent Impacts (Acres)
EFVR—North	0.117	0.117	0.000
EFVR—South	0.023	0.023	0.000
EFVR-Lambs	0.155	0.000	0.000
Stream 1*	2.685	0.000	0.000
Stream 1A	0.021	0.000	0.021
Stream 2*	1.218	0.000	0.000
Stream 2A*	0.150	0.000	0.000
Stream 3*	0.055	0.000	0.000
Stream 3A*	0.004	0.000	0.000
Stream 4	0.004	0.004	0.000
Stream 5	0.012	0.012	0.000
Stream 6	0.059	0.059	0.000
Stream 7	0.011	0.011	0.000
Stream 8	0.004	0.004	0.000
Stream 9	0.004	0.004	0.000

ID	Acres within Survey Area	Temporary Impacts (Acres)	Permanent Impacts (Acres)
Stream 10	0.019	0.019	0.000
Stream 11	0.176	0.000	0.00
W1*	0.033	0.000	0.000
W2*	0.170	0.000	0.000
Mt. Carmel Irrigation Ditch*	3.376	0.000	0.000
Pond 1*	0.187	0.000	0.000
Pond 2*	0.122	0.000	0.000
Pond 3*	0.122	0.000	0.000
TOTAL POTENTIAL IMPACTS		0.253	0.021

*Streams 1, 2, 2A, 3, and 3A are ephemeral and not jurisdictional under the Revised Definition of WOTUS as of March 12, 2025; Wetlands 1, 2, and the Mt. Carmel Irrigation Ditch are isolated, manmade features. Ponds 1, 2, and 3, are seasonal, ephemeral features. Prior communications with USACE have indicated these are not considered jurisdictional features and thus are not used in calculating the sum of anticipated impacts to WOTUS.

CHAPTER 5 CONCLUSION

Based on our desktop review and field reconnaissance, it has been determined that a total of two wetlands, 12 potentially jurisdictional intermittent and perennial streams, five non-jurisdictional ephemeral streams, and three non-jurisdictional ponds occur within the 719.2-acre survey area. Per USACE guidance, both wetlands are considered isolated wetlands and are not considered jurisdictional. It is anticipated that total temporary disturbance would be limited to approximately 0.253 acres and the total permanent disturbance would be limited to approximately 0.021 acres within the OHWM of potentially jurisdictional streams. Although plans for project activities have not yet been finalized, all disturbances would be contained within the survey area analyzed in this report. To limit impacts outside of the proposed project footprint, all aquatic features, both within and near the survey area, would be further protected through the implementation of BMPs to limit erosion and prevent increased sedimentation.

CHAPTER 6 REFERENCES

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APPENDIX A

Aquatic Resource Delineation Maps

Sheet 18

Sheet 16

Sheet 17

Sheet 21

Sheet 9

Sheet 10

Sheet 12

Sheet 13

Sheet 11

Sheet 15

Sheet 20

Sheet 14

Sheet 19

Cove Reservoir Project

Drawn By: J. Pfadt
Date: 7/11/2022

Aquatic Resources Detail Map Index

No.		Date	By	Appr.
1	Updates for 2025	3/28/25	MG	

N

0 1 2
Miles

Eocene™ Environmental Group

E-423

Legend

- Study Area (719.8 ac)
- Primary Spillway
- Auxiliary Spillway
- Dam Structure
- Proposed Cove Reservoir
- Proposed Access Road Grading Limits
- Instrumentation Buffer



Name	Acres	Lat	Long	Name	Acres	Lat	Long
East Fork VR North	0.116664	37.266034	-112.64719	Stream 6	0.058862	37.262565	-112.65143
East Fork VR South	0.022582	37.257743	-112.65519	Stream 7	0.01113	37.257852	-112.65614
East Fork VR South -							
Lamb's Borrow Pit	0.155236	37.228235	-112.67547	Stream 8	0.004199	37.256596	-112.65212
Stream 1	2.685577	37.274125	-112.66397	Stream 9	0.004086	37.256111	-112.65959
Stream 1A	0.021114	37.274738	-112.6632	Stream 10	0.019387	37.254452	-112.63581
Stream 2	1.217954	37.275276	-112.65728	Stream 11	0.176282	37.274707	-112.653335
Stream 2A	0.150142	37.276002	-112.65601	Wetland 1	0.032989	37.269568	-112.65711
Stream 3	0.054881	37.272271	-112.66806	Wetland 2	0.169996	37.393818	-112.61412
Stream 3A	0.004436	37.271862	-112.66882	Pond 1	0.187236	37.272445	-112.653074
Stream 4	0.003977	37.303455	-112.61455	Pond 2	0.121872	37.247673	-112.673194
Stream 5	0.012195	37.301543	-112.61647	Pond 3	0.121969	37.25132	-112.654995
Mt. Carmel Irrigation							
Ditch	3.37638	37.259118	-112.65626				

No.		Date	By	Appr.
1	Updates for 2025	3/28/2025	MG	
2	Updates to show additional features	12/3/2025	KM	
3	Updates to show Existing Irrigation Ditch	2/18/2026	KM	

Aquatic Resources Detail Map (Sheet 1 of 21)

Cove - East Fork Virgin River
Watershed Plan - EIS Project
Drawn By: C Melisi
Date: 7/21/2022

0 200 400
Feet

N

Eocene Environmental Group

E-424

- OHWM Data Plot
- Photo Location/Direction
- OHWM
- Study Area (719.2 ac)

Stream 1

Name	Acres	Lat	Long	Name	Acres	Lat	Long
East Fork VR North	0.116664	37.266034	-112.64719	Stream 6	0.058862	37.262565	-112.65143
East Fork VR South	0.022582	37.257743	-112.65519	Stream 7	0.01113	37.257852	-112.65814
East Fork VR South -							
Lamb's Borrow Pit	0.155236	37.228235	-112.67547	Stream 8	0.004199	37.256596	-112.65212
Stream 1	2.685577	37.274125	-112.66397	Stream 9	0.004086	37.256111	-112.65959
Stream 1A	0.021114	37.274738	-112.6632	Stream 10	0.019387	37.254452	-112.63581
Stream 2	1.217954	37.275276	-112.65728	Stream 11	0.176282	37.274707	-112.653335
Stream 2A	0.150142	37.276002	-112.65601	Wetland 1	0.032989	37.269568	-112.65711
Stream 3	0.054881	37.272271	-112.66806	Wetland 2	0.169996	37.393818	-112.61412
Stream 3A	0.004436	37.271862	-112.66882	Pond 1	0.187236	37.272445	-112.653074
Stream 4	0.003977	37.303455	-112.61455	Pond 2	0.121872	37.247673	-112.673194
Stream 5	0.012195	37.301543	-112.61647	Pond 3	0.121969	37.25132	-112.654995
Mt. Carmel Irrigation Ditch	3.37638	37.259118	-112.65626				

No.		Date	By	Appr.
1	Updates for 2025	3/28/2025	MG	
2	Updates to show additional features	12/3/2025	KM	
3	Updates to show Existing Irrigation Ditch	2/18/2026	KM	

Aquatic Resources Detail Map (Sheet 2 of 21)

Cove - East Fork Virgin River
Watershed Plan - EIS Project
Drawn By: C Melisi
Date: 7/21/2022

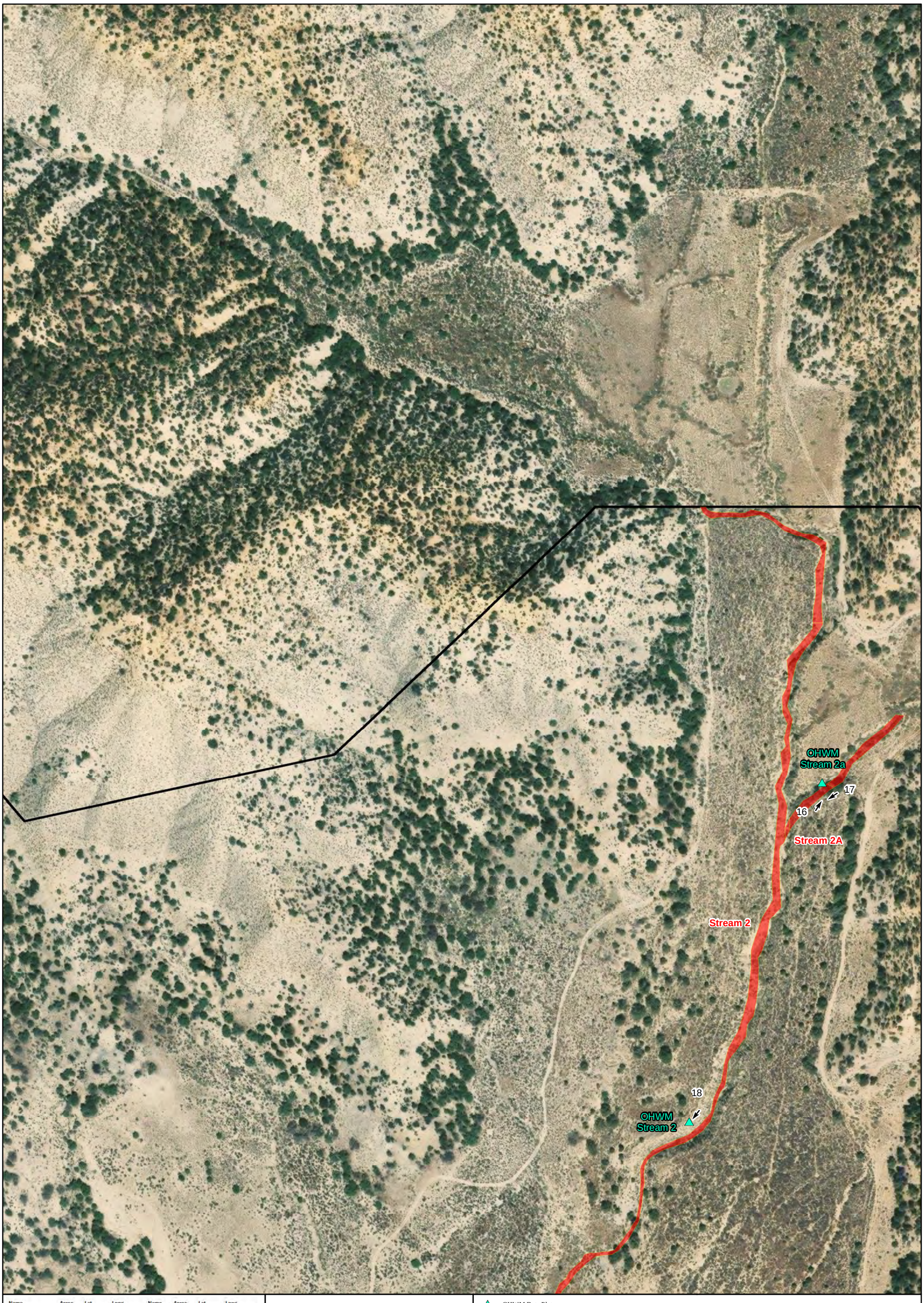
0 200 400
Feet

N

Eocene Environmental Group

OHWM

Study Area (719.2 ac)



Name	Acres	Lat	Long	Name	Acres	Lat	Long
East Fork VR North	0.116664	37.266034	-112.64719	Stream 6	0.058862	37.262565	-112.65143
East Fork VR South	0.022582	37.257743	-112.65519	Stream 7	0.01113	37.257652	-112.65614
East Fork VR South - Lamb's Borrow Pit	0.155236	37.228235	-112.67547	Stream 8	0.004199	37.256596	-112.65212
Stream 1	2.685577	37.274125	-112.66397	Stream 9	0.004086	37.256111	-112.65959
Stream 1A	0.021114	37.274738	-112.6632	Stream 10	0.019387	37.254452	-112.63581
Stream 2	1.217954	37.275276	-112.65728	Stream 11	0.176282	37.274707	-112.653335
Stream 2A	0.150142	37.276002	-112.65601	Wetland 1	0.032989	37.269568	-112.65711
Stream 3	0.054881	37.272271	-112.66806	Wetland 2	0.169996	37.393818	-112.61412
Stream 3A	0.004436	37.271862	-112.66882	Pond 1	0.187236	37.272445	-112.653074
Stream 4	0.003977	37.303455	-112.61455	Pond 2	0.121872	37.247673	-112.673194
Stream 5	0.012195	37.301543	-112.61647	Pond 3	0.121969	37.25132	-112.654995
Mt. Carmel Irrigation Ditch	3.37638	37.259118	-112.65626				

No.		Date	By	Appr.
1	Updates for 2025	3/28/2025	MG	
2	Updates to show additional features	12/3/2025	KM	
3	Updates to show Existing Irrigation Ditch	2/18/2026	KM	

Aquatic Resources Detail Map (Sheet 3 of 21)

Cove - East Fork Virgin River
Watershed Plan - EIS Project
Drawn By: C Melisi
Date: 7/21/2022

0 200 400
Feet

N

Eocene Environmental Group

E-426

- OHWM Data Plot
- Photo Location/Direction
- OHWM
- Study Area (719.2 ac)

15

Stream 11

Name	Acres	Lat	Long	Name	Acres	Lat	Long
East Fork VR North	0.116664	37.266034	-112.64719	Stream 6	0.058862	37.262565	-112.65143
East Fork VR South	0.022582	37.257743	-112.65519	Stream 7	0.01113	37.257852	-112.65614
East Fork VR South -							
Lamb's Borrow Pit	0.155236	37.228235	-112.67547	Stream 8	0.004199	37.256596	-112.65212
Stream 1	2.685577	37.274125	-112.66397	Stream 9	0.004086	37.256111	-112.65959
Stream 1A	0.021114	37.274738	-112.6632	Stream 10	0.019387	37.254452	-112.63581
Stream 2	1.217954	37.275276	-112.65728	Stream 11	0.176282	37.274707	-112.653335
Stream 2A	0.150142	37.276002	-112.65601	Wetland 1	0.032989	37.269568	-112.65711
Stream 3	0.054881	37.272271	-112.66806	Wetland 2	0.169996	37.393818	-112.61412
Stream 3A	0.004436	37.271862	-112.66882	Pond 1	0.187236	37.272445	-112.653074
Stream 4	0.003977	37.303455	-112.61455	Pond 2	0.121872	37.247673	-112.673194
Stream 5	0.012195	37.301543	-112.61647	Pond 3	0.121969	37.25132	-112.654995
Mt. Carmel Irrigation							
Ditch	3.37638	37.259118	-112.65626				

No.		Date	By	Appr.
1	Updates for 2025	3/28/2025	MG	
2	Updates to show additional features	12/3/2025	KM	
3	Updates to show Existing Irrigation Ditch	2/18/2026	KM	

Aquatic Resources Detail Map (Sheet 4 of 21)

Cove - East Fork Virgin River
Watershed Plan - EIS Project
Drawn By: C Melisi
Date: 7/21/2022

0 200 400
Feet

N

Eocene Environmental Group

Photo Location/Direction

OHWM

Study Area (719.2 ac)

Name	Acres	Lat	Long	Name	Acres	Lat	Long
East Fork VR North	0.116664	37.266034	-112.64719	Stream 6	0.058862	37.262565	-112.65143
East Fork VR South	0.022582	37.257743	-112.65519	Stream 7	0.01113	37.257852	-112.65614
East Fork VR South -							
Lamb's Borrow Pit	0.155236	37.226235	-112.67547	Stream 8	0.004199	37.256596	-112.65212
Stream 1	2.685577	37.274125	-112.66397	Stream 9	0.004086	37.256111	-112.65959
Stream 1A	0.021114	37.274738	-112.6632	Stream 10	0.019387	37.254452	-112.63581
Stream 2	1.217954	37.275276	-112.65728	Stream 11	0.176282	37.274707	-112.653335
Stream 2A	0.150142	37.276002	-112.65601	Wetland 1	0.032989	37.269568	-112.65711
Stream 3	0.054881	37.272271	-112.66806	Wetland 2	0.169996	37.393818	-112.61412
Stream 3A	0.004436	37.271862	-112.66882	Pond 1	0.187236	37.272445	-112.653074
Stream 4	0.003977	37.303455	-112.61455	Pond 2	0.121872	37.247673	-112.673194
Stream 5	0.012195	37.301543	-112.61647	Pond 3	0.121969	37.25132	-112.654995
Mt. Carmel Irrigation Ditch	3.37638	37.259118	-112.65626				

No.		Date	By	Appr.
1	Updates for 2025	3/28/2025	MG	
2	Updates to show additional features	12/3/2025	KM	
3	Updates to show Existing Irrigation Ditch	2/18/2026	KM	

Aquatic Resources Detail Map (Sheet 5 of 21)

Cove - East Fork Virgin River
Watershed Plan - EIS Project
Drawn By: C Melisi
Date: 7/21/2022

0 200 400
Feet

N

Eocene Environmental Group

E-428

OHWM

Study Area (719.2 ac)



Name	Acres	Lat	Long	Name	Acres	Lat	Long
East Fork VR North	0.116664	37.266034	-112.64719	Stream 6	0.058862	37.262565	-112.65143
East Fork VR South	0.022582	37.257743	-112.65519	Stream 7	0.01113	37.257852	-112.65614
East Fork VR South -							
Lamb's Borrow Pit	0.155236	37.228235	-112.67547	Stream 8	0.004199	37.256596	-112.65212
Stream 1	2.685577	37.274125	-112.66397	Stream 9	0.004086	37.256111	-112.65959
Stream 1A	0.021114	37.274738	-112.6632	Stream 10	0.019387	37.254452	-112.63581
Stream 2	1.217954	37.275276	-112.65728	Stream 11	0.176282	37.274707	-112.653335
Stream 2A	0.150142	37.276002	-112.65601	Wetland 1	0.032989	37.269568	-112.65711
Stream 3	0.054881	37.272271	-112.66806	Wetland 2	0.169996	37.393818	-112.61412
Stream 3A	0.004436	37.271862	-112.66882	Pond 1	0.187236	37.272445	-112.653074
Stream 4	0.003977	37.303455	-112.61455	Pond 2	0.121872	37.247673	-112.673194
Stream 5	0.012195	37.301543	-112.61647	Pond 3	0.121969	37.25132	-112.654995
Mt. Carmel Irrigation Ditch	3.37638	37.259118	-112.65626				

No.		Date	By	Appr.
1	Updates for 2025	3/28/2025	MG	
2	Updates to show additional features	12/3/2025	KM	
3	Updates to show Existing Irrigation Ditch	2/18/2026	KM	

Aquatic Resources Detail Map (Sheet 6 of 21)

Cove - East Fork Virgin River
Watershed Plan - EIS Project
Drawn By: C Melisi
Date: 7/21/2022

0 200 400
Feet

N

Eocene Environmental Group

- OHWM Data Plot
- Photo Location/Direction
- OHWM
- Study Area (719.2 ac)



Name	Acres	Lat	Long	Name	Acres	Lat	Long
East Fork VR North	0.116664	37.266034	-112.64719	Stream 6	0.058862	37.262565	-112.65143
East Fork VR South	0.022582	37.257743	-112.65519	Stream 7	0.01113	37.257852	-112.65614
East Fork VR South -							
Lamb's Borrow Pit	0.155236	37.228235	-112.67547	Stream 8	0.004199	37.256596	-112.65212
Stream 1	2.685577	37.274125	-112.66397	Stream 9	0.004086	37.256111	-112.65959
Stream 1A	0.021114	37.274738	-112.6632	Stream 10	0.019387	37.254452	-112.63581
Stream 2	1.217954	37.275276	-112.65728	Stream 11	0.176282	37.274707	-112.653335
Stream 2A	0.150142	37.276002	-112.65601	Wetland 1	0.032989	37.269568	-112.65711
Stream 3	0.054881	37.272271	-112.66806	Wetland 2	0.169996	37.393818	-112.61412
Stream 3A	0.004436	37.271862	-112.66882	Pond 1	0.187236	37.272445	-112.653074
Stream 4	0.003977	37.303455	-112.61455	Pond 2	0.121872	37.247673	-112.673194
Stream 5	0.012195	37.301543	-112.61647	Pond 3	0.121969	37.25132	-112.654995
Mt. Carmel Irrigation							
Ditch	3.37638	37.259118	-112.65626				

No.		Date	By	Appr.
1	Updates for 2025	3/28/2025	MG	
2	Updates to show additional features	12/3/2025	KM	
3	Updates to show Existing Irrigation Ditch	2/18/2026	KM	

Aquatic Resources Detail Map (Sheet 7 of 21)

Cove - East Fork Virgin River
Watershed Plan - EIS Project
Drawn By: C Melisi
Date: 7/21/2022

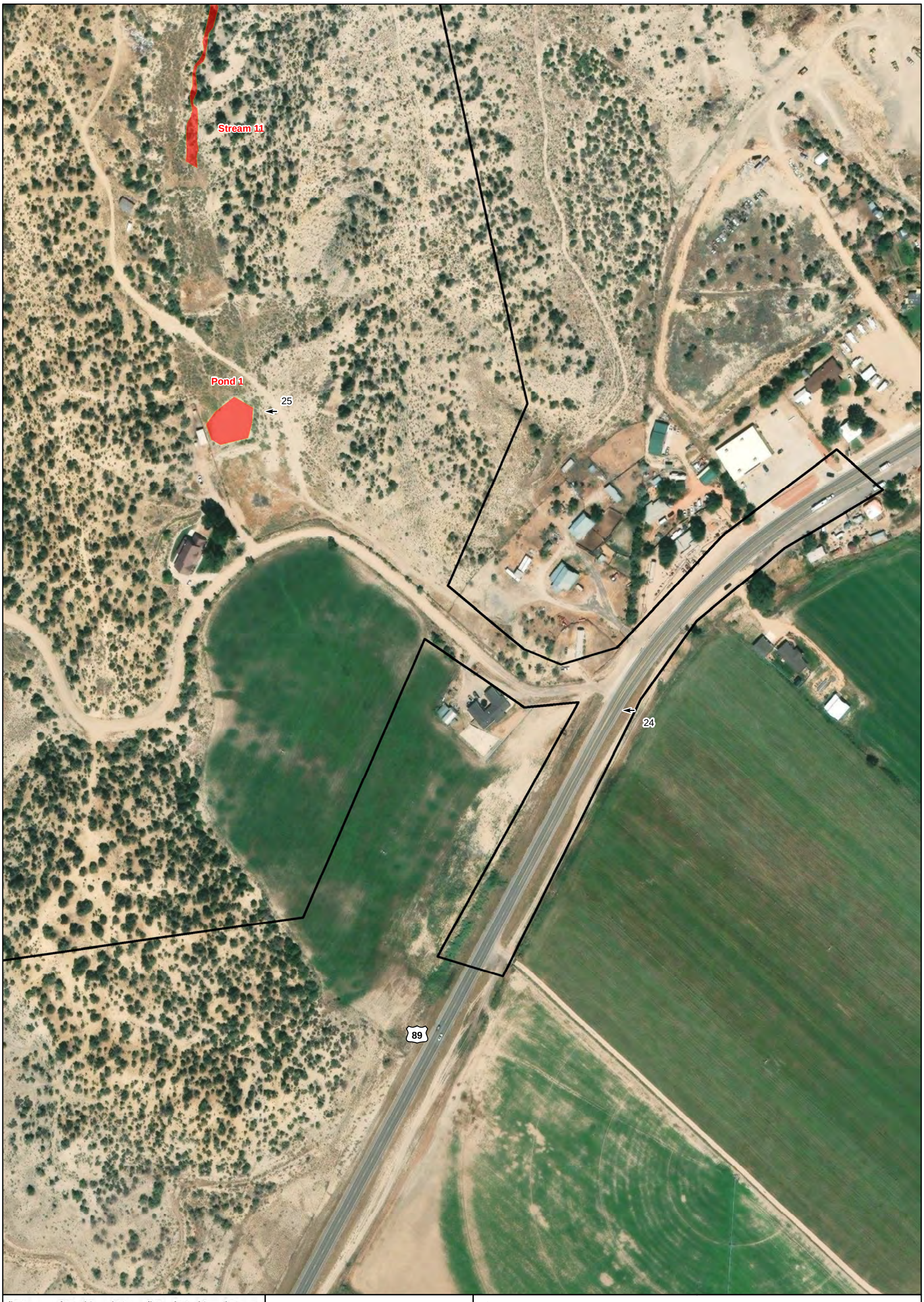
0 200 400
Feet

N

Eocene Environmental Group

E-430

- OHWM Data Plot
- Photo Location/Direction
- OHWM
- Soil Pit
- Wetland
- Study Area (719.2 ac)



Name	Acres	Lat	Long	Name	Acres	Lat	Long
East Fork VR North	0.116664	37.266034	-112.64719	Stream 6	0.058862	37.262565	-112.65143
East Fork VR South	0.022582	37.257743	-112.65519	Stream 7	0.01113	37.257852	-112.65614
East Fork VR South -							
Lamb's Borrow Pit	0.155236	37.228235	-112.67547	Stream 8	0.004199	37.256596	-112.65212
Stream 1	2.685577	37.274125	-112.66397	Stream 9	0.004086	37.256111	-112.65959
Stream 1A	0.021114	37.274738	-112.6632	Stream 10	0.019387	37.254452	-112.63581
Stream 2	1.217954	37.275276	-112.65728	Stream 11	0.176282	37.274707	-112.653335
Stream 2A	0.150142	37.276002	-112.65601	Wetland 1	0.032989	37.269568	-112.65711
Stream 3	0.054881	37.272271	-112.66806	Wetland 2	0.169996	37.393818	-112.61412
Stream 3A	0.004436	37.271862	-112.66882	Pond 1	0.187236	37.272445	-112.653074
Stream 4	0.003977	37.303455	-112.61455	Pond 2	0.121872	37.247673	-112.673194
Stream 5	0.012195	37.301543	-112.61647	Pond 3	0.121969	37.25132	-112.654995
Mt. Carmel Irrigation							
Ditch	3.37638	37.259118	-112.65626				

No.		Date	By	Appr.
1	Updates for 2025	3/28/2025	MG	
2	Updates to show additional features	12/3/2025	KM	
3	Updates to show Existing Irrigation Ditch	2/18/2026	KM	

Aquatic Resources Detail Map (Sheet 8 of 21)

Cove - East Fork Virgin River
Watershed Plan - EIS Project
Drawn By: C Melisi
Date: 7/21/2022

0 200 400
Feet

N

Eocene Environmental Group

E-431

Photo Location/Direction

OHWM

Study Area (719.2 ac)

89

34

Stream 6

Mt. Carmel
Irrigation Ditch

37

OHWM
Stream 8

Stream 8

East Fork Virgin River

Name	Acres	Lat	Long	Name	Acres	Lat	Long
East Fork VR North	0.116664	37.266034	-112.64719	Stream 6	0.058862	37.262565	-112.65143
East Fork VR South	0.022582	37.257743	-112.65519	Stream 7	0.01113	37.257852	-112.65814
East Fork VR South - Lamb's Borrow Pit	0.155236	37.228235	-112.67547	Stream 8	0.004199	37.256596	-112.65212
Stream 1	2.685577	37.274125	-112.66397	Stream 9	0.004086	37.256111	-112.65959
Stream 1A	0.021114	37.274738	-112.6632	Stream 10	0.019387	37.254452	-112.63581
Stream 2	1.217954	37.275276	-112.65728	Stream 11	0.176282	37.274707	-112.653335
Stream 2A	0.150142	37.276002	-112.65601	Wetland 1	0.032989	37.269568	-112.65711
Stream 3	0.054881	37.272271	-112.66806	Wetland 2	0.169996	37.393818	-112.61412
Stream 3A	0.004436	37.271862	-112.66882	Pond 1	0.187236	37.272445	-112.653074
Stream 4	0.003977	37.303455	-112.61455	Pond 2	0.121872	37.247673	-112.673194
Stream 5	0.012195	37.301543	-112.61647	Pond 3	0.121969	37.25132	-112.654995
Mt. Carmel Irrigation Ditch	3.37638	37.259118	-112.65626				

No.		Date	By	Appr.
1	Updates for 2025	3/28/2025	MG	
2	Updates to show additional features	12/3/2025	KM	
3	Updates to show Existing Irrigation Ditch	2/18/2026	KM	

Aquatic Resources Detail Map (Sheet 9 of 21)

Cove - East Fork Virgin River
Watershed Plan - EIS Project
Drawn By: C Melisi
Date: 7/21/2022

0 200 400
Feet

N

Eocene Environmental Group

E-432

OHWM Data Plot

Photo Location/Direction

OHWM

Study Area (719.2 ac)

East Fork
of the Virgin River

40

Mt. Carmel
Irrigation Ditch

East Fork Virgin River

OHWM
Stream 6

Stream 6

35

Mt. Carmel
Irrigation Ditch

Name	Acres	Lat	Long	Name	Acres	Lat	Long
East Fork VR North	0.116664	37.266034	-112.64719	Stream 6	0.058862	37.262565	-112.65143
East Fork VR South	0.022582	37.257743	-112.65519	Stream 7	0.01113	37.257852	-112.65814
East Fork VR South -							
Lamb's Borrow Pit	0.155236	37.228235	-112.67547	Stream 8	0.004199	37.256596	-112.65212
Stream 1	2.685577	37.274125	-112.66397	Stream 9	0.004086	37.256111	-112.65959
Stream 1A	0.021114	37.274738	-112.6632	Stream 10	0.019387	37.254452	-112.63581
Stream 2	1.217954	37.275276	-112.65728	Stream 11	0.176282	37.274707	-112.653335
Stream 2A	0.150142	37.276002	-112.65601	Wetland 1	0.032989	37.269568	-112.65711
Stream 3	0.054881	37.272271	-112.66806	Wetland 2	0.169996	37.393818	-112.61412
Stream 3A	0.004436	37.271862	-112.66882	Pond 1	0.187236	37.272445	-112.653074
Stream 4	0.003977	37.303455	-112.61455	Pond 2	0.121872	37.247673	-112.673194
Stream 5	0.012195	37.301543	-112.61647	Pond 3	0.121969	37.25132	-112.654995
Mt. Carmel Irrigation Ditch	3.37638	37.259118	-112.65626				

No.		Date	By	Appr.
1	Updates for 2025	3/28/2025	MG	
2	Updates to show additional features	12/3/2025	KM	
3	Updates to show Existing Irrigation Ditch	2/18/2026	KM	

Aquatic Resources Detail Map (Sheet 10 of 21)

Cove - East Fork Virgin River
Watershed Plan - EIS Project
Drawn By: C Melisi
Date: 7/21/2022

0 200 400
Feet

N

Eocene Environmental Group

- OHWM Data Plot
- Photo Location/Direction
- OHWM
- Study Area (719.2 ac)

Pond 2

Mt. Carmel Irrigation Ditch

89

Name	Acres	Lat	Long	Name	Acres	Lat	Long
East Fork VR North	0.116664	37.266034	-112.64719	Stream 6	0.058862	37.262565	-112.65143
East Fork VR South	0.022582	37.257743	-112.65519	Stream 7	0.01113	37.257852	-112.65814
East Fork VR South - Lamb's Borrow Pit	0.155236	37.228235	-112.67547	Stream 8	0.004199	37.256596	-112.65212
Stream 1	2.685577	37.274125	-112.66397	Stream 9	0.004086	37.256111	-112.65959
Stream 1A	0.021114	37.274738	-112.6632	Stream 10	0.019387	37.254452	-112.63581
Stream 2	1.217954	37.275276	-112.65728	Stream 11	0.176282	37.274707	-112.653335
Stream 2A	0.150142	37.276002	-112.65601	Wetland 1	0.032989	37.269568	-112.65711
Stream 3	0.054881	37.272271	-112.66806	Wetland 2	0.169996	37.393818	-112.61412
Stream 3A	0.004436	37.271862	-112.66882	Pond 1	0.187236	37.272445	-112.653074
Stream 4	0.003977	37.303455	-112.61455	Pond 2	0.121872	37.247673	-112.673194
Stream 5	0.012195	37.301543	-112.61647	Pond 3	0.121969	37.25132	-112.654995
Mt. Carmel Irrigation Ditch	3.37638	37.259118	-112.65626				

No.		Date	By	Appr.
1	Updates for 2025	3/28/2025	MG	
2	Updates to show additional features	12/3/2025	KM	
3	Updates to show Existing Irrigation Ditch	2/18/2026	KM	

Aquatic Resources Detail Map (Sheet 11 of 21)

Cove - East Fork Virgin River
Watershed Plan - EIS Project
Drawn By: C Melisi
Date: 7/21/2022

0 200 400
Feet

N

Eocene Environmental Group

Study Area (719.2 ac)



Name	Acres	Lat	Long	Name	Acres	Lat	Long
East Fork VR North	0.116664	37.266034	-112.64719	Stream 6	0.058062	37.262565	-112.65143
East Fork VR South	0.022582	37.257743	-112.65519	Stream 7	0.01113	37.257852	-112.65614
East Fork VR South -							
Lamb's Borrow Pit	0.155236	37.228235	-112.67547	Stream 8	0.004199	37.256596	-112.65212
Stream 1	2.685577	37.274125	-112.66397	Stream 9	0.004086	37.256111	-112.65959
Stream 1A	0.021114	37.274738	-112.6632	Stream 10	0.019387	37.254452	-112.63581
Stream 2	1.217954	37.275276	-112.65728	Stream 11	0.176282	37.274707	-112.653335
Stream 2A	0.150142	37.276002	-112.65601	Wetland 1	0.032989	37.269568	-112.65711
Stream 3	0.054881	37.272271	-112.66806	Wetland 2	0.169996	37.393818	-112.61412
Stream 3A	0.004436	37.271862	-112.66882	Pond 1	0.187236	37.272445	-112.653074
Stream 4	0.003977	37.303455	-112.61455	Pond 2	0.121872	37.247673	-112.673194
Stream 5	0.012195	37.301543	-112.61647	Pond 3	0.121969	37.25132	-112.654995
Mt. Carmel Irrigation Ditch	3.37638	37.259118	-112.65626				

No.		Date	By	Appr.
1	Updates for 2025	3/28/2025	MG	
2	Updates to show additional features	12/3/2025	KM	
3	Updates to show Existing Irrigation Ditch	2/18/2026	KM	

Aquatic Resources Detail Map (Sheet 12 of 21)

Cove - East Fork Virgin River
Watershed Plan - EIS Project
Drawn By: C Melisi
Date: 7/21/2022

0 200 400
Feet

N

Eocene Environmental Group

- OHWM Data Plot
- Photo Location/Direction
- OHWM
- Study Area (719.2 ac)



Name	Acres	Lat	Long	Name	Acres	Lat	Long
East Fork VR North	0.116664	37.266034	-112.64719	Stream 6	0.058862	37.262565	-112.65143
East Fork VR South	0.022582	37.257743	-112.65519	Stream 7	0.01113	37.257852	-112.65614
East Fork VR South - Lamb's Borrow Pit	0.155236	37.228235	-112.67547	Stream 8	0.004199	37.256596	-112.65212
Stream 1	2.685577	37.274125	-112.66397	Stream 9	0.004086	37.256111	-112.65959
Stream 1A	0.021114	37.274738	-112.6632	Stream 10	0.019387	37.254452	-112.63581
Stream 2	1.217954	37.275276	-112.65728	Stream 11	0.176282	37.274707	-112.653335
Stream 2A	0.150142	37.276002	-112.65601	Wetland 1	0.032989	37.269568	-112.65711
Stream 3	0.054881	37.272271	-112.66806	Wetland 2	0.169996	37.393818	-112.61412
Stream 3A	0.004436	37.271862	112.66882	Pond 1	0.187236	37.272445	-112.653074
Stream 4	0.003977	37.303455	-112.61455	Pond 2	0.121872	37.247673	-112.673194
Stream 5	0.012195	37.301543	-112.61647	Pond 3	0.121969	37.25132	-112.654995
Mt. Carmel Irrigation Ditch	3.37638	37.259118	-112.65626				

No.		Date	By	Appr.
1	Updates for 2025	3/28/2025	MG	
2	Updates to show additional features	12/3/2025	KM	
3	Updates to show Existing Irrigation Ditch	2/18/2026	KM	

Aquatic Resources Detail Map (Sheet 13 of 21)

Cove - East Fork Virgin River
Watershed Plan - EIS Project
Drawn By: C Melisi
Date: 7/21/2022

0 200 400
Feet

N

Eocene Environmental Group

E-436

- OHWM Data Plot
- Photo Location/Direction
- OHWM
- Study Area (719.2 ac)



Name	Acres	Lat	Long	Name	Acres	Lat	Long
East Fork VR North	0.116664	37.266034	-112.64719	Stream 6	0.058862	37.262565	-112.65143
East Fork VR South	0.022582	37.257743	-112.65519	Stream 7	0.01113	37.257852	-112.65614
East Fork VR South							
Lamb's Borrow Pit	0.155236	37.228235	-112.67547	Stream 8	0.004199	37.256596	-112.65212
Stream 1	2.685577	37.274125	-112.66397	Stream 9	0.004086	37.256111	-112.65959
Stream 1A	0.021114	37.274738	-112.6632	Stream 10	0.019387	37.254452	-112.63581
Stream 2	1.217954	37.275276	-112.65728	Stream 11	0.176282	37.274707	-112.653335
Stream 2A	0.150142	37.276002	-112.65601	Wetland 1	0.032989	37.269568	-112.65711
Stream 3	0.054881	37.272271	-112.66806	Wetland 2	0.169996	37.393818	-112.61412
Stream 3A	0.004436	37.271862	-112.66882	Pond 1	0.187236	37.272445	-112.653074
Stream 4	0.003977	37.303455	-112.61455	Pond 2	0.121872	37.247673	-112.673194
Stream 5	0.012195	37.301543	-112.61647	Pond 3	0.121969	37.25132	-112.654995
Mt. Carmel Irrigation Ditch	3.37638	37.259118	-112.65626				

No.		Date	By	Appr.
1	Updates for 2025	3/28/2025	MG	
2	Updates to show additional features	12/3/2025	KM	
3	Updates to show Existing Irrigation Ditch	2/18/2026	KM	

Aquatic Resources Detail Map (Sheet 14 of 21)

Cove - East Fork Virgin River
Watershed Plan - EIS Project
Drawn By: C Melisi
Date: 7/21/2022

0 200 400
Feet

N

Eocene Environmental Group

Study Area (719.2 ac)



Name	Acres	Lat	Long	Name	Acres	Lat	Long
East Fork VR North	0.116664	37.266034	-112.64719	Stream 6	0.058862	37.262565	-112.65143
East Fork VR South	0.022582	37.257743	-112.65519	Stream 7	0.01113	37.257852	-112.65614
East Fork VR South -							
Lamb's Borrow Pit	0.155236	37.228235	-112.67547	Stream 8	0.004199	37.256596	-112.65212
Stream 1	2.685577	37.274125	-112.66397	Stream 9	0.004086	37.256111	-112.65959
Stream 1A	0.021114	37.274738	-112.6632	Stream 10	0.019387	37.254452	-112.63581
Stream 2	1.217954	37.275276	-112.65728	Stream 11	0.176282	37.274707	-112.653335
Stream 2A	0.150142	37.276002	-112.65601	Wetland 1	0.032989	37.269568	-112.65711
Stream 3	0.054881	37.272271	-112.66806	Wetland 2	0.169996	37.393818	-112.61412
Stream 3A	0.004436	37.271862	-112.66882	Pond 1	0.187236	37.272445	-112.653074
Stream 4	0.003977	37.303455	-112.61455	Pond 2	0.121872	37.247673	-112.673194
Stream 5	0.012195	37.301543	-112.61647	Pond 3	0.121969	37.25132	-112.654995
Mt. Carmel Irrigation Ditch	3.37638	37.259118	-112.65626				

No.		Date	By	Appr.
1	Updates for 2025	3/28/2025	MG	
2	Updates to show additional features	12/3/2025	KM	
3	Updates to show Existing Irrigation Ditch	2/18/2026	KM	

Aquatic Resources Detail Map (Sheet 15 of 21)

Cove - East Fork Virgin River
Watershed Plan - EIS Project
Drawn By: C Melisi
Date: 7/21/2022

0 200 400
Feet

N

Eocene Environmental Group

E-438

Study Area (719.2 ac)



Name	Acres	Lat	Long	Name	Acres	Lat	Long
East Fork VR North	0.116664	37.266034	-112.64719	Stream 6	0.058862	37.262565	-112.65143
East Fork VR South	0.022582	37.257743	-112.65519	Stream 7	0.01113	37.257852	-112.65814
East Fork VR South - Lamb's Borrow Pit	0.155236	37.228235	-112.67547	Stream 8	0.004199	37.256596	-112.65212
Stream 1	2.685577	37.274125	-112.66397	Stream 9	0.004086	37.256111	-112.65959
Stream 1A	0.021114	37.274738	-112.6632	Stream 10	0.019387	37.254452	-112.63581
Stream 2	1.217954	37.275276	-112.65728	Stream 11	0.176282	37.274707	-112.653335
Stream 2A	0.150142	37.276002	-112.65601	Wetland 1	0.032989	37.269568	-112.65711
Stream 3	0.054881	37.272271	-112.66806	Wetland 2	0.169996	37.393818	-112.61412
Stream 3A	0.004436	37.271862	-112.66882	Pond 1	0.187236	37.272445	-112.653074
Stream 4	0.003977	37.303455	-112.61455	Pond 2	0.121872	37.247673	-112.673194
Stream 5	0.012195	37.301543	-112.61647	Pond 3	0.121969	37.25132	-112.654995
Mt. Carmel Irrigation Ditch	3.37638	37.259118	-112.65626				

No.		Date	By	Appr.
1	Updates for 2025	3/28/2025	MG	
2	Updates to show additional features	12/3/2025	KM	
3	Updates to show Existing Irrigation Ditch	2/18/2026	KM	

Aquatic Resources Detail Map (Sheet 16 of 21)

Cove - East Fork Virgin River
Watershed Plan - EIS Project
Drawn By: C Melisi
Date: 7/21/2022

0 200 400
Feet

N

Eocene Environmental Group

E-439

- OHWM Data Plot
- Photo Location/Direction
- OHWM
- Soil Pit
- Wetland
- Study Area (719.2 ac)



Name	Acres	Lat	Long	Name	Acres	Lat	Long
East Fork VR North	0.116664	37.266034	-112.64719	Stream 6	0.058862	37.262565	-112.65143
East Fork VR South	0.022582	37.257743	-112.65519	Stream 7	0.01113	37.257852	-112.65614
East Fork VR South - Lamb's Borrow Pit	0.155236	37.228235	-112.67547	Stream 8	0.004199	37.256596	-112.65212
Stream 1	2.685577	37.274125	-112.66397	Stream 9	0.004086	37.256111	-112.65959
Stream 1A	0.021114	37.274738	-112.6632	Stream 10	0.019387	37.254452	-112.63581
Stream 2	1.217954	37.275276	-112.65728	Stream 11	0.176282	37.274707	-112.653335
Stream 2A	0.150142	37.276002	-112.65601	Wetland 1	0.032989	37.269568	-112.65711
Stream 3	0.054881	37.272271	-112.66806	Wetland 2	0.169996	37.393818	-112.61412
Stream 3A	0.004436	37.271862	-112.66882	Pond 1	0.187236	37.272445	-112.653074
Stream 4	0.003977	37.303455	-112.61455	Pond 2	0.121872	37.247673	-112.673194
Stream 5	0.012195	37.301543	-112.61647	Pond 3	0.121969	37.25132	-112.654995
Mt. Carmel Irrigation Ditch	3.37638	37.259118	-112.65626				

No.		Date	By	Appr.
1	Updates for 2025	3/28/2025	MG	
2	Updates to show additional features	12/3/2025	KM	
3	Updates to show Existing Irrigation Ditch	2/18/2026	KM	

Aquatic Resources Detail Map (Sheet 17 of 21)

Cove - East Fork Virgin River
Watershed Plan - EIS Project
Drawn By: C Melisi
Date: 7/21/2022

0 200 400
Feet

N

Eocene Environmental Group

E-440

Study Area (719.2 ac)



Name	Acres	Lat	Long	Name	Acres	Lat	Long
East Fork VR North	0.116664	37.266034	-112.64719	Stream 6	0.058062	37.262565	-112.65143
East Fork VR South	0.022582	37.257743	-112.65519	Stream 7	0.01113	37.257852	-112.65814
East Fork VR South - Lamb's Borrow Pit	0.155236	37.228235	-112.67547	Stream 8	0.004199	37.256596	-112.65212
Stream 1	2.685577	37.274125	-112.66397	Stream 9	0.004086	37.256111	-112.65959
Stream 1A	0.021114	37.274738	-112.6632	Stream 10	0.019387	37.254452	-112.63581
Stream 2	1.217954	37.275276	-112.65728	Stream 11	0.176282	37.274707	-112.653335
Stream 2A	0.150142	37.276002	-112.65601	Wetland 1	0.032989	37.269568	-112.65711
Stream 3	0.054881	37.272271	-112.66806	Wetland 2	0.169996	37.393818	-112.61412
Stream 3A	0.004436	37.271862	-112.66882	Pond 1	0.187236	37.272445	-112.653074
Stream 4	0.003977	37.303455	-112.61455	Pond 2	0.121872	37.247673	-112.673194
Stream 5	0.012195	37.301543	-112.61647	Pond 3	0.121969	37.25132	-112.654995
Mt. Carmel Irrigation Ditch	3.37638	37.259118	-112.65626				

No.		Date	By	Appr.
1	Updates for 2025	3/28/2025	MG	
2	Updates to show additional features	12/3/2025	KM	
3	Updates to show Existing Irrigation Ditch	2/18/2026	KM	

Aquatic Resources Detail Map (Sheet 18 of 21)

Cove - East Fork Virgin River
Watershed Plan - EIS Project
Drawn By: C Melisi
Date: 7/21/2022

0 200 400
Feet

N

Eocene Environmental Group

E-441

Study Area (719.2 ac)



Name	Acres	Lat	Long	Name	Acres	Lat	Long
East Fork VR North	0.116664	37.266034	-112.64719	Stream 6	0.058862	37.262565	-112.65143
East Fork VR South	0.022582	37.257743	-112.65519	Stream 7	0.01113	37.257852	-112.65614
East Fork VR South - Lamb's Borrow Pit	0.155236	37.228235	-112.67547	Stream 8	0.004199	37.258596	-112.65212
Stream 1	2.685577	37.274125	-112.66397	Stream 9	0.004086	37.256111	-112.65959
Stream 1A	0.021114	37.274738	-112.6632	Stream 10	0.019387	37.254452	-112.63581
Stream 2	1.217954	37.275276	-112.65728	Stream 11	0.176282	37.274707	-112.653335
Stream 2A	0.150142	37.276002	-112.65601	Wetland 1	0.032989	37.269568	-112.65711
Stream 3	0.054881	37.272271	-112.66806	Wetland 2	0.169996	37.393818	-112.61412
Stream 3A	0.004436	37.271862	-112.66882	Pond 1	0.187236	37.272445	-112.653074
Stream 4	0.003977	37.303455	-112.61455	Pond 2	0.121872	37.247673	-112.673194
Stream 5	0.012195	37.301543	-112.61647	Pond 3	0.121969	37.25132	-112.654995
Mt. Carmel Irrigation Ditch	3.37638	37.259118	-112.65626				

No.		Date	By	Appr.
1	Updates for 2025	3/28/2025	MG	
2	Updates to show additional features	12/3/2025	KM	
3	Updates to show Existing Irrigation Ditch	2/18/2026	KM	

Aquatic Resources Detail Map (Sheet 19 of 21)

Cove - East Fork Virgin River
Watershed Plan - EIS Project
Drawn By: C Melisi
Date: 7/21/2022

0 200 400
Feet

N

Eocene Environmental Group

Photo Location/Direction

Study Area (719.2 ac)



Name	Acres	Lat	Long	Name	Acres	Lat	Long
East Fork VR North	0.116664	37.266034	-112.64719	Stream 6	0.058862	37.262565	-112.65143
East Fork VR South	0.022582	37.257743	-112.65519	Stream 7	0.01113	37.257852	-112.65614
East Fork VR South - Lamb's Borrow Pit	0.155236	37.228235	-112.67547	Stream 8	0.004199	37.256596	-112.65212
Stream 1	2.685577	37.274125	-112.66397	Stream 9	0.004086	37.256111	-112.65959
Stream 1A	0.021114	37.274738	-112.6632	Stream 10	0.019387	37.254452	-112.63581
Stream 2	1.217954	37.275276	-112.65728	Stream 11	0.176282	37.274707	-112.653335
Stream 2A	0.150142	37.276002	-112.65601	Wetland 1	0.032989	37.269568	-112.65711
Stream 3	0.054881	37.272271	-112.66806	Wetland 2	0.169996	37.393818	-112.61412
Stream 3A	0.004436	37.271862	112.66882	Pond 1	0.187236	37.272445	-112.653074
Stream 4	0.003977	37.303455	-112.61455	Pond 2	0.121872	37.247673	-112.673194
Stream 5	0.012195	37.301543	-112.61647	Pond 3	0.121969	37.25132	-112.654995
Mt. Carmel Irrigation Ditch	3.37638	37.259118	-112.65626				

No.		Date	By	Appr.
1	Updates for 2025	3/28/2025	MG	
2	Updates to show additional features	12/3/2025	KM	
3	Updates to show Existing Irrigation Ditch	2/18/2026	KM	

Aquatic Resources Detail Map (Sheet 20 of 21)

Cove - East Fork Virgin River
Watershed Plan - EIS Project
Drawn By: C Melisi
Date: 7/21/2022

0 200 400
Feet

N

Eocene Environmental Group

Photo Location/Direction

Study Area (719.2 ac)

Name	Acres	Lat	Long	Name	Acres	Lat	Long
East Fork VR North	0.116664	37.266034	-112.64719	Stream 6	0.058062	37.262565	-112.65143
East Fork VR South	0.022582	37.257743	-112.65519	Stream 7	0.01113	37.257852	-112.65814
East Fork VR South -							
Lamb's Borrow Pit	0.155236	37.228235	-112.67547	Stream 8	0.004199	37.256596	-112.65212
Stream 1	2.685577	37.274125	-112.66397	Stream 9	0.004086	37.256111	-112.65959
Stream 1A	0.021114	37.274738	-112.6632	Stream 10	0.019387	37.254452	-112.63581
Stream 2	1.217954	37.275276	-112.65728	Stream 11	0.176282	37.274707	-112.653335
Stream 2A	0.150142	37.276002	-112.65601	Wetland 1	0.032989	37.269568	-112.65711
Stream 3	0.054881	37.272271	-112.66806	Wetland 2	0.169996	37.393818	-112.61412
Stream 3A	0.004436	37.271862	-112.66882	Pond 1	0.187236	37.272445	-112.653074
Stream 4	0.003977	37.303455	-112.61455	Pond 2	0.121872	37.247673	-112.673194
Stream 5	0.012195	37.301543	-112.61647	Pond 3	0.121969	37.25132	-112.654995
Mt. Carmel Irrigation							
Ditch	3.37638	37.259118	-112.65626				

No.		Date	By	Appr.
1	Updates for 2025	3/28/2025	MG	
2	Updates to show additional features	12/3/2025	KM	
3	Updates to show Existing Irrigation Ditch	2/18/2026	KM	

Aquatic Resources Detail Map (Sheet 21 of 21)

Cove - East Fork Virgin River
Watershed Plan - EIS Project
Drawn By: C Melisi
Date: 7/21/2022

0 200 400
Feet

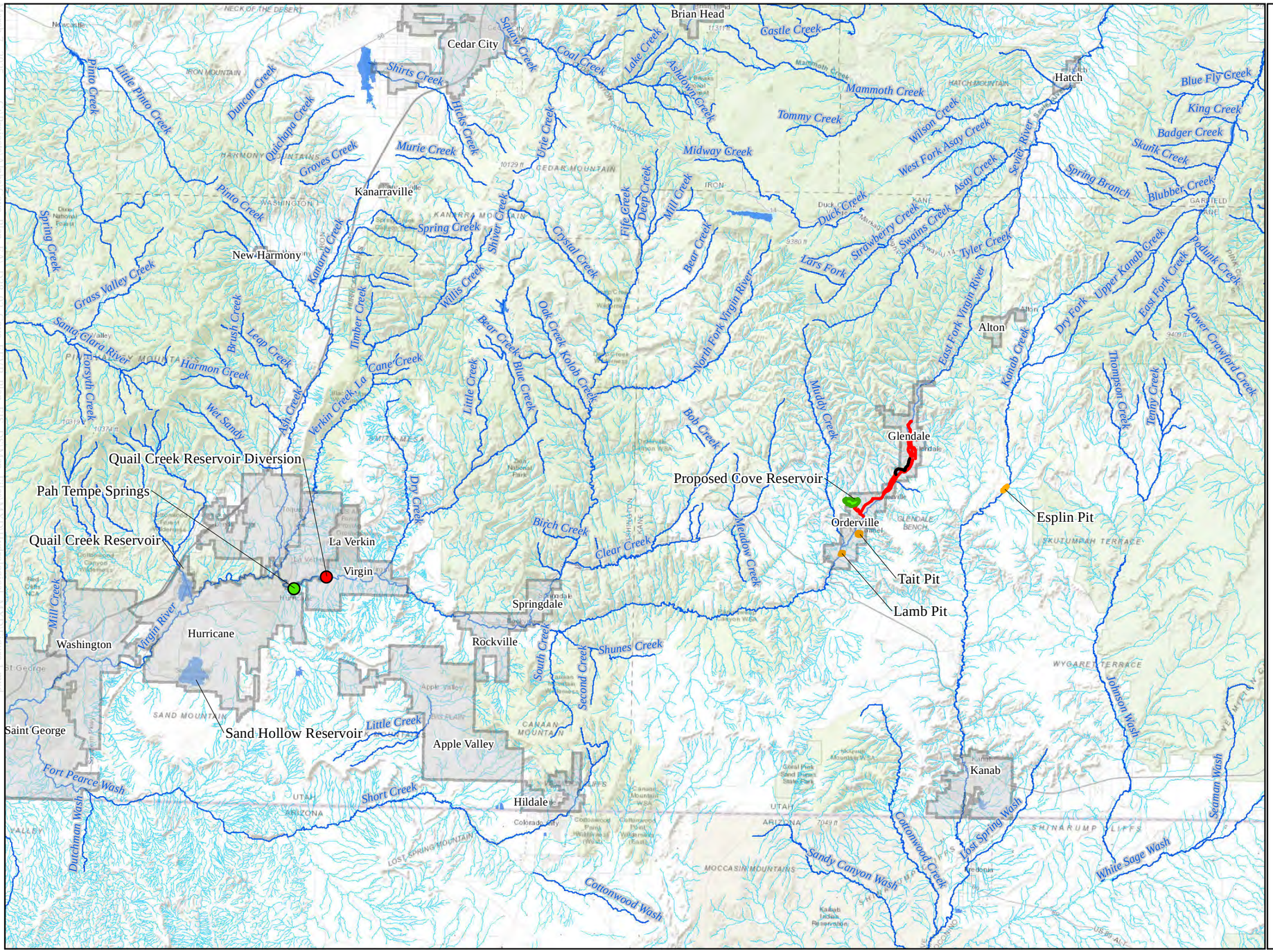
N

Eocene Environmental Group

Study Area (719.2 ac)

APPENDIX B

Supporting Maps



Proposed Cove Reservoir Vicinity Map

Cove - East Fork Virgin River Watershed Plan - EIS Project

Legend

- Proposed Cove Reservoir
- Quail Creek Reservoir Diversion
- Pah Tempe Springs
- Proposed Glendale Pipeline
- Existing Pipeline
- Borrow Pits
- Municipal Boundary
- NHD
- NWI - Lake
- NWI - Riverine

Proposed Cove Reservoir Topographic Map

Cove - East Fork Virgin River Watershed Plan - EIS Project

Legend

- Study Area
- NHD
- NWI - Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- NWI - Freshwater Pond
- NWI - Riverine

Cove Reservoir

Supplemental Survey Area

Mt. Carmel Irrigation Improvements

Tait Pit

Lamb's Pit

Esplin Pit

Glendale

Orderville

Mt Carmel

Mt. Carmel Junction

Utah

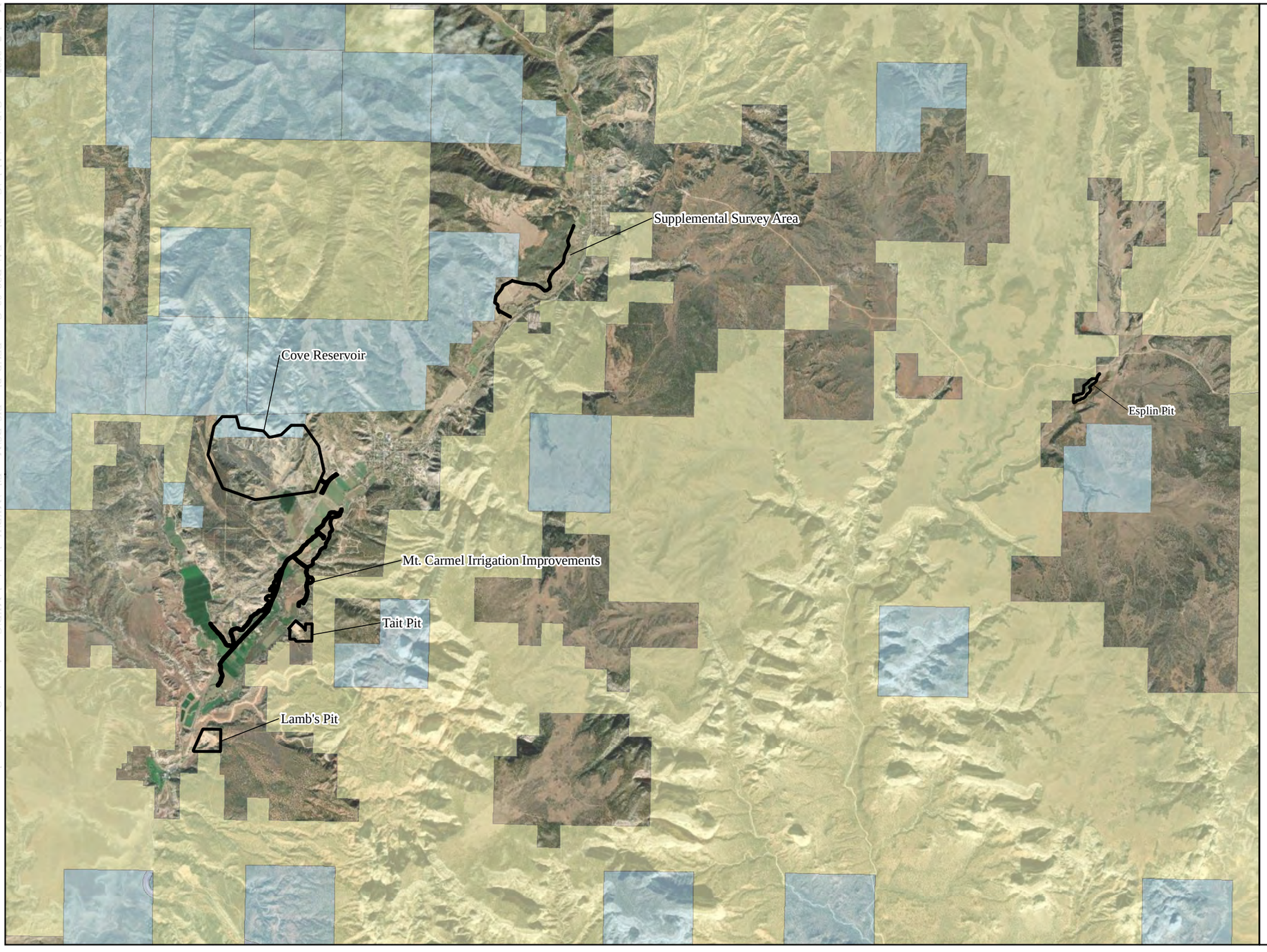
N

0 2 Miles

Eocene Environmental Group

March 7, 2025

G:\Projects\Alpha\Cove_Plan_EA_D30_02_Cove_EFVR_Plan_EIS_DSWMP\mxd\Digital_MXD\Cove_Alphaec_Cove_ewmxd



Proposed Cove Reservoir Land Ownership

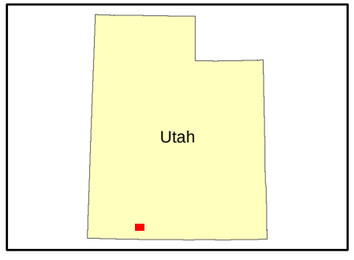
Cove - East Fork Virgin River Watershed Plan - EIS Project

Legend

- Study Area

Land Ownership

- BLM
- Private
- SITLA
- UDOT



N

0 2 Miles

Eocene™ Environmental Group

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Kane County Area, Utah



March 24, 2025

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

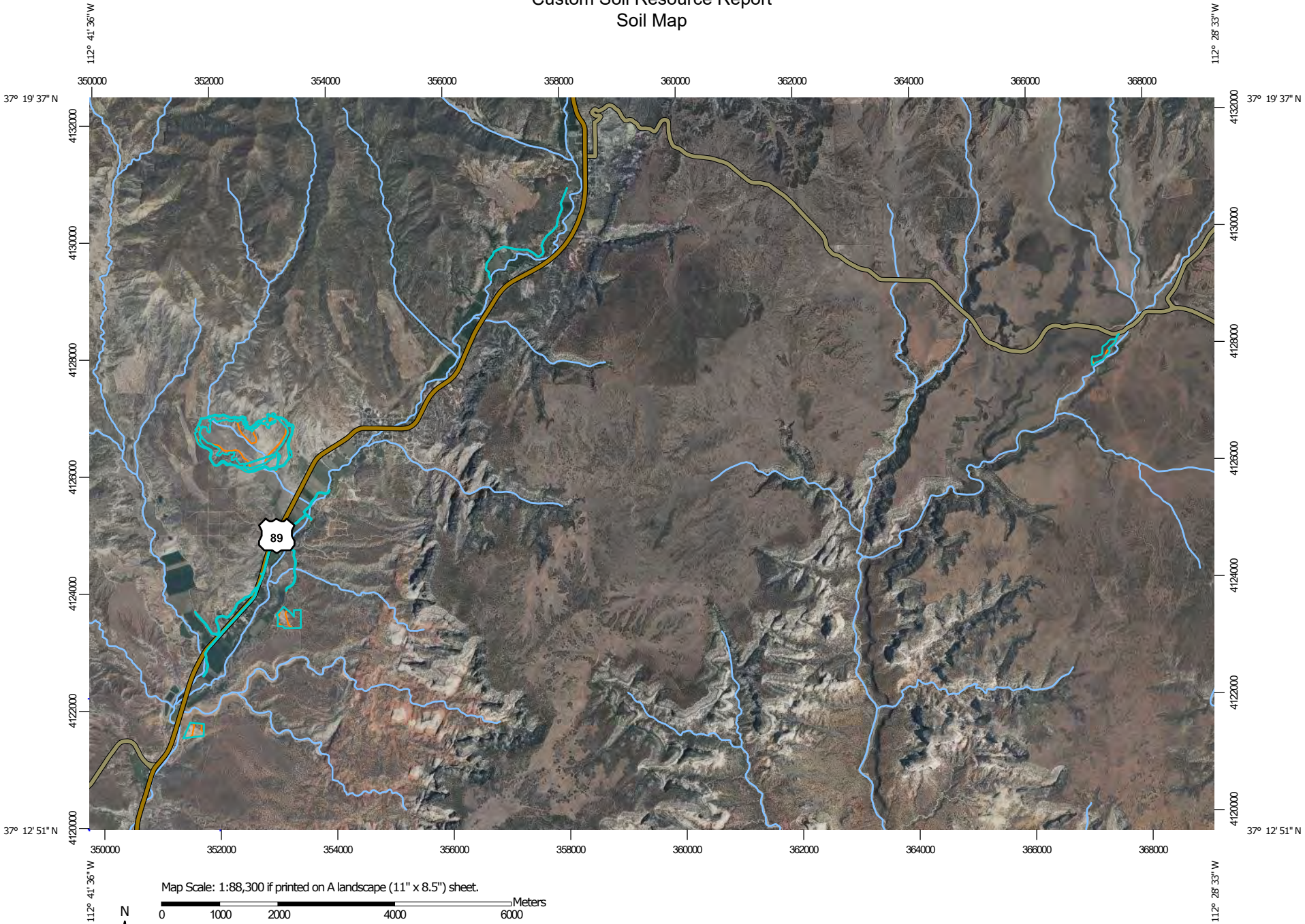
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:63,400.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Kane County Area, Utah
Survey Area Data: Version 9, Aug 28, 2024

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 5, 2021—Nov 26, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
12	Catdraw family-Orderville-Quezcan family complex, 15 to 35 percent slopes	0.2	0.1%
13	Catdraw-Quezcan-Vessilla complex, 35 to 60 percent slopes	6.5	2.0%
28	Elpedro-Plumasano-Teromote family-Flatnose complex, 0 to 8 percent slopes	1.7	0.5%
55	Naplene-Teromote-Arboles-Oxyaquic Ustifluvents complex, 2 to 8 percent slopes	27.0	8.3%
68	Pinepoint-Waumac-Royosa complex, 0 to 4 percent slopes	6.8	2.1%
69	Pinepoint-Paria-Parkwash complex, 2 to 8 percent slopes	18.0	5.5%
72	Quezcan, deep-Sideshow-Orderville complex, 15 to 35 percent slopes	42.5	13.0%
94	Sili-Sideshow-Gypsic Haplustepts complex, 2 to 15 percent slopes	169.0	51.8%
98	Tonalea family-Bamac complex, 15 to 65 percent slopes	21.9	6.7%
104	Welring-Arabrab-Rock outcrop complex, Carmel Formation, 4 to 35 percent slopes	0.2	0.1%
105	Wetoe family-Flugle-Royosa family-Lava flows complex, 2 to 60 percent slopes	11.9	3.7%
110	Zigzag family-Badland-Quezcan complex, 35 to 90 percent slopes	20.5	6.3%
Totals for Area of Interest		**326.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named

according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Kane County Area, Utah

12—Catdraw family-Orderville-Quezcan family complex, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 2ndzc
Elevation: 5,350 to 7,550 feet
Mean annual precipitation: 14 to 17 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 100 to 119 days
Farmland classification: Not prime farmland

Map Unit Composition

Catdraw family and similar soils: 40 percent
Orderville and similar soils: 30 percent
Quezcan family and similar soils: 15 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Catdraw Family

Setting

Landform: Structural benches
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from sandstone and shale over residuum weathered from sandstone and shale

Typical profile

AC - 0 to 4 inches: loam
C1 - 4 to 9 inches: loam
C2 - 9 to 27 inches: fine sandy loam
R - 27 to 37 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: 24 to 39 inches to lithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 3 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: R035XY308UT - Upland Loam (Mountain Big Sagebrush)

Hydric soil rating: No

Description of Orderville

Setting

Landform: Structural benches
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Slope alluvium derived from sandstone and shale over residuum weathered from sandstone and shale

Typical profile

A - 0 to 4 inches: silty clay loam
Bw - 4 to 12 inches: clay loam
Bk1 - 12 to 23 inches: silt loam
Bk2 - 23 to 33 inches: silt loam
Bk3 - 33 to 61 inches: silt loam

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: R035XY308UT - Upland Loam (Mountain Big Sagebrush)
Hydric soil rating: No

Description of Quezcan Family

Setting

Landform: Structural benches
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from sandstone and shale over residuum weathered from sandstone and shale

Typical profile

A - 0 to 4 inches: clay loam
BC - 4 to 15 inches: clay
C1 - 15 to 21 inches: clay loam
C2 - 21 to 24 inches: gravelly clay loam
R - 24 to 34 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Surface area covered with cobbles, stones or boulders: 7.0 percent

Depth to restrictive feature: 24 to 33 inches to lithic bedrock
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R035XY304UT - Upland Clay Loam (Pinyon - Juniper)
Hydric soil rating: No

Minor Components

Unnamed soils

Percent of map unit: 15 percent
Hydric soil rating: No

13—Catdraw-Quezcan-Vessilla complex, 35 to 60 percent slopes

Map Unit Setting

National map unit symbol: 2nd10
Elevation: 5,540 to 7,700 feet
Mean annual precipitation: 14 to 17 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 100 to 119 days
Farmland classification: Not prime farmland

Map Unit Composition

Catdraw and similar soils: 40 percent
Quezcan and similar soils: 25 percent
Vessilla and similar soils: 15 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Catdraw

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Down-slope shape: Linear

Across-slope shape: Linear
Parent material: Colluvium derived from sandstone and shale over residuum weathered from sandstone and shale

Typical profile

AC - 0 to 3 inches: gravelly sandy clay loam
C1 - 3 to 15 inches: gravelly silty clay loam
C2 - 15 to 34 inches: silty clay loam
Cy - 34 to 60 inches: silty clay loam

Properties and qualities

Slope: 35 to 60 percent
Surface area covered with cobbles, stones or boulders: 15.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 10.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Ecological site: R035XY302UT - Upland Dissected Slope (Twoneedle Pinyon-Utah Juniper)
Hydric soil rating: No

Description of Quezcan

Setting

Landform: Escarpments
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from sandstone and shale

Typical profile

AC - 0 to 5 inches: gravelly silt loam
C1 - 5 to 19 inches: very paragravelly clay
C2 - 19 to 26 inches: very paragravelly silt loam
R - 26 to 35 inches: bedrock

Properties and qualities

Slope: 35 to 60 percent
Surface area covered with cobbles, stones or boulders: 4.0 percent
Depth to restrictive feature: 22 to 33 inches to lithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches

Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: R035XY317UT - Upland Steep Stony Loam (Utah Juniper-Pinyon)
Hydric soil rating: No

Description of Vessilla

Setting

Landform: Escarpments
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from sandstone and shale

Typical profile

AC - 0 to 7 inches: gravelly fine sandy loam
R - 7 to 17 inches: bedrock

Properties and qualities

Slope: 35 to 60 percent
Depth to restrictive feature: 4 to 16 inches to lithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Very low (about 0.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: R035XY315UT - Upland Shallow Loam (Pinyon-Utah Juniper) AWC <3
Hydric soil rating: No

Minor Components

Unnamed soils

Percent of map unit: 20 percent
Hydric soil rating: No

28—Elpedro-Plumasano-Teromote family-Flatnose complex, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2mhbz
Elevation: 5,940 to 7,400 feet
Mean annual precipitation: 13 to 17 inches
Mean annual air temperature: 47 to 52 degrees F
Frost-free period: 130 to 147 days
Farmland classification: Farmland of statewide importance, if irrigated

Map Unit Composition

Elpedro and similar soils: 31 percent
Plumasano and similar soils: 30 percent
Teromote family and similar soils: 20 percent
Flatnose and similar soils: 10 percent
Minor components: 9 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Elpedro

Setting

Landform: Terraces, alluvial flats
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile

A - 0 to 4 inches: silt loam
Bt - 4 to 11 inches: silty clay loam
Btk1 - 11 to 49 inches: silty clay loam
Btk2 - 49 to 65 inches: silt loam

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 11.7 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R035XY308UT - Upland Loam (Mountain Big Sagebrush)
Hydric soil rating: No

Description of Plumasano

Setting

Landform: Terraces, alluvial flats
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile

A - 0 to 5 inches: fine sandy loam
Bw1 - 5 to 13 inches: loam
Bw2 - 13 to 36 inches: fine sandy loam
Bk - 36 to 60 inches: fine sandy loam

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 8.8 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: R035XY308UT - Upland Loam (Mountain Big Sagebrush)
Hydric soil rating: No

Description of Teromote Family

Setting

Landform: Terraces, alluvial flats
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile

A - 0 to 6 inches: fine sandy loam
Bw - 6 to 19 inches: silt loam
Bk - 19 to 32 inches: sandy clay loam
2C1 - 32 to 41 inches: silt loam

2C2 - 41 to 52 inches: silty clay loam
2C3 - 52 to 63 inches: silty clay loam

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 11.0 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R035XY308UT - Upland Loam (Mountain Big Sagebrush)
Hydric soil rating: No

Description of Flatnose

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile

C1 - 0 to 2 inches: loamy fine sand
C2 - 2 to 10 inches: sandy clay loam
C3 - 10 to 25 inches: fine sandy loam
C4 - 25 to 59 inches: gravelly loamy sand

Properties and qualities

Slope: 0 to 4 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 5.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B

Ecological site: R035XY306UT - Upland Loam (Basin Big Sagebrush)
Hydric soil rating: No

Minor Components

Unnamed soils
Percent of map unit: 9 percent
Hydric soil rating: No

55—Naplene-Teromote-Arboles-Oxyaquic Ustifluvents complex, 2 to 8 percent slopes

Map Unit Setting
National map unit symbol: 2nczn
Elevation: 6,290 to 7,250 feet
Mean annual precipitation: 14 to 17 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 100 to 119 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition
Naplene and similar soils: 45 percent
Teromote and similar soils: 20 percent
Arboles and similar soils: 15 percent
Oxyaquic ustifluvents and similar soils: 10 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Naplene

Setting
Landform: Stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile
A - 0 to 7 inches: silt loam
C1 - 7 to 12 inches: silt loam
C2 - 12 to 33 inches: silt loam
C3 - 33 to 43 inches: silt loam
C4 - 43 to 45 inches: loam
C5 - 45 to 59 inches: loam

Properties and qualities
Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches

Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 11.5 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R035XY308UT - Upland Loam (Mountain Big Sagebrush)
Hydric soil rating: No

Description of Teromote

Setting

Landform: Alluvial flats
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile

A - 0 to 6 inches: silt loam
Bw - 6 to 20 inches: clay loam
Bk - 20 to 36 inches: loam
C - 36 to 59 inches: fine sandy loam

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 10.9 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R035XY308UT - Upland Loam (Mountain Big Sagebrush)
Hydric soil rating: No

Description of Arboles

Setting

Landform: Alluvial flats

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile

A - 0 to 3 inches: clay loam
Bss1 - 3 to 21 inches: clay
Bss2 - 21 to 30 inches: clay
Ck - 30 to 32 inches: clay
2C - 32 to 43 inches: silty clay loam
3C - 43 to 59 inches: silt loam

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 10.7 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R035XY301UT - Upland Clay Loam (Low Sagebrush)
Hydric soil rating: No

Description of Oxyaquic Ustifluvents

Setting

Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile

A - 0 to 5 inches: silt loam
AC1 - 5 to 11 inches: silt loam
AC2 - 11 to 22 inches: silt loam
C1 - 22 to 33 inches: silt loam
C2 - 33 to 39 inches: silt loam
C3 - 39 to 49 inches: silt loam
Cg - 49 to 59 inches: silt loam

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Very high (about 12.1 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: B
Ecological site: R035XY010UT - Semiwet Fresh Meadow
Hydric soil rating: No

Minor Components

Unnamed soils

Percent of map unit: 10 percent
Hydric soil rating: No

68—Pinepoint-Waumac-Royosa complex, 0 to 4 percent slopes

Map Unit Setting

National map unit symbol: 2mz0b
Elevation: 4,530 to 6,360 feet
Mean annual precipitation: 13 to 17 inches
Mean annual air temperature: 47 to 52 degrees F
Frost-free period: 130 to 147 days
Farmland classification: Not prime farmland

Map Unit Composition

Pinepoint and similar soils: 50 percent
Waumac and similar soils: 25 percent
Royosa and similar soils: 20 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pinepoint

Setting

Landform: Sand sheets on alluvial flats
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sandstone

Typical profile

C1 - 0 to 17 inches: loamy fine sand

C2 - 17 to 71 inches: fine sand

Properties and qualities

Slope: 0 to 4 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: R035XY307UT - Upland Sand (Mountain Big Sagebrush)
Hydric soil rating: No

Description of Waumac

Setting

Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sandstone

Typical profile

C - 0 to 8 inches: loamy fine sand
2C - 8 to 17 inches: sandy clay loam
3C1 - 17 to 54 inches: fine sandy loam
3C2 - 54 to 69 inches: loamy fine sand

Properties and qualities

Slope: 0 to 4 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (0.20 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: Rare
Calcium carbonate, maximum content: 4 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: R035XY306UT - Upland Loam (Basin Big Sagebrush)
Hydric soil rating: No

Description of Royosa

Setting

Landform: Sand sheets on alluvial flats
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sandstone

Typical profile

A - 0 to 4 inches: loamy fine sand
C1 - 4 to 13 inches: loamy fine sand
C2 - 13 to 27 inches: loamy fine sand
C3 - 27 to 61 inches: loamy sand

Properties and qualities

Slope: 0 to 4 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: R035XY307UT - Upland Sand (Mountain Big Sagebrush)
Hydric soil rating: No

Minor Components

Unnamed soils

Percent of map unit: 5 percent
Hydric soil rating: No

69—Pinepoint-Paria-Parkwash complex, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2ml1v
Elevation: 5,040 to 7,030 feet
Mean annual precipitation: 13 to 17 inches
Mean annual air temperature: 47 to 52 degrees F
Frost-free period: 130 to 147 days

Farmland classification: Not prime farmland

Map Unit Composition

Pinepoint and similar soils: 60 percent
Paria and similar soils: 15 percent
Parkwash and similar soils: 15 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pinepoint

Setting

Landform: Sand sheets, alluvial flats
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sandstone

Typical profile

A - 0 to 4 inches: loamy sand
C1 - 4 to 17 inches: loamy sand
C2 - 17 to 48 inches: loamy sand
C3 - 48 to 62 inches: loamy sand

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: R035XY307UT - Upland Sand (Mountain Big Sagebrush)
Hydric soil rating: No

Description of Parkwash

Setting

Landform: Sand sheets
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sandstone over residuum weathered from sandstone

Typical profile

C1 - 0 to 5 inches: loamy sand
C2 - 5 to 12 inches: fine sand
R - 12 to 22 inches: bedrock

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: 8 to 19 inches to lithic bedrock
Drainage class: Excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Very low (about 0.7 inches)

Interpretive groups

Land capability classification (irrigated): 7s
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: R035XY314UT - Upland Shallow Sand (Pinyon-Utah Juniper)
Hydric soil rating: No

Description of Paria

Setting

Landform: Sand sheets
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian sands derived from sandstone

Typical profile

C1 - 0 to 7 inches: loamy fine sand
C2 - 7 to 33 inches: loamy fine sand
R - 33 to 43 inches: bedrock

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: 20 to 39 inches to lithic bedrock
Drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Very low (about 2.3 inches)

Interpretive groups

Land capability classification (irrigated): 6s
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: R035XY307UT - Upland Sand (Mountain Big Sagebrush)
Hydric soil rating: No

Minor Components

Unnamed soils

Percent of map unit: 10 percent

Hydric soil rating: No

72—Quezcan, deep-Sideshow-Orderville complex, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 2pfbl
Elevation: 5,370 to 7,570 feet
Mean annual precipitation: 14 to 17 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 100 to 119 days
Farmland classification: Not prime farmland

Map Unit Composition

Quezcan, deep, and similar soils: 35 percent
Orderville and similar soils: 25 percent
Sideshow and similar soils: 25 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Quezcan, Deep

Setting

Landform: Structural benches
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Slope alluvium derived from shale over residuum weathered from shale

Typical profile

A - 0 to 3 inches: clay loam
Bk - 3 to 20 inches: clay loam
Ck1 - 20 to 33 inches: silty clay
Ck2 - 33 to 61 inches: silty clay

Properties and qualities

Slope: 15 to 35 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Available water supply, 0 to 60 inches: High (about 10.4 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: R035XY304UT - Upland Clay Loam (Pinyon - Juniper)
Hydric soil rating: No

Description of Orderville

Setting

Landform: Structural benches
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Slope alluvium derived from shale over residuum weathered from shale

Typical profile

A - 0 to 4 inches: silt loam
Bw - 4 to 19 inches: silty clay loam
Bk1 - 19 to 46 inches: silty clay loam
Bk2 - 46 to 63 inches: silty clay loam

Properties and qualities

Slope: 15 to 35 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: R035XY305UT - Upland Loam (Gambel Oak)
Hydric soil rating: No

Description of Sideshow

Setting

Landform: Structural benches
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Slope alluvium derived from shale over residuum weathered from shale

Typical profile

A - 0 to 4 inches: silty clay
Bwss1 - 4 to 20 inches: clay

Bwss2 - 20 to 31 inches: clay
By - 31 to 53 inches: clay
C - 53 to 61 inches: silty clay loam

Properties and qualities

Slope: 15 to 35 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.4 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: R035XY304UT - Upland Clay Loam (Pinyon - Juniper)
Hydric soil rating: No

Minor Components

Unnamed soils

Percent of map unit: 15 percent
Hydric soil rating: No

94—Sili-Sideshow-Gypsic Haplustepts complex, 2 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2nd0z
Elevation: 5,430 to 7,450 feet
Mean annual precipitation: 14 to 17 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 100 to 119 days
Farmland classification: Farmland of statewide importance, if irrigated

Map Unit Composition

Sili and similar soils: 40 percent
Sideshow and similar soils: 35 percent
Gypsic haplustepts and similar soils: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sili

Setting

Landform: Structural benches
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Slope alluvium derived from shale over residuum weathered from shale

Typical profile

Ap - 0 to 5 inches: silty clay
Bw - 5 to 41 inches: silty clay
By - 41 to 50 inches: silty clay
Cy - 50 to 61 inches: silty clay

Properties and qualities

Slope: 2 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Gypsum, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.9 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R035XY301UT - Upland Clay Loam (Low Sagebrush)
Hydric soil rating: No

Description of Sideshow

Setting

Landform: Structural benches
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Slope alluvium derived from shale over residuum weathered from shale

Typical profile

Ap - 0 to 7 inches: silty clay loam
Bss - 7 to 17 inches: silty clay loam
Bw - 17 to 44 inches: silty clay loam
By1 - 44 to 56 inches: silty clay
By2 - 56 to 61 inches: silty clay loam

Properties and qualities

Slope: 2 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained

Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R035XY304UT - Upland Clay Loam (Pinyon - Juniper)
Hydric soil rating: No

Description of Gypsic Haplustepts

Setting

Landform: Structural benches
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Slope alluvium derived from shale over residuum weathered from shale

Typical profile

A - 0 to 5 inches: clay loam
Bw - 5 to 24 inches: clay loam
By1 - 24 to 37 inches: clay loam
By2 - 37 to 63 inches: clay loam

Properties and qualities

Slope: 2 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 11.5 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R035XY301UT - Upland Clay Loam (Low Sagebrush)
Hydric soil rating: No

98—Tonalea family-Bamac complex, 15 to 65 percent slopes

Map Unit Setting

National map unit symbol: 2q7f1
Elevation: 5,190 to 5,980 feet
Mean annual precipitation: 13 to 17 inches
Mean annual air temperature: 47 to 52 degrees F
Frost-free period: 130 to 147 days
Farmland classification: Not prime farmland

Map Unit Composition

Tonalea family and similar soils: 50 percent
Bamac and similar soils: 30 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tonalea Family

Setting

Landform: Ridges
Landform position (two-dimensional): Summit
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from sandstone and/or residuum weathered from sandstone

Typical profile

A - 0 to 2 inches: gravelly loamy fine sand
C - 2 to 43 inches: loamy fine sand
R - 43 to 53 inches: bedrock

Properties and qualities

Slope: 15 to 65 percent
Surface area covered with cobbles, stones or boulders: 3.0 percent
Depth to restrictive feature: 39 to 49 inches to lithic bedrock
Drainage class: Excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e

Hydrologic Soil Group: A
Ecological site: R035XY321UT - Upland Stony Loam (Pinyon-Utah Juniper)
Hydric soil rating: No

Description of Bamac

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Colluvium derived from sandstone

Typical profile

AC - 0 to 2 inches: gravelly loamy fine sand
C1 - 2 to 7 inches: very gravelly loamy fine sand
C2 - 7 to 63 inches: very cobbly loamy fine sand

Properties and qualities

Slope: 15 to 65 percent
Surface area covered with cobbles, stones or boulders: 16.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: R035XY321UT - Upland Stony Loam (Pinyon-Utah Juniper)
Hydric soil rating: No

Minor Components

Unnamed soils

Percent of map unit: 20 percent
Hydric soil rating: No

104—Welring-Arabrab-Rock outcrop complex, Carmel Formation, 4 to 35 percent slopes

Map Unit Setting

National map unit symbol: 2mgkc
Elevation: 5,940 to 7,110 feet
Mean annual precipitation: 13 to 17 inches
Mean annual air temperature: 47 to 52 degrees F
Frost-free period: 130 to 147 days
Farmland classification: Not prime farmland

Map Unit Composition

Welring and similar soils: 45 percent
Arabrab and similar soils: 25 percent
Rock outcrop, carmel formation: 15 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Welring

Setting

Landform: Structural benches, hillslopes
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from limestone over residuum weathered from limestone

Typical profile

A - 0 to 4 inches: channery sandy loam
C - 4 to 13 inches: very channery loam
R - 13 to 23 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Surface area covered with cobbles, stones or boulders: 10.0 percent
Depth to restrictive feature: 9 to 18 inches to lithic bedrock
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 60 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Very low (about 1.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: R035XY315UT - Upland Shallow Loam (Pinyon-Utah Juniper) AWC <3
Hydric soil rating: No

Description of Arabrab

Setting

Landform: Structural benches, hillslopes
Down-slope shape: Convex
Across-slope shape: Concave
Parent material: Slope alluvium derived from sandstone over residuum weathered from sandstone

Typical profile

A - 0 to 6 inches: fine sandy loam
Bt - 6 to 17 inches: loam
R - 17 to 27 inches: bedrock

Properties and qualities

Slope: 4 to 25 percent
Depth to restrictive feature: 14 to 19 inches to lithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Very low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: R035XY315UT - Upland Shallow Loam (Pinyon-Utah Juniper) AWC <3
Hydric soil rating: No

Description of Rock Outcrop, Carmel Formation

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8

Minor Components

Unnamed soils

Percent of map unit: 15 percent

Hydric soil rating: No

105—Wetoe family-Flugle-Royosa family-Lava flows complex, 2 to 60 percent slopes

Map Unit Setting

National map unit symbol: 2ml1y
Elevation: 5,960 to 7,010 feet
Mean annual precipitation: 13 to 17 inches
Mean annual air temperature: 47 to 52 degrees F
Frost-free period: 130 to 147 days
Farmland classification: Not prime farmland

Map Unit Composition

Wetoe family and similar soils: 40 percent
Flugle and similar soils: 30 percent
Lava flows: 15 percent
Royosa family and similar soils: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wetoe Family

Setting

Landform: Lava flows
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from basalt

Typical profile

A - 0 to 4 inches: very cobbly fine sandy loam
Bt - 4 to 21 inches: very cobbly fine sandy loam
R - 21 to 31 inches: bedrock

Properties and qualities

Slope: 2 to 35 percent
Surface area covered with cobbles, stones or boulders: 25.0 percent
Depth to restrictive feature: 20 to 39 inches to lithic bedrock
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.01 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Very low (about 1.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Ecological site: R035XY321UT - Upland Stony Loam (Pinyon-Utah Juniper)
Hydric soil rating: No

Description of Flugle

Setting

Landform: Lava flows
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from basalt over residuum weathered from basalt

Typical profile

A - 0 to 4 inches: fine sandy loam
Bt1 - 4 to 26 inches: loam
Bt2 - 26 to 33 inches: loam
Bt3 - 33 to 59 inches: gravelly loam

Properties and qualities

Slope: 2 to 35 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 10.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R035XY308UT - Upland Loam (Mountain Big Sagebrush)
Hydric soil rating: No

Description of Lava Flows

Setting

Landform: Lava flows
Parent material: Residuum weathered from basalt

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8

Description of Royosa Family

Setting

Landform: Cinder cones

Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Colluvium derived from pumice over residuum weathered from pumice

Typical profile

A - 0 to 7 inches: gravelly sandy loam
C1 - 7 to 39 inches: gravelly loamy sand
C2 - 39 to 59 inches: gravelly loamy sand

Properties and qualities

Slope: 35 to 60 percent
Surface area covered with cobbles, stones or boulders: 25.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High to very high (2.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: R035XY318UT - Upland Stony Loam (Wyoming Big Sagebrush, Indian Ricegrass)
Hydric soil rating: No

110—Zigzag family-Badland-Quezcan complex, 35 to 90 percent slopes

Map Unit Setting

National map unit symbol: 2nczh
Elevation: 5,440 to 7,480 feet
Mean annual precipitation: 13 to 17 inches
Mean annual air temperature: 47 to 52 degrees F
Frost-free period: 130 to 147 days
Farmland classification: Not prime farmland

Map Unit Composition

Zigzag family and similar soils: 35 percent
Quezcan and similar soils: 25 percent
Badland: 25 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Zigzag Family

Setting

Landform: Escarpments
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from shale

Typical profile

A - 0 to 4 inches: parachannery silty clay loam
Cy1 - 4 to 13 inches: very paragravelly silty clay
Cy2 - 13 to 19 inches: very paragravelly silty clay
Cr - 19 to 29 inches: bedrock

Properties and qualities

Slope: 35 to 90 percent
Surface area covered with cobbles, stones or boulders: 1.0 percent
Depth to restrictive feature: 12 to 19 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Very low (about 2.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Hydric soil rating: No

Description of Quezcan

Setting

Landform: Escarpments
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from shale and/or residuum weathered from shale

Typical profile

A - 0 to 6 inches: paragravelly silty clay
C1 - 6 to 11 inches: paragravelly silty clay loam
C2 - 11 to 22 inches: silty clay
Cr - 22 to 31 inches: bedrock

Properties and qualities

Slope: 35 to 90 percent
Surface area covered with cobbles, stones or boulders: 10.0 percent
Depth to restrictive feature: 20 to 28 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Very high

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: R035XY304UT - Upland Clay Loam (Pinyon - Juniper)
Hydric soil rating: No

Description of Badland

Setting

Landform: Escarpments
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from shale

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8

Minor Components

Unnamed soils

Percent of map unit: 15 percent
Hydric soil rating: No

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APPENDIX C

On-Site Photographs



Photo 1. View facing north (upstream) of the upstream reaches of Stream 1 showing the clear channel and vegetation lining the banks at the OHWM.



Photo 2. View facing south (downstream) of the upstream portion of Stream 1.



Photo 3. View facing northeast showing the intermittent stream channel and canyon landscape surrounding the upstream portion of Stream 1. No water was observed flowing in Stream 1 despite heavy rains 48–72 hours prior to field surveys.



Photo 4. View facing northwest (upstream) of the lower portion of Stream 1 showing the clear channel and OHWM with evidence of recent flow of precipitation and sediment.



Photo 5. View facing southeast (downstream) of the lower portion of Stream 1 showing the surrounding valley landscape farther downstream.



Photo 6. View facing northwest of the confluence of Stream 1 (left) and Stream 2 (right) at the location where the proposed dam structure would be constructed.



Photo 7. View facing west showing where sheet flow originating from the surrounding valley and Stream 3 further uphill flow along Cove Road and meet Stream 1 (right side; out of view). No OHWM was observed along the road, and Stream 3 no longer has significant surficial connectivity downstream.



Photo 8. View facing southwest of an old manmade pond feature. NWI maps indicated that this may be a wetland; however, field investigations determined that it lacked the necessary indicators characteristic of a wetland.



Photo 9. View facing southeast of a stand of coyote willow adjacent to a cattle trough south of Cove Road. Though vegetation here is FACW, the site lacked any indicators of wetland hydrology or hydric soils.



Photo 10. View facing south of W1 south of Cove Road. This manmade feature exhibited the necessary vegetation, hydrology, and soil indicators to be considered a wetland.



Photo 11. View facing northwest (upstream) of Stream 1 at the southern end of the survey area showing no clear OHWM.



Photo 12. View facing south overlooking the proposed location of the Cove Reservoir alternative.



Photo 13. View facing northwest (upstream) of Stream 1A showing the clear channel and deposition at the OHWM.



Photo 14. View facing north (upstream) of the confluence of Stream 1 (bottom) and Stream 1A.



Photo 15. View facing east of a sediment pond just above Stream 2A. The pond's basin was observed to be mostly full of sediment and does not appear to be currently functional. No wetland indicators were observed here.



Photo 16. View facing northeast (upstream) of Stream 2A. The channel (not shown) was at the bottom of this approximately 50-foot canyon.



Photo 17. View facing southwest (downstream) of Stream 2A.



Photo 18. View facing south (downstream) of the upper reach of Stream 2. The channel (not shown) was at the bottom of this approximately 50–60-foot canyon.



Photo 19. View facing northeast (upstream) of the lower reach of Stream 2 showing the channel and steep-walled banks. Early successional vegetation in the channel indicated that flow within Stream 2 is likely ephemeral.



Photo 20. View facing south (downstream) of the lower reach of Stream 2 showing the channel, active floodplain, and steep-walled banks.



Photo 21. View facing northeast (downstream) of Stream 3 west of the proposed reservoir location. Stream 3 and Stream 3A were small ephemeral streams but showed to have a defined channel and OHWM.



Photo 22. View facing southwest (upstream) of Stream 3A.



Photo 23. View facing southeast of sheet flow along Cove Road originating from Stream 3. Here Stream 3 loses all definition of a bed and bank.



Photo 24. View facing northeast showing the access to the reservoir portion of the survey area at the intersection of US-89 and Cove Road (background).



Photo 25. View facing west of the lower of three sediment ponds found west of the proposed reservoir location but within the survey area.



Photo 26. View facing southwest of W2. Replacement of the Glendale Pipeline would occur within this wetland.



Photo 27. View facing northwest (upstream) of Stream 4 showing flowing water in the channel and matted vegetation due to high flow caused by recent heavy rains.



Photo 28. View facing southeast (downstream) of Stream 4.



Photo 29. View facing northwest (upstream) of Stream 5.



Photo 30. View facing southeast of Stream 5 showing flowing water and matted vegetation due to heavy rains prior to field surveys.



Photo 31. View facing north of the Lamb borrow pit. No potentially jurisdictional WOTUS were observed here.



Photo 32. View facing northwest of where the Tait borrow pit could be expanded to. No potentially jurisdictional WOTUS were observed here.



Photo 33. View facing northeast of the Tait borrow pit.



Photo 34. View of Stream 6 facing southeast, downstream.



Photo 35. View of Stream 6 facing southeast, downstream.



Photo 36. View of Stream 7 facing southeast, downstream.



Photo 37. View of Stream 8 looking upstream. Note the irrigation pipe to be abandoned.



Photo 38. View of Stream 9 facing downstream.



Photo 39. View of Stream 10 looking downstream. Note the irrigation pipe to be abandoned.



Photo 40. View of EFVR looking downstream near the head of the proposed Glendale Pipeline.



Photo 41. View of the East Fork Virgin River looking upstream at the Pinyon Pine Drive bridge crossing.



Photo 42. View of the soil pit sample for W1 redox depressions and some gleyed matrix.



Photo 43. View of the soil pit for W1.



Photo 44: View of paired upland soil pit investigated for the delineation of W1.



Photo 45. View of soil pit investigated for W2.



Photo 46. View of soil sample for W2 showing redox depressions.



Photo 47: View of paired upland soil pit investigated for the delineation of W2.

APPENDIX D

Wetland Data Sheets

WETLAND DETERMINATION DATA FORM – Arid West Region

Project Site: Cove Reservor | City/County: Orderville/Kane | Sampling Date: 10/8/18

Applicant/Owner: Kane County Water Conservancy District | State: UT | Sampling Point: W1

Investigator(s): Brian Parker | Section, Township, Range: S5 T41S R7W

Landform (hillslope, terrace, etc.): depression | Local relief (concave, convex, none): concave | Slope (%): 1

Subregion (LRR): D | Lat: 37.269568 | Long: -112.65711 | Datum: Nad 83 Zone 12N

Soil Map Unit Name: 55—Naplene-Teromote-Arboles-Oxyaquic Ustifluvents complex, 2 to 8 percent slopes | NWI classification: lFreshwater Pond

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☒ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐

Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☒	No ☐		
Hydric Soil Present?	Yes ☒	No ☐	**Is the Sampled Area within a Wetland?**	**Yes ☒ No ☐**
Wetland Hydrology Present?	Yes ☒	No ☐		

Remarks: Wetland is the product of a man-made pond. The pond has not natural outlet and is artificially fed through underground and above ground irrigation. Isolated. No surface water appeared to be present at the time of survey and it appears that the pond is no longer used regularly.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size:1000 sq.ft.)	Absolute % Cover	Dominant Species?	Indicator Status
1. *N/A*			
2.			
3.			
4.			
50% = ____, 20% = ____	0	= Total Cover	
Sapling/Shrub Stratum (Plot size:1000 sq.ft.)			
1. *N/A*			
2.			
3.			
4.			
5.			
50% = ____, 20% = ____	0	= Total Cover	
Herb Stratum (Plot size:1000 sq.ft.)			
1. *Typha latifolia*	99	yes	OBL
2.			
3.			
4.			
5.			
6.			
7.			
8.			
50% = ____, 20% = ____	99	= Total Cover	
Woody Vine Stratum (Plot size:1000 sq.ft.)			
1. *N/A*			
2.			
50% = ____, 20% = ____	0	= Total Cover	
% Bare Ground in Herb Stratum 0	% Cover of Biotic Crust 0		

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	1	(A)
Total Number of Dominant Species Across All Strata:	1	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	100	(A/B)

Prevalence Index worksheet:

Total % Cover of :		Multiply by:	
OBL species	____	x1 =	____
FACW species	____	x2 =	____
FAC species	____	x3 =	____
FACU species	____	x4 =	____
UPL species	____	x5 =	____
Column Totals:	____ (A)		____ (B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:

☒ Dominance Test is >50%

☐ Prevalence Index is ≤3.0[1]

☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes ☒ No ☐**

Remarks: Vegetaton is almost completely cattail w/ some unknown grasses around the edge of the pond.

Project Site: Cove Reservoir

SOIL Sampling Point: W1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (Moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-4	6/10BG Gley2	80	6/4 10YR	20			clay	
0-4	Plant material	20						
4-20	6/10BG Gley2	99	6/4 10YR	20			clay	Plant material mostly absent

[1]Type: C= Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (**LRR C**)
- ☐ 1 cm Muck (A9) (**LRR D**)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☒ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☒ Redox Depressions (F8)
- ☐ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR C)**
- ☐ 2 cm Muck (A10) **(LRR B)**
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (Inches):

Hydric Soils Present? **Yes** ☒ **No** ☐

Remarks: Redox features present throughout sample pit and around roots.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1) **(Nonriverine)**
- ☐ Sediment Deposits (B2) **(Nonriverine)**
- ☐ Drift Deposits (B3) **(Nonriverine)**
- ☐ Surface Soil Cracks (B6)
- ☒ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Biotic Crust (B12)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☒ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Marks (B1) **(Riverine)**
- ☐ Sediment Deposits (B2) **(Riverine)**
- ☐ Drift Deposits (B3) **(Riverine)**
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ☐ No ☒ Depth (inches):

Water Table Present? Yes ☐ No ☒ Depth (inches):

Saturation Present? (includes capillary fringe) Yes ☐ No ☒ Depth (inches):

Wetland Hydrology Present? **Yes** ☒ **No** ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Aerial imagery and evidence of periodic artificial fed indundation (irrigation hoses/lines around pond) indicate that the pond occasionally has surface water.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project Site: Cove Reservor | City/County: Orderville/Kane | Sampling Date: 10/8/18

Applicant/Owner: Kane County Water Conservancy District | State: UT | Sampling Point: UPL1

Investigator(s): Brian Parker | Section, Township, Range: S5 T41S R7W

Landform (hillslope, terrace, etc.): hillslope | Local relief (concave, convex, none): none | Slope (%): 1

Subregion (LRR): D | Lat: 37.269568 | Long: -112.65711 | Datum: Nad 83 Zone 12N

Soil Map Unit Name: 55—Naplene-Teromote-Arboles-Oxyaquic Ustifluvents complex, 2 to 8 percent slopes | NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☒ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐

Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☐	No ☒		
Hydric Soil Present?	Yes ☐	No ☒	**Is the Sampled Area within a Wetland?**	**Yes ☐ No ☒**
Wetland Hydrology Present?	Yes ☐	No ☒		

Remarks: **Location is adjacent and slightly upslope of the man made pond/wetland feature.**

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size:200 sq. ft.)	Absolute % Cover	Dominant Species?	Indicator Status
1. *N/A*			
2.			
3.			
4.			
50% = ____, 20% = ____	0	= Total Cover	
Sapling/Shrub Stratum (Plot size:200 sq..ft.)			
1. *N/A*			
2.			
3.			
4.			
5.			
50% = ____, 20% = ____	0	= Total Cover	
Herb Stratum (Plot size:200 sq. ft.)			
1. *Atriplex confertifolia*	5	no	FAC
2. *Pascopyrum smithii*	5	no	FAC
3. *Hesperotstipa comata*	35	yes	NL (UPL)
4. *Symphyotrichum spathulatum*	10	no	UPL
5.			
6.			
7.			
8.			
50% = ____, 20% = ____	55	= Total Cover	
Woody Vine Stratum (Plot size:200 sq. ft.)			
1. *N/A*			
2.			
50% = ____, 20% = ____	0	= Total Cover	
% Bare Ground in Herb Stratum 45	% Cover of Biotic Crust 0		

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of :	Multiply by:
OBL species ____	x1 = ____
FACW species ____	x2 = ____
FAC species ____	x3 = ____
FACU species ____	x4 = ____
UPL species ____	x5 = ____
Column Totals: ____ (A)	____ (B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:

☐ Dominance Test is >50%

☐ Prevalence Index is ≤3.0[1]

☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes ☐ No ☒**

Remarks: Vegetaton is almost completely cattail w/ some unknown grasses around the edge of the pond.

Project Site: Cove Reservoir

SOIL Sampling Point: UPL1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (Moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-20	4/3 2.5 YR	100	N/A					

[1]Type: C= Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (**LRR C**)
- ☐ 1 cm Muck (A9) (**LRR D**)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR C)**
- ☐ 2 cm Muck (A10) **(LRR B)**
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (Inches):

Hydric Soils Present? **Yes** ☐ **No** ☒

Remarks: Soil slightly moist; likely due to heavy rain a few days prior to field survey (massive sheet flow, flash flooding in area)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1) **(Nonriverine)**
- ☐ Sediment Deposits (B2) **(Nonriverine)**
- ☐ Drift Deposits (B3) **(Nonriverine)**
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Biotic Crust (B12)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Marks (B1) **(Riverine)**
- ☐ Sediment Deposits (B2) **(Riverine)**
- ☐ Drift Deposits (B3) **(Riverine)**
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ☐ No ☒ Depth (inches):

Water Table Present? Yes ☐ No ☒ Depth (inches):

Saturation Present? (includes capillary fringe) Yes ☐ No ☒ Depth (inches):

Wetland Hydrology Present? **Yes** ☐ **No** ☒

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Hillside above pond

WETLAND DETERMINATION DATA FORM – Arid West Region

Project Site: Glendale Pipeline | City/County: Orderville/Kane | Sampling Date: 10/9/18

Applicant/Owner: Kane County Water Conservancy District | State: UT | Sampling Point: W2

Investigator(s): Brian Parker | Section, Township, Range: S27 T40S R7W

Landform (hillslope, terrace, etc.): pond basin | Local relief (concave, convex, none): concave | Slope (%): 0

Subregion (LRR): D | Lat: 37.303818 | Long: -112.61412 | Datum: Nad 83 Zone 12N

Soil Map Unit Name: 55—Naplene-Teromote-Arboles-Oxyaquic Ustifluvents complex, 2 to 8 percent slopes | NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☒ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐

Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☒	No ☐		
Hydric Soil Present?	Yes ☒	No ☐	**Is the Sampled Area within a Wetland?**	**Yes ☒ No ☐**
Wetland Hydrology Present?	Yes ☒	No ☐		

Remarks: **Location is within the basin of a man-made pond**

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1000 sq. ft.)	Absolute % Cover	Dominant Species?	Indicator Status
1. *N/A*			
2.			
3.			
4.			
50% = , 20% =	0	= Total Cover	
Sapling/Shrub Stratum (Plot size: 1000 sq..ft.)			
1. *Salix exigua*	70	yes	FACW
2.			
3.			
4.			
5.			
50% = , 20% =	0	= Total Cover	
Herb Stratum (Plot size: 1000 sq. ft.)			
1. *Unknown grass*	40	yes	NO
2. *Symphyotrichum spathulatum*	20	yes	FAC
3.			
4.			
5.			
6.			
7.			
8.			
50% = , 20% =	45	= Total Cover	
Woody Vine Stratum (Plot size: 1000 sq. ft.)			
1. *N/A*			
2.			
50% = , 20% =	0	= Total Cover	

% Bare Ground in Herb Stratum 20 | % Cover of Biotic Crust 0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	3	(A)
Total Number of Dominant Species Across All Strata:	3	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	100	(A/B)

Prevalence Index worksheet:

Total % Cover of :		Multiply by:	
OBL species		x1 =	
FACW species		x2 =	
FAC species		x3 =	
FACU species		x4 =	
UPL species		x5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☒ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes ☒ No ☐**

Remarks: Unable to identify grass species outside of flowering/seeding season. Assumed to be OBL, FACW, or FAC..

Project Site: Glendale Pipeline

SOIL Sampling Point: W2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (Moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-20	6/2 5YR	100	5/6 7.5YR	10			clay	redox throughout entire sample

[1]Type: C= Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (**LRR C**)
- ☐ 1 cm Muck (A9) (**LRR D**)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☒ Redox Depressions (F8)
- ☐ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR C)**
- ☐ 2 cm Muck (A10) **(LRR B)**
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (Inches): _____

Hydric Soils Present? **Yes** ☒ **No** ☐

Remarks: Soil slightly moist

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1) **(Nonriverine)**
- ☐ Sediment Deposits (B2) **(Nonriverine)**
- ☐ Drift Deposits (B3) **(Nonriverine)**
- ☒ Surface Soil Cracks (B6)
- ☒ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Biotic Crust (B12)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Marks (B1) **(Riverine)**
- ☐ Sediment Deposits (B2) **(Riverine)**
- ☐ Drift Deposits (B3) **(Riverine)**
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes	☐	No	☒	Depth (inches):	
Water Table Present?	Yes	☐	No	☒	Depth (inches):	
Saturation Present? (includes capillary fringe)	Yes	☐	No	☒	Depth (inches):	

Wetland Hydrology Present? **Yes** ☒ **No** ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Likely seasonal inundation during periods of irrigation and/or heavy precipitation

WETLAND DETERMINATION DATA FORM – Arid West Region

Project Site: Glendale Pipeline | City/County: Orderville/Kane | Sampling Date: 10/9/18

Applicant/Owner: Kane County Water Conservancy District | State: UT | Sampling Point: UPL2

Investigator(s): Brian Parker | Section, Township, Range: S27 T40S R7W

Landform (hillslope, terrace, etc.): pond basin | Local relief (concave, convex, none): concave | Slope (%): 0

Subregion (LRR): D | Lat: 37.303818 | Long: -112.61412 | Datum: Nad 83 Zone 12N

Soil Map Unit Name: 55—Naplene-Teromote-Arboles-Oxyaquic Ustifluvents complex, 2 to 8 percent slopes | NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☒ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐

Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☐	No ☒	**Is the Sampled Area within a Wetland?**	**Yes ☐ No ☒**
Hydric Soil Present?	Yes ☒	No ☐		
Wetland Hydrology Present?	Yes ☐	No ☒		

Remarks: **Location is above pond on relatively flat terrace**

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size:100 sq.ft)	Absolute % Cover	Dominant Species?	Indicator Status
1. *N/A*			
2.			
3.			
4.			
50% = ____, 20% = ____	0	= Total Cover	
Sapling/Shrub Stratum (Plot size:100 sq..ft.)			
1. *Chrysothamnus viscidiflorus*	20	yes	NL (UPL)
2. *Purshia tridentata*	20	yes	NL (UPL)
3.			
4.			
5.			
50% = ____, 20% = ____	40	= Total Cover	
Herb Stratum (Plot size:100 sq. ft.)			
1. *Sphaeralcea sp.*	10	no	NL (UPL)
2. *Salsola tragus*	5	no	FACU
3. *Erodium cicutarium*	10	no	NL (UPL)
4.			
5.			
6.			
7.			
8.			
50% = ____, 20% = ____	25	= Total Cover	
Woody Vine Stratum (Plot size:100 sq. ft.)			
1. *N/A*			
2.			
50% = ____, 20% = ____	0	= Total Cover	

% Bare Ground in Herb Stratum 20 | % Cover of Biotic Crust 0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	0	(A)
Total Number of Dominant Species Across All Strata:	2	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	0	(A/B)

Prevalence Index worksheet:

Total % Cover of :		Multiply by:	
OBL species	____	x1 =	____
FACW species	____	x2 =	____
FAC species	____	x3 =	____
FACU species	____	x4 =	____
UPL species	____	x5 =	____
Column Totals:	____ (A)		____ (B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:

- ☒ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes ☐ No ☒**

Remarks: Edge of man-made pond structure

Project Site: Glendale Pipeline

SOIL Sampling Point: UPL2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (Moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-8	5/4 2.5YR	100	N/A				Sandy	
8-20	8/3 5Y	100	6/6 7.5YR	5			Sandy	hard soil area

[1]Type: C= Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (**LRR C**)
- ☐ 1 cm Muck (A9) (**LRR D**)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☒ Redox Depressions (F8)
- ☐ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR C)**
- ☐ 2 cm Muck (A10) **(LRR B)**
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (Inches):

Hydric Soils Present? **Yes** ☒ **No** ☐

Remarks: Redox feature present below 8 inches may have existed prior to human disturbance as there is evidence of sandy soil above hard layer indicating that the soil has probably been turned over or disturbed above. Lacks hydrology and wetland veg.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1) **(Nonriverine)**
- ☐ Sediment Deposits (B2) **(Nonriverine)**
- ☐ Drift Deposits (B3) **(Nonriverine)**
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Biotic Crust (B12)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Marks (B1) **(Riverine)**
- ☐ Sediment Deposits (B2) **(Riverine)**
- ☐ Drift Deposits (B3) **(Riverine)**
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ☐ No ☒ Depth (inches):

Water Table Present? Yes ☐ No ☒ Depth (inches):

Saturation Present? (includes capillary fringe) Yes ☐ No ☒ Depth (inches):

Wetland Hydrology Present? **Yes** ☐ **No** ☒

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

US Army Corps of Engineers Arid West – Version 2.0

APPENDIX E

Ordinary High-Water Mark Data Sheets

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Cove Reservoir
Project Number:
Stream: PJD 1
Investigator(s): Brian Parker

Date: 10/8/18 **Time:** 11:20
Town: Orderville **State:** UT
Photo begin file#: **Photo end file#:**

Y [X] / N [ ] Do normal circumstances exist on the site?

Y [ ] / N [X] Is the site significantly disturbed?

Location Details:
PJD1 [illegible]' North of Reservoir + access road

Projection: UTM NAD 83 **Datum:**
Coordinates: 12S 0353659; 4126944

Potential anthropogenic influences on the channel system:
Retention Pond, (2) downstream

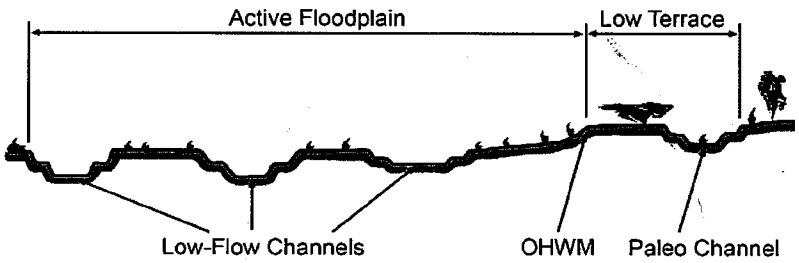
Brief site description:
Steep walled intermittent stream draining adjacent hillsides and leading to retention ponds downstream. Little to no surficial connectivity downstream of ponds

Checklist of resources (if available):

- [X] Aerial photography
  Dates:
- [ ] Topographic maps
- [X] Geologic maps
- [ ] Vegetation maps
- [X] Soils maps
- [ ] Rainfall/precipitation maps
- [ ] Existing delineation(s) for site
- [X] Global positioning system (GPS)
- [ ] Other studies

- [ ] Stream gage data
  Gage number:
  Period of record:
  - [ ] History of recent effective discharges
  - [ ] Results of flood frequency analysis
  - [ ] Most recent shift-adjusted rating
  - [ ] Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

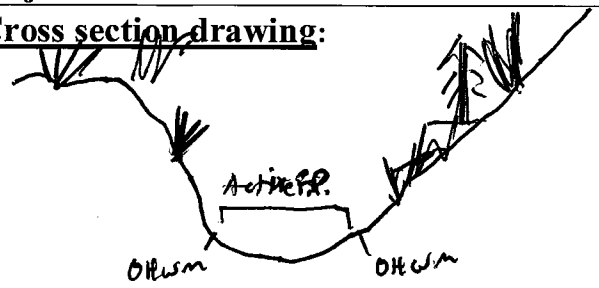


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - [X] Mapping on aerial photograph
   - [X] Digitized on computer
   - [X] GPS
   - [ ] Other:

Project ID: Cove **Cross section ID:** XSD 1 **Date:** 10/8/14 **Time:** 11:20

Cross section drawing:



OHWM

GPS point: 12S 0353490 ; 4126985

Indicators:

- [x] Change in average sediment texture
- [ ] Change in vegetation species
- [x] Change in vegetation cover
- [x] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Steep walled banks. Channel void of vegetation.

Floodplain unit: [x] Low-Flow Channel [ ] Active Floodplain [ ] Low Terrace

GPS point: 12S 0353490 ; 4127009

Characteristics of the floodplain unit:

Average sediment texture: fine silt

Total veg cover: 0 % Tree: ____% Shrub: ____% Herb: ____%

Community successional stage:

- [x] NA
- [ ] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [ ] Late (herbaceous, shrubs, mature trees)

Indicators:

- [x] Mudcracks
- [x] Ripples
- [x] Drift and/or debris
- [ ] Presence of bed and bank
- [ ] Benches
- [ ] Soil development
- [ ] Surface relief
- [ ] Other: _____
- [ ] Other: _____
- [ ] Other: _____

Comments:

Recent flow due to heavy rainfall in the days prior to survey

Project ID: Cove **Cross section ID:** PSD 1 **Date:** 10/8/18 **Time:** 11:20

Floodplain unit: ☐ Low-Flow Channel ☒ Active Floodplain ☐ Low Terrace

GPS point: 12S 0353490; 4136985

Characteristics of the floodplain unit:

Average sediment texture: clay

Total veg cover: 5 % Tree: 0 % Shrub: 2 % Herb: 3 %

Community successional stage:

- ☐ NA
- ☒ Early (herbaceous & seedlings)
- ☒ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☒ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Steep walled bank @ floodplain edge

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☐ ~~Low Terrace~~ N/A

GPS point: _____

Characteristics of the floodplain unit:

Average sediment texture: _____

Total veg cover: _____ % Tree: _____ % Shrub: _____ % Herb: _____ %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

No Low terrace here.

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Cove Reservoir	**Date:** 10/8/18	**Time:** 1300
Project Number:	**Town:** Orderville	**State:** UT
Stream: PJD 1a	**Photo begin file#:**	**Photo end file#:**
Investigator(s):		

Y [X] / N [ ] Do normal circumstances exist on the site?

Y [ ] / N [X] Is the site significantly disturbed?

Location Details: Tributary to PJD 1

Projection: UTM **Datum:** NAD 83

Coordinates: 12S 352531; 4132 6665

Potential anthropogenic influences on the channel system:

None

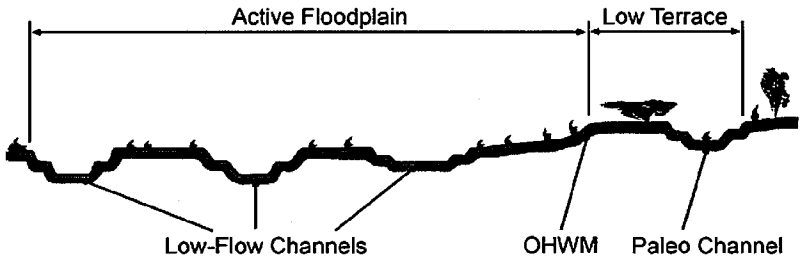
Brief site description:

Small tributary w/ approx 2-3 ft wide channel. Medium sloped banks; clear channel w/ OHWM

Checklist of resources (if available):

- [X] Aerial photography
  - Dates:
- [X] Topographic maps
- [ ] Geologic maps
- [ ] Vegetation maps
- [X] Soils maps
- [ ] Rainfall/precipitation maps
- [ ] Existing delineation(s) for site
- [X] Global positioning system (GPS)
- [ ] Other studies
- [ ] Stream gage data
  - Gage number:
  - Period of record:
- [ ] History of recent effective discharges
- [ ] Results of flood frequency analysis
- [ ] Most recent shift-adjusted rating
- [ ] Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

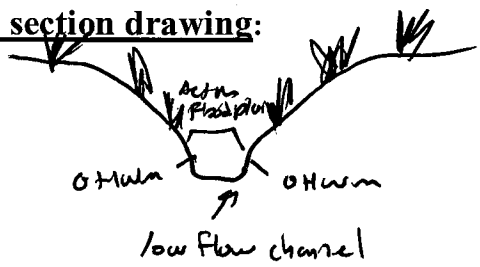


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - [X] Mapping on aerial photograph
   - [X] Digitized on computer
   - [X] GPS
   - [ ] Other:

Project ID: Love **Cross section ID:** PJD 19 **Date:** 10/9/18 **Time:** 1300

Cross section drawing:



OHWM

GPS point: 125 352531; 4126613

Indicators:

- [ ] Change in average sediment texture
- [ ] Change in vegetation species
- [x] Change in vegetation cover
- [x] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Clear channel. No veg. Evidence of recent flow

Floodplain unit:

- [x] Low-Flow Channel
- [ ] Active Floodplain
- [ ] Low Terrace

GPS point: 125 352530; 4126663

Characteristics of the floodplain unit:

Average sediment texture: Medium sand

Total veg cover: 0 % Tree: _____ % Shrub: _____ % Herb: _____ %

Community successional stage:

- [x] NA
- [ ] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [ ] Late (herbaceous, shrubs, mature trees)

Indicators:

- [x] Mudcracks
- [x] Ripples
- [ ] Drift and/or debris
- [ ] Presence of bed and bank
- [ ] Benches
- [ ] Soil development
- [ ] Surface relief
- [ ] Other: _____
- [ ] Other: _____
- [ ] Other: _____

Comments:

No vegetation in channel

Project ID: Cove **Cross section ID:** PJD 1a **Date:** 10/9/18 **Time:** 1300

Floodplain unit: ☐ Low-Flow Channel ☒ Active Floodplain ☐ Low Terrace

GPS point: 12S 352581; 4126663

Characteristics of the floodplain unit:

Average sediment texture: medium sand

Total veg cover: 15 % Tree: 0 % Shrub: 10 % Herb: 5 %

Community successional stage:

- ☐ NA
- ☒ Early (herbaceous & seedlings)
- ☒ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☒ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Narrow floodplain due to deep bank steep bank

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☒ Low Terrace

GPS point: N/A

Characteristics of the floodplain unit:

Average sediment texture: _____

Total veg cover: _____ % Tree: _____ % Shrub: _____ % Herb: _____ %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

No terracing

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Cove Reservoir
Project Number:
Stream: PJD 2
Investigator(s): Brian Parker

Date: 10/8/18 **Time:** 13:45
Town: Orderville **State:** UT
Photo begin file#: [redacted] **Photo end file#:** [redacted]

Y ☒ / N ☐ Do normal circumstances exist on the site?

Y ☐ / N ☒ Is the site significantly disturbed?

Location Details: Cove Reservoir footprint

Projection: utm **Datum:** NAD 83

Coordinates: 12S 6352969 ; 412 6425

Potential anthropogenic influences on the channel system:

Irrigation downstream ; grazing

Brief site description:

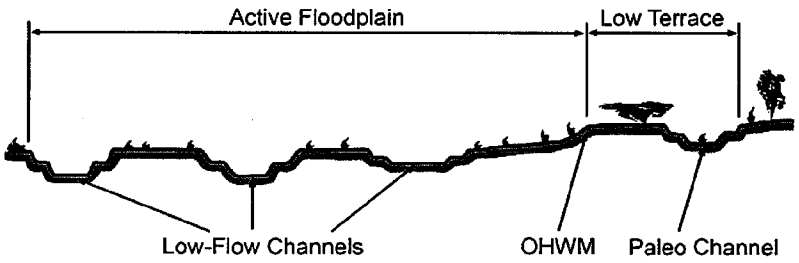
Intermittent stream running ~~West~~ East. ~~from~~ Looks to drain large watershed beyond the footprint of the project.

Checklist of resources (if available):

- ☒ Aerial photography
  Dates:
- ☒ Topographic maps
- ☐ Geologic maps
- ☐ Vegetation maps
- ☐ Soils maps
- ☐ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ☒ Global positioning system (GPS)
- ☐ Other studies

- ☐ Stream gage data
  Gage number:
  Period of record:
- ☐ History of recent effective discharges
- ☐ Results of flood frequency analysis
- ☐ Most recent shift-adjusted rating
- ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

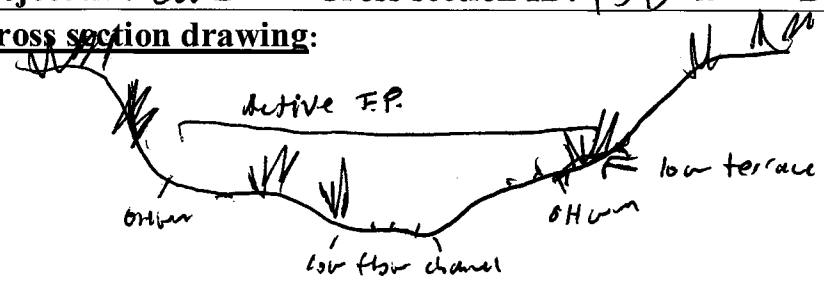


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ☒ Mapping on aerial photograph
   - ☒ Digitized on computer
   - ☐ GPS
   - ☐ Other:

Project ID: Cove **Cross section ID:** PJD 2 **Date:** 10/8/18 **Time:** 1345

Cross section drawing:



OHWM

GPS point: 125 0352970; 4126430

Indicators:

- [x] Change in average sediment texture
- [ ] Change in vegetation species
- [x] Change in vegetation cover
- [x] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Medium to steep walled banks above OHWM funnel flow fairly consistently with little ability to meander.

Floodplain unit:

- [x] Low-Flow Channel
- [ ] Active Floodplain
- [ ] Low Terrace

GPS point: 125 0352968; 4126432

Characteristics of the floodplain unit:

Average sediment texture: Clay

Total veg cover: 30 % Tree: 0 % Shrub: 20 % Herb: 10 %

Community successional stage:

- [ ] NA
- [x] Early (herbaceous & seedlings)
- [x] Mid (herbaceous, shrubs, saplings)
- [ ] Late (herbaceous, shrubs, mature trees)

Indicators:

- [x] Mudcracks
- [x] Ripples
- [x] Drift and/or debris
- [ ] Presence of bed and bank
- [ ] Benches
- [ ] Soil development
- [ ] Surface relief
- [ ] Other: _____
- [ ] Other: _____
- [ ] Other: _____

Comments:

Recent flow. Channel has some herbaceous ~~cover~~ seedlings and grasses

Project ID: Cora **Cross section ID:** PSD 2 **Date:** 10/8/18 **Time:** 1345

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☒ Low Terrace

GPS point: 125 0352970; 4126428

Characteristics of the floodplain unit:

Average sediment texture: Clay

Total veg cover: 41 % Tree: 1 % Shrub: 20 % Herb: 20 %

Community successional stage:

- ☐ NA
- ☒ Early (herbaceous & seedlings)
- ☒ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Terraces only in some areas, Mostly on ~~[illegible]~~ / near beds. Evidence of grazing throughout edges of stream and surrounding valley

Floodplain unit: ☐ Low-Flow Channel ☒ Active Floodplain ☐ Low Terrace

GPS point: 125 0352965; 4126431

Characteristics of the floodplain unit:

Average sediment texture: Clay

Total veg cover: 50 % Tree: 0 % Shrub: 40 % Herb: 10 %

Community successional stage:

- ☐ NA
- ☒ Early (herbaceous & seedlings)
- ☒ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☒ Presence of bed and bank
- ☒ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Floodplain is more prominent in areas along the inside of bends in the stream

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Cove Reservoir
Project Number:
Stream: PJD 2 (upstream)
Investigator(s): Brian Parker

Date: 10/8/18 **Time:** 1630
Town: Orderville **State:** UT
Photo begin file#: **Photo end file#:**

Y [X] / N [ ] Do normal circumstances exist on the site?

Y [ ] / N [X] Is the site significantly disturbed?

Location Details: upstream portion of PJD 2

Projection: NAD 83 **Datum:** UTM
Coordinates: 12S 0353122; 4126795

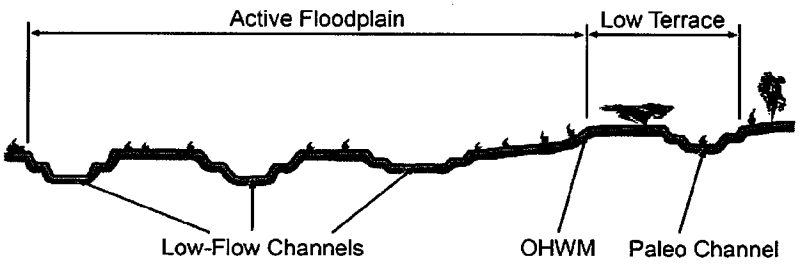
Potential anthropogenic influences on the channel system:
Numerous flood control retention ponds upstream

Brief site description:
steep canyon portion of PJD 2 (upstream). This northern section is very deep with a narrow 'slot' channel at the bottom.

Checklist of resources (if available):

- [X] Aerial photography
  - Dates:
- [X] Topographic maps
- [ ] Geologic maps
- [ ] Vegetation maps
- [X] Soils maps
- [ ] Rainfall/precipitation maps
- [ ] Existing delineation(s) for site
- [X] Global positioning system (GPS)
- [ ] Other studies
- [ ] Stream gage data
  - Gage number:
  - Period of record:
  - [ ] History of recent effective discharges
  - [ ] Results of flood frequency analysis
  - [ ] Most recent shift-adjusted rating
  - [ ] Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

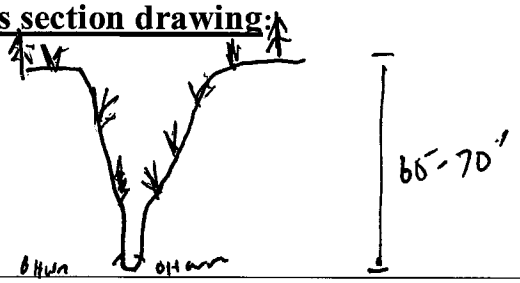


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - [X] Mapping on aerial photograph
   - [X] Digitized on computer
   - [X] GPS
   - [ ] Other:

Project ID: Cove **Cross section ID:** PJD2 (upstream) **Date:** 8/8/18 **Time:** 1630

Cross section drawing:



OHWM

GPS point: _____

Indicators:

- [ ] Change in average sediment texture
- [ ] Change in vegetation species
- [ ] Change in vegetation cover
- [x] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

slot canyon at bottom, progressively deeper as you go upstream

Floodplain unit: [x] Low-Flow Channel [ ] Active Floodplain [ ] Low Terrace

GPS point: _____

Characteristics of the floodplain unit:

Average sediment texture: clay

Total veg cover: 10 % Tree: 0 % Shrub: 5 % Herb: 5 %

Community successional stage:

- [x] NA
- [x] Early (herbaceous & seedlings)
- [x] Mid (herbaceous, shrubs, saplings)
- [ ] Late (herbaceous, shrubs, mature trees)

Indicators:

- [x] Mudcracks
- [x] Ripples
- [x] Drift and/or debris
- [ ] Presence of bed and bank
- [ ] Benches
- [ ] Soil development
- [ ] Surface relief
- [ ] Other: _____
- [ ] Other: _____
- [ ] Other: _____

Comments:

Some veg. growing in slot channel.

Project ID: COVE **Cross section ID:** PJD2 (upstream) **Date:** 10/8/14 **Time:** 1630

Floodplain unit: ☐ Low-Flow Channel ☒ Active Floodplain ☐ Low Terrace

GPS point: _____

Characteristics of the floodplain unit:

Average sediment texture: Clay

Total veg cover: 20 % Tree: ____ % Shrub: 15 % Herb: 5 %

Community successional stage:

- ☐ NA
- ☒ Early (herbaceous & seedlings)
- ☒ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☒ Presence of bed and bank
- ☒ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Some benches where stream meanders. Not a continous floodplain

Mostly just a channel @ the bottom of the canyon

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☐ ~~Low Terrace~~ N/A

GPS point: _____

Characteristics of the floodplain unit:

Average sediment texture: _____

Total veg cover: ____ % Tree: ____ % Shrub: ____ % Herb: ____ %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

No terrace. Only steep canyon walls

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Cove Reservoir
Project Number:
Stream: PJD 3 (downstream)
Investigator(s): Brian Carter

Date: 10/8/14 **Time:** 1730
Town: Orderville **State:** UT
Photo begin file#: **Photo end file#:**

Y ☒ / N ☐ Do normal circumstances exist on the site?

Y ☐ / N ☒ Is the site significantly disturbed?

Location Details:
lower reach of PJD 3

Projection: UTM **Datum:** NAD 83
Coordinates: 12S 0352740 ; 4126424

Potential anthropogenic influences on the channel system:

None @ this reach of PJD 3

Brief site description:

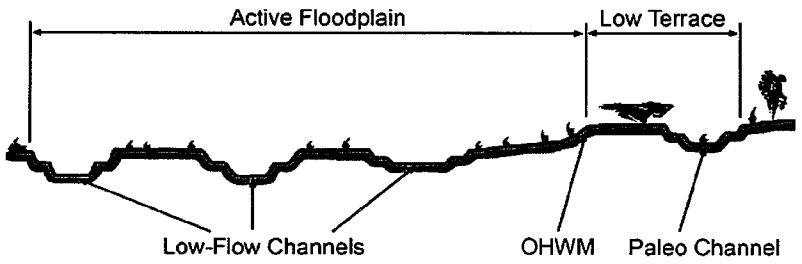
lower reach of intermittent stream before confluence w/ PJD 2. Evidence of heavy flood event last week (large shrubs layed down or uprooted, Debris)

Checklist of resources (if available):

- ☒ Aerial photography
  Dates:
- ☒ Topographic maps
- ☐ Geologic maps
- ☐ Vegetation maps
- ☒ Soils maps
- ☒ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ☒ Global positioning system (GPS)
- ☐ Other studies

- ☐ Stream gage data
  Gage number:
  Period of record:
- ☐ History of recent effective discharges
- ☐ Results of flood frequency analysis
- ☐ Most recent shift-adjusted rating
- ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

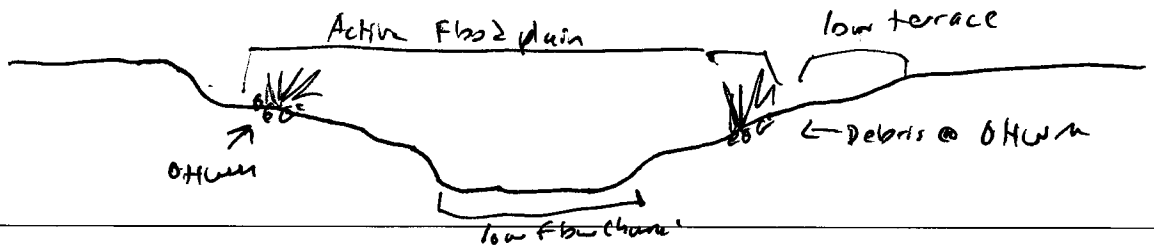


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ☒ Mapping on aerial photograph
   - ☒ Digitized on computer
   - ☒ GPS
   - ☐ Other:

Project ID: Core **Cross section ID:** PJJ3 downstream **Date:** 10/9/18 **Time:** 1730

Cross section drawing:



OHWM

GPS point: 12S 0352739; 4126426

Indicators:

- [ ] Change in average sediment texture
- [ ] Change in vegetation species
- [x] Change in vegetation cover
- [x] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Significant debris observed @ OHWM. May be larger than normal flood event that occurred last week/weekend. Approx. width ~~8~~ 20 feet

Floodplain unit:

- [x] Low-Flow Channel
- [ ] Active Floodplain
- [ ] Low Terrace

GPS point: 12S 0352737; 4126422

Characteristics of the floodplain unit:

Average sediment texture: pebble

Total veg cover: 0 % Tree: _____% Shrub: _____% Herb: _____%

Community successional stage:

- [x] NA
- [ ] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [ ] Late (herbaceous, shrubs, mature trees)

Indicators:

- [x] Mudcracks
- [x] Ripples
- [ ] Drift and/or debris
- [ ] Presence of bed and bank
- [ ] Benches
- [ ] Soil development
- [ ] Surface relief
- [ ] Other: _____
- [ ] Other: _____
- [ ] Other: _____

Comments:

Mix of sand, cobble and boulders

Project ID: Cove **Cross section ID:** SSD3 downstream **Date:** 10/8/18 **Time:** 1730

Floodplain unit: ☐ Low-Flow Channel ☒ Active Floodplain ☐ Low Terrace

GPS point: 125 0352735; 4126419

Characteristics of the floodplain unit:

Average sediment texture: Medium sand

Total veg cover: 30 % Tree: X % Shrub: 25 % Herb: 5 %

Community successional stage:

- ☐ NA
- ☒ Early (herbaceous & seedlings)
- ☒ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☒ Drift and/or debris
- ☒ Presence of bed and bank
- ☒ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Large flood event may have widened floodplain as evident by scouring of banks and uprooting/laydown of medium sized shrubs.

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☒ Low Terrace

GPS point: 125 0352733; 4126414

Characteristics of the floodplain unit:

Average sediment texture: Fine sand/silt

Total veg cover: 50 % Tree: X % Shrub: 45 % Herb: 5 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☒ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☒ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Evidence of sheet flow from recent event.

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Cove Reservoir
Project Number:
Stream: PJD 3 (upstream)
Investigator(s): Brian Parker

Date: 10/9/18 **Time:** 1230
Town: Orderville **State:** UT
Photo begin file#: **Photo end file#:**

Y [X] / N [ ] Do normal circumstances exist on the site?

Y [ ] / N [X] Is the site significantly disturbed?

Location Details:
Upstream canyon reach of PJD 3

Projection: UTM **Datum:** NAD 83
Coordinates: 12S 0351949; 4127317

Potential anthropogenic influences on the channel system:

None

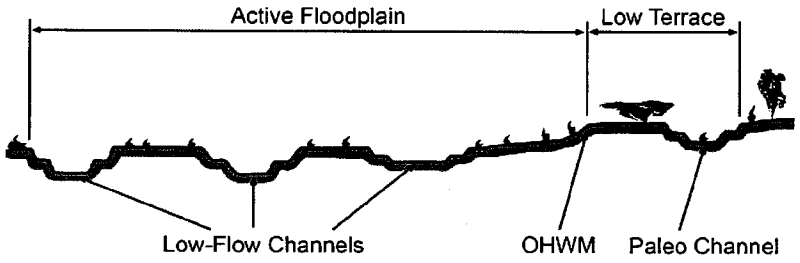
Brief site description:

Deep canyon (~25-30 ft.) in pinyon-juniper habitat

Checklist of resources (if available):

- [X] Aerial photography
  Dates:
- [X] Topographic maps
- [ ] Geologic maps
- [ ] Vegetation maps
- [X] Soils maps
- [ ] Rainfall/precipitation maps
- [ ] Existing delineation(s) for site
- [X] Global positioning system (GPS)
- [ ] Other studies
- [ ] Stream gage data
  Gage number:
  Period of record:
  - [ ] History of recent effective discharges
  - [ ] Results of flood frequency analysis
  - [ ] Most recent shift-adjusted rating
  - [ ] Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

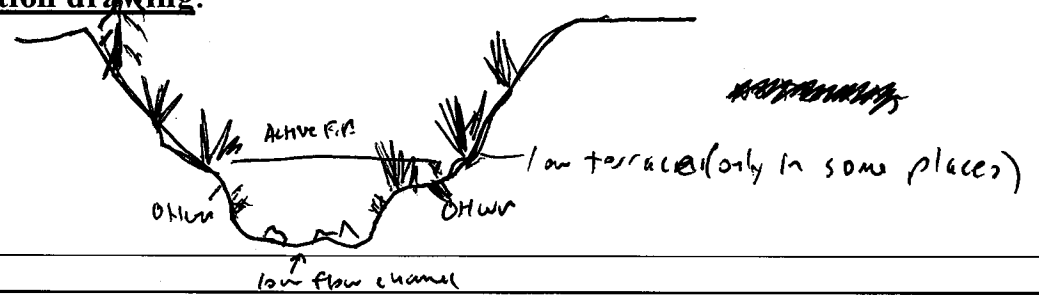


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - [X] Mapping on aerial photograph
   - [X] Digitized on computer
   - [X] GPS
   - [ ] Other:

Project ID: Cove **Cross section ID:** POD 3 (upstream) **Date:** 10/9/18 **Time:** 1230

Cross section drawing:



OHWM

GPS point: 125 0351948; 4127317

Indicators:

- [ ] Change in average sediment texture
- [ ] Change in vegetation species
- [x] Change in vegetation cover
- [x] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Well defined. Mix of clay + boulders

Floodplain unit:

- [x] Low-Flow Channel
- [ ] Active Floodplain
- [ ] Low Terrace

GPS point: 125 0351944; 4127314

Characteristics of the floodplain unit:

Average sediment texture: Boulder

Total veg cover: 0 % Tree: _____% Shrub: _____% Herb: _____%

Community successional stage:

- [x] NA
- [ ] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [ ] Late (herbaceous, shrubs, mature trees)

Indicators:

- [x] Mudcracks
- [x] Ripples
- [x] Drift and/or debris
- [ ] Presence of bed and bank
- [ ] Benches
- [ ] Soil development
- [ ] Surface relief
- [ ] Other: _____
- [ ] Other: _____
- [ ] Other: _____

Comments:

Project ID: COVE **Cross section ID:** QSD3upstream **Date:** 10/9/14 **Time:** 1235

Floodplain unit: ☐ Low-Flow Channel ☒ Active Floodplain ☐ Low Terrace

GPS point: 12S 0351944; 4127314

Characteristics of the floodplain unit:

Average sediment texture: Medium sand / cobble

Total veg cover: 20 % Tree: 0 % Shrub: 10 % Herb: 10 %

Community successional stage:

- ☐ NA
- ☒ Early (herbaceous & seedlings)
- ☒ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☒ Presence of bed and bank
- ☒ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Small, narrow floodplain above low flow due to steep canyon walls

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☒ Low Terrace

GPS point: 12S 0351944; 4127313

Characteristics of the floodplain unit:

Average sediment texture: _____

Total veg cover: 50 % Tree: _____ % Shrub: 30 % Herb: 20 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☒ Mid (herbaceous, shrubs, saplings)
- ☒ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☒ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Terracing only in a few places along this stretch

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Cove Reruar
Project Number:
Stream: PJD4
Investigator(s): Brian Parker

Date: 10/8/18 **Time:** 1500
Town: Orderville **State:** UT
Photo begin file#: **Photo end file#:**

Y [X] / N [ ] Do normal circumstances exist on the site?

Y [ ] / N [X] Is the site significantly disturbed?

Location Details:
East fork above PJD 2

Projection: ~~UTM~~ UTM **Datum:** ~~NAD83~~ NAD83
Coordinates: 12S 035 3214; 4127015

Potential anthropogenic influences on the channel system:
upstream, 2 retention ponds are found which collect water that would normally flow downstream. water in this small canyon only flows from adjacent sheet flow runoff and during heavy rains where the ponds overflow

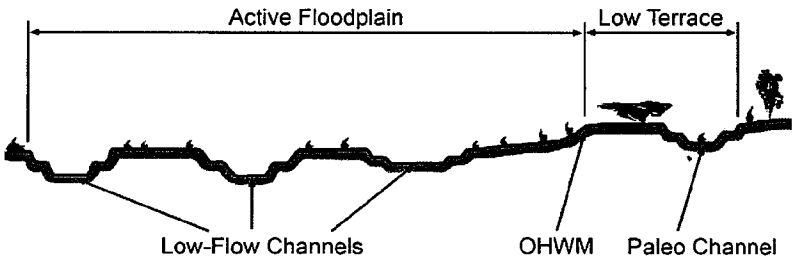
Brief site description:
small tributary canyon (~50 ft. deep) leading to PJD 2

Checklist of resources (if available):

- [X] Aerial photography
  Dates:
- [X] Topographic maps
- [ ] Geologic maps
- [ ] Vegetation maps
- [X] Soils maps
- [ ] Rainfall/precipitation maps
- [ ] Existing delineation(s) for site
- [X] Global positioning system (GPS)
- [ ] Other studies

- [ ] Stream gage data
  Gage number:
  Period of record:
- [ ] History of recent effective discharges
- [ ] Results of flood frequency analysis
- [ ] Most recent shift-adjusted rating
- [ ] Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

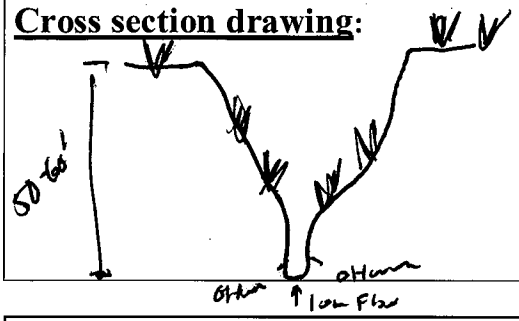


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - [X] Mapping on aerial photograph
   - [X] Digitized on computer
   - [X] GPS
   - [ ] Other:

Project ID: Cove **Cross section ID:** PJD 4 **Date:** 10/4/19 **Time:** 1500

Cross section drawing:



OHWM

GPS point: 12S 0353212; 4127018

Indicators:

- [ ] Change in average sediment texture
- [ ] Change in vegetation species
- [x] Change in vegetation cover
- [x] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

50'-60' deep canyon. Not traversible by foot. Observations from above indicated a clear channel ~~[illegible]~~. Approximately 8 ft. wide @ bottom here.

Floodplain unit: [x] Low-Flow Channel [ ] Active Floodplain [ ] Low Terrace

GPS point: 12S 0353212; 4127019

Characteristics of the floodplain unit:

Average sediment texture: Clay

Total veg cover: 0 % Tree: ____ % Shrub: ____ % Herb: ____ %

Community successional stage:

- [x] NA
- [ ] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [ ] Late (herbaceous, shrubs, mature trees)

Indicators:

- [x] Mudcracks
- [x] Ripples
- [ ] Drift and/or debris
- [ ] Presence of bed and bank
- [ ] Benches
- [ ] Soil development
- [ ] Surface relief
- [ ] Other: _____
- [ ] Other: _____
- [ ] Other: _____

Comments:

Project ID: Love **Cross section ID:** PJD 4 **Date:** 10/8/18 **Time:** 1500

Floodplain unit: ☐ Low-Flow Channel ☒ Active Floodplain ☐ Low Terrace

GPS point: 12S 0353212; 4127018

Characteristics of the floodplain unit:

Average sediment texture: clay

Total veg cover: 5 % Tree: ____ % Shrub: 3 % Herb: 2 %

Community successional stage:

- ☐ NA
- ☒ Early (herbaceous & seedlings)
- ☒ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: ____
- ☐ Other: ____
- ☐ Other: ____

Comments:

Some veg. lining walls of canyon

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: 12S 0353214; 4127015 (@ exit of upper canyon) N/A

Characteristics of the floodplain unit:

Average sediment texture: ____

Total veg cover: ____ % Tree: ____ % Shrub: ____ % Herb: ____ %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: ____
- ☐ Other: ____
- ☐ Other: ____

Comments:

No terrace. Steep canyon walls, contain all flow to slot-like canyon.

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Cove Reservoir
Project Number:
Stream: PSD 5
Investigator(s): Brian Parker

Date: 10/9/18 **Time:** 11:30
Town: Orderville **State:** UT
Photo begin file#: **Photo end file#:**

Y [X] / N [ ] Do normal circumstances exist on the site?

Y [ ] / N [X] Is the site significantly disturbed?

Location Details:
upstream portion of PSD 5

Projection: UTM **Datum:** NAD83
Coordinates: 12S 0352081 ; 4126364

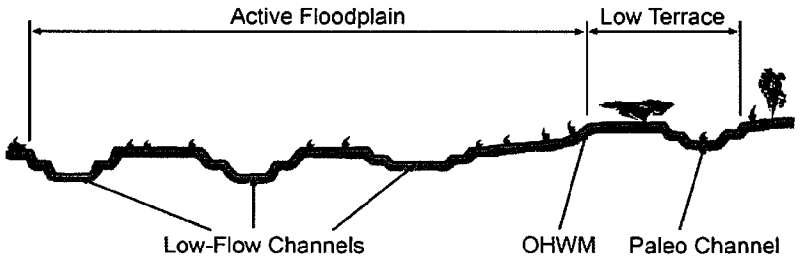
Potential anthropogenic influences on the channel system:
None upstream. Downstream is a dirt road that has been constructed where flow naturally occurs. Recent sheet flow due to flooding in the area appears to have obscured a clearly defined channel

Brief site description:
Gully or deeply eroded channel; moderately deep (2-3 ft.) w/ cut bank

Checklist of resources (if available):

- [X] Aerial photography
  Dates:
- [X] Topographic maps
- [ ] Geologic maps
- [ ] Vegetation maps
- [X] Soils maps
- [ ] Rainfall/precipitation maps
- [ ] Existing delineation(s) for site
- [X] Global positioning system (GPS)
- [ ] Other studies
- [ ] Stream gage data
  Gage number:
  Period of record:
- [ ] History of recent effective discharges
- [ ] Results of flood frequency analysis
- [ ] Most recent shift-adjusted rating
- [ ] Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

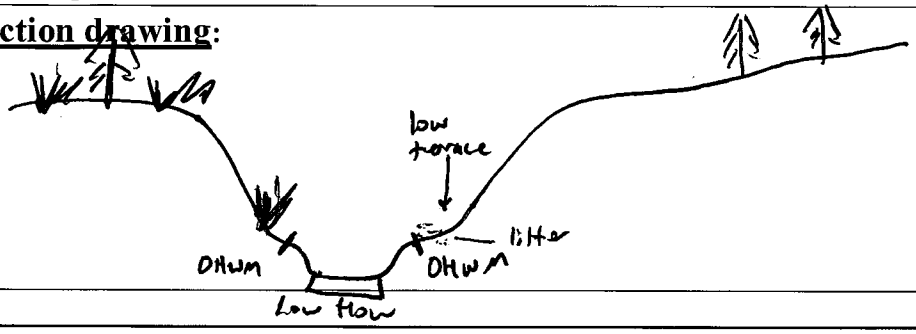


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - [X] Mapping on aerial photograph
   - [X] Digitized on computer
   - [X] GPS
   - [ ] Other:

Project ID: Cove **Cross section ID:** POD 5 **Date:** 10/9/18 **Time:** 11:30

Cross section drawing:



OHWM

GPS point: 12S 0352080; 4126366

Indicators:

- [ ] Change in average sediment texture
- [ ] Change in vegetation species
- [x] Change in vegetation cover
- [ ] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Clear channel. No water observed in channel.

Floodplain unit:

- [x] Low-Flow Channel
- [ ] Active Floodplain
- [ ] Low Terrace

GPS point: 12S 0352080; 4126365

Characteristics of the floodplain unit:

Average sediment texture: Clay

Total veg cover: 0 % Tree: ____% Shrub: ____% Herb: ____%

Community successional stage:

- [x] NA
- [ ] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [ ] Late (herbaceous, shrubs, mature trees)

Indicators:

- [x] Mudcracks
- [x] Ripples
- [x] Drift and/or debris
- [ ] Presence of bed and bank
- [ ] Benches
- [ ] Soil development
- [ ] Surface relief
- [ ] Other: _____
- [ ] Other: _____
- [ ] Other: _____

Comments:

Project ID: Cove **Cross section ID:** PJD 5 **Date:** 10/9/18 **Time:** 11:30

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: 12S 0352081; 4126364

Characteristics of the floodplain unit:

Average sediment texture: clay / fine silt

Total veg cover: 5 % Tree: 0 % Shrub: 5 % Herb: 0 %

Community successional stage:

- ☐ NA
- ☒ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☒ Presence of bed and bank
- ☒ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Narrow floodplain. Floodplain is mostly [illegible] synonomous with the channel in most places

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☒ Low Terrace

GPS point: 12S 0352081; 4126363

Characteristics of the floodplain unit:

Average sediment texture: clay

Total veg cover: 25 % Tree: 0 % Shrub: 20 % Herb: 5 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☒ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☒ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Larger shrubs here

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Cove Reservoir
Project Number:
Stream: PSD6
Investigator(s): Brian Parker

Date: 10/9/18 **Time:** 1745
Town: Orderville **State:** UT
Photo begin file#: **Photo end file#:**

Y [X] / N [ ] Do normal circumstances exist on the site?

Y [ ] / N [X] Is the site significantly disturbed?

Location Details:
Stream above irrigated farmland

Projection: UTM **Datum:** NAD83
Coordinates: DS 0358914 ; 4129955

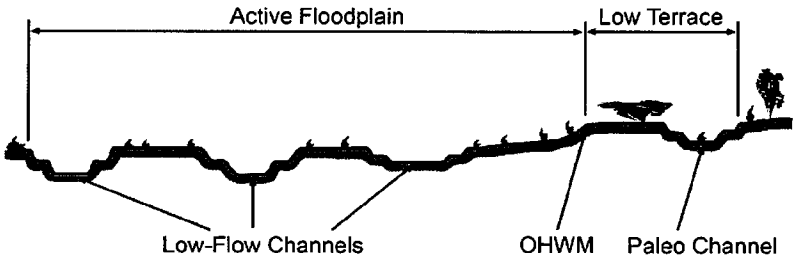
Potential anthropogenic influences on the channel system:
Dirt road, pipelines installed (irrigation)

Brief site description:
Running stream above pastureland. Cottonwood, oaks and pinyon/juniper adjacent to stream

Checklist of resources (if available):

- [X] Aerial photography
  Dates:
- [X] Topographic maps
- [ ] Geologic maps
- [X] Vegetation maps
- [X] Soils maps
- [ ] Rainfall/precipitation maps
- [ ] Existing delineation(s) for site
- [X] Global positioning system (GPS)
- [ ] Other studies
- [ ] Stream gage data
  Gage number:
  Period of record:
- [ ] History of recent effective discharges
- [ ] Results of flood frequency analysis
- [ ] Most recent shift-adjusted rating
- [ ] Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

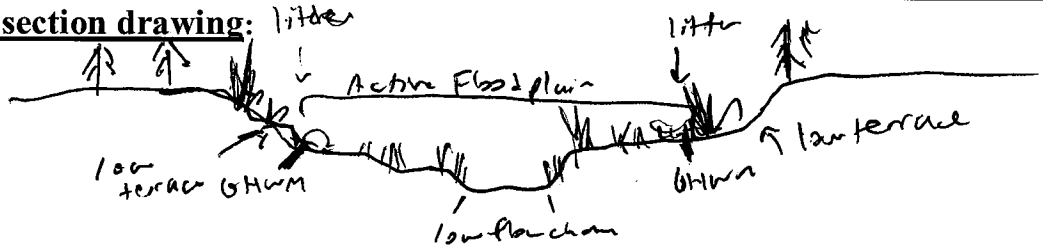


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - [X] Mapping on aerial photograph
   - [X] Digitized on computer
   - [X] GPS
   - [ ] Other:

Project ID: COVE **Cross section ID:** **Date:** 10/9/18 **Time:** 1745

Cross section drawing:



OHWM

GPS point: 125 0356914 ; 4129756

Indicators:

- [ ] Change in average sediment texture
- [x] Change in vegetation species
- [x] Change in vegetation cover
- [x] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Flowing water in channel @ time of survey.

Floodplain unit:

- [ ] Low-Flow Channel
- [ ] Active Floodplain
- [x] Low Terrace

GPS point: 125 0356914 ; 4129746

Characteristics of the floodplain unit:

Average sediment texture: Medium Sand

Total veg cover: 60 % Tree: 25 % Shrub: 25 % Herb: 10 %

Community successional stage:

- [ ] NA
- [x] Early (herbaceous & seedlings)
- [x] Mid (herbaceous, shrubs, saplings)
- [x] Late (herbaceous, shrubs, mature trees)

Indicators:

- [ ] Mudcracks
- [ ] Ripples
- [ ] Drift and/or debris
- [ ] Presence of bed and bank
- [ ] Benches
- [x] Soil development
- [ ] Surface relief
- [ ] Other: _____
- [ ] Other: _____
- [ ] Other: _____

Comments:

Project ID: COVE **Cross section ID:** PSD 6 **Date:** 10/9/18 **Time:** 1745

Floodplain unit: ☐ Low-Flow Channel ☒ Active Floodplain ☐ Low Terrace

GPS point: 12 S 0356908 ; 4129750

Characteristics of the floodplain unit:

Average sediment texture: Medium silt

Total veg cover: 40 % Tree: 0 % Shrub: 5 % Herb: 35 %

Community successional stage:

- ☐ NA
- ☒ Early (herbaceous & seedlings)
- ☒ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☒ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Vegetation layed down due to recent flow

Floodplain unit: ☒ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: 12S 0356909 ; 4129751

Characteristics of the floodplain unit:

Average sediment texture: cobble

Total veg cover: 0 % Tree: ____ % Shrub: ____ % Herb: ____ %

Community successional stage:

- ☒ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☒ Mudcracks
- ☒ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Flowing water. 3 ft wide channel.

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Cove Reroir
Project Number:
Stream: JD 7
Investigator(s): Brian Parker

Date: 10/9/18 **Time:** 1800
Town: Glendale **State:** UT
Photo begin file#: **Photo end file#:**

Y ☒ / N ☐ Do normal circumstances exist on the site?

Y ☐ / N ☒ Is the site significantly disturbed?

Location Details:
Stream adjacent to farmland

Projection: UTM **Datum:** NAD83
Coordinates: 12S 0356736 ; 4129546

Potential anthropogenic influences on the channel system:
Irrigated farmland adjacent to stream. Northern bank has been built up likely for flood control of farmland

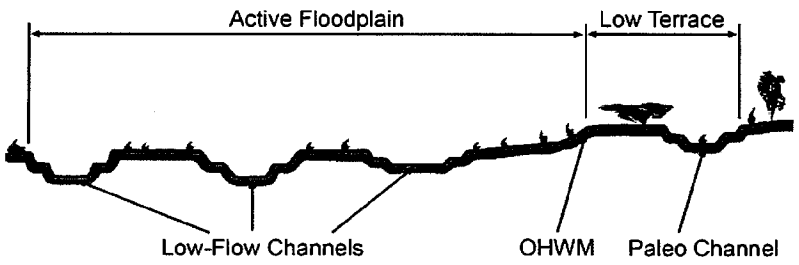
Brief site description:
Running stream south of irrigated farmland towards southern end of Glendale Pipeline. Wooded (Oak, Cottonwood, Sycamore)

Checklist of resources (if available):

- ☒ Aerial photography
  Dates:
- ☒ Topographic maps
- ☐ Geologic maps
- ☒ Vegetation maps
- ☒ Soils maps
- ☐ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ☒ Global positioning system (GPS)
- ☐ Other studies

- ☐ Stream gage data
  Gage number:
  Period of record:
- ☐ History of recent effective discharges
- ☐ Results of flood frequency analysis
- ☐ Most recent shift-adjusted rating
- ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

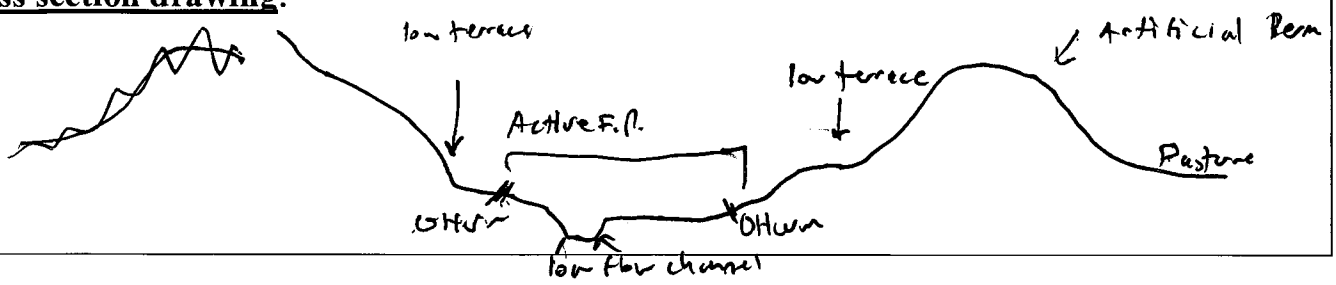


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ☒ Mapping on aerial photograph
   - ☒ GPS
   - ☒ Digitized on computer
   - ☐ Other:

Project ID: Cove **Cross section ID:** POD 7 **Date:** 10/9/18 **Time:** 1800

Cross section drawing:



OHWM

GPS point: 12S 0356735; 4129559

Indicators:

- ☐ Change in average sediment texture
- ☐ Change in vegetation species
- ☐ Change in vegetation cover
- ☒ Break in bank slope
- ☐ Other: _____
- ☐ Other: _____

Comments:

Veg. layed down and litter/debris present

Floodplain unit: ☐ Low-Flow Channel ☒ Active Floodplain ☐ Low Terrace

GPS point: 12S 0356735; 4129559

Characteristics of the floodplain unit:

Average sediment texture: ~~boggy~~ medium sand

Total veg cover: 25 % Tree: 0 % Shrub: 2 % Herb: 23 %

Community successional stage:

- ☐ NA
- ☒ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☒ Ripples
- ☒ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Project ID: Cow **Cross section ID:** 307 **Date:** 10/9/18 **Time:** 1800

Floodplain unit: ☒ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: 125 0356731; 4129555

Characteristics of the floodplain unit:

Average sediment texture: Coarse sand

Total veg cover: 10 % Tree: 0 % Shrub: 0 % Herb: 10 %

Community successional stage:

- ☐ NA
- ☒ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☒ Mudcracks
- ☒ Ripples
- ☒ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☒ Low Terrace

GPS point: 125 0356733; 4129555

Characteristics of the floodplain unit:

Average sediment texture: Coarse silt

Total veg cover: 50 % Tree: 15 % Shrub: 15 % Herb: 20 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☒ Mid (herbaceous, shrubs, saplings)
- ☒ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☒ Benches
- ☒ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Zion National Park

Water Rights Settlement Agreement

This Agreement is made and entered into by and among the United States of America (United States), the State of Utah (Utah), the Washington County Water Conservancy District (Washington District), and the Kane County Water Conservancy District (Kane District).

RECITALS

A. Utah, pursuant to Chapter 4, Title 73, Utah Code Ann. 1953, as amended, initiated a statutory adjudication of water rights on July 21, 1980, in the Fifth Judicial District Court of the State of Utah in and for Washington County, Civil No. 800507596, which encompasses all the rights to the use of water, both surface and underground, within the drainage area of the Virgin River and its tributaries in Utah.
B. The United States has been joined as a party to this statutory adjudication pursuant to the provisions of 43 U.S.C. § 666. A "Statement of Water User's Claims on behalf of the United States of America on Lands Administered by the Department of the Interior, National Park Service, for Division No. 3," was filed on May 18, 1987.
C. In order to remove causes of present and future controversy over the waters of the Virgin River system without further litigation, the United States, Utah and the Washington and Kane Districts have conducted extensive negotiations regarding
the settlement of reserved water right claims filed by the United States for Zion National Park (or Park).
D. These negotiations have resulted in the recognition of the reserved water rights of the United States for Zion National Park and also the agreement of the United States to subordinate its reserved water rights to existing State water rights, and to allow for some potential future development of water above Zion National Park, as set forth herein.
E. Pursuant to the terms of this Agreement, the Washington District has agreed to abandon two major reservoir sites above Zion National Park, the Bullock site on the Upper North Fork Virgin River and a site in the Barracks area of Parunuweap Canyon on the East Fork Virgin River (East Fork). Steps have also been taken which have resulted in the elimination of a proposal to divert water out of the Virgin River Basin from points above the Park. The Washington District has identified potential projects below the Park, which include: (1) the Sand Hollow Reservoir Project; (2) a collection system and pipeline to divert the flows of Pah Tempe (La Verkin) Springs; (3) securing a reduction in the minimum flows required in the Virgin River from 86 to 50 cubic feet per second (cfs) during the period of November 1 to March 31; and (4) the Ash Creek Project. A more detailed description of each of these four projects is set forth in the draft Virgin River Management Plan dated May 2, 1996.
F. The terms and provisions of the Zion National Park Settlement Agreement are set forth below.
NOW, THEREFORE, based on the mutual promises contained herein, the parties agree as follows:

AGREEMENT

Article 1: Federal Reserved Water Rights for Zion National Park
A. To fulfill the purposes for which lands now comprising Zion National Park were reserved from the public domain, the United States has water rights for all federal lands within the present boundaries of Zion National Park that were reserved and withdrawn from settlement, occupancy, or disposal under the laws of the United States. This federal reserved water right originates and is defined in federal law. The aliquot part descriptions of these reserved lands are set forth in the applicable proclamations, executive orders, and legislation identified below and in Appendix A. The United States has a reserved right to all water underlying, originating within or flowing through Zion National Park, including perennial, intermittent, and ephemeral streams, springs, seeps,

lakes, ponds, ground water, and other natural sources of water, pertaining or belonging to the reserved lands, that was unappropriated as of the dates of reservation of the lands now within the boundaries of the park, which waters are to remain in a free flowing condition, subject to present and future administrative uses necessary to fulfill reservation purposes. The date of priority for either in-stream or administrative uses of the United States' federal reserved water rights for Zion National Park will be the date on which the place of use was first reserved from the public domain.

B. By virtue of mesne conveyances and appropriations, the United States also holds state appropriative rights in wells, springs and surface diversions on streams, at the locations, in the amounts, and for the uses indicated in the table attached as Appendix B. Water diverted and used for present and future administrative purposes necessary to fulfill reservation purposes will first be satisfied from existing state appropriative rights held by the United States for Zion National Park. In addition to the water provided by the state appropriative rights listed in Appendix B, at least 466 acre-feet per year (AFY) may be diverted and used from those waters reserved for Park purposes, in order to satisfy the administrative needs of the Park. At least 180 days prior to placing any increment of this federal reserved water right for administrative purposes to use or changing the use thereof, the United States agrees to provide notice to the State Engineer concerning the location and means of diversion, the source, quantity, and diversion rate of water, depth and diameter of well (if applicable), the nature of use, the anticipated effective date, and a map depicting the existing system and proposed modifications. This information will be publicly available. The total amount of water available for Park administrative purposes under state and federal reserved rights combined shall not exceed 1295 AFY. The state appropriative rights identified in this paragraph and in Appendix B, and the federal reserved water rights for administrative purposes identified in this paragraph, are not subject to the subordination set forth in Article 11.

C. The purposes for which Zion National Park was established and priority dates to water reserved therefor are as identified in Presidential Proclamation No. 877, 36 Stat. 2498, dated July 31, 1909; Presidential Proclamation No. 1435, 40 Stat. 760, dated March 18, 1918; the Act of November 19, 1919, 41 Stat. 356; Executive Order No. 418 1, dated March 24, 1925; Executive Order No. 5037, dated January 28, 1929; the Act of June 13, 1930; 46 Stat. 582; Presidential Proclamation No. 2221, 50 Stat. 1809, dated January 22, 1937; the Act of July 11, 1956, 70 Stat. 527; the Act of February 20, 1960, 74 Stat. 4; the Antiquities Act of June 8, 1906, 59 Stat. 225, 16 U.S.C. § 431; the Act of October 21, 1976, 90 Stat. 2732; and the National Park Service Establishment Act, 64 Stat. 225, 16 U.S.C. § 1. The purposes and uses of the reserved water rights include the preservation of extraordinary examples of canyon erosion, preservation of the area for scientific research, protection of objects of historic and scientific interest and, pursuant to the National Park Service Establishment Act, conservation of "the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." 16 U.S.C. § 1 . Accordingly, for enforcement purposes, the federal reserved water right for Zion National Park shall be deemed to comprise those waters in the Virgin River Basin as set forth in Article I.A. and I.B., less those quantities subject to the subordinations set forth below. The federal reserved water rights recognized hereby include all water rights of every nature and description derived from the reserved water rights doctrine, from all sources of water, both surface and underground, and includes all types and kinds of uses whatsoever, and encompasses all claims asserted by or through the United States for Zion National Park as now constituted.

Article 11. Subordination of Federal Reserved Water Rights

A. The United States subordinates the non-administrative federal reserved water rights described in Article LA., subject to the limitations contained herein, to all valid existing perfected water rights and approved applications with priority dates prior to January 1, 1996, and to certain new diversions and depletions, as set forth more specifically below.

B. Generally

1. No reservoir shall be located upstream of Zion National Park on the main stems of the East Fork, the North Fork of the Virgin River (North Fork), La Verkin Creek, Deep Creek, Crystal Creek, or on any tributary of the North Fork or East Fork, except as specifically provided herein.

2. Any flood control structure constructed upstream of the Park shall be designed only to attenuate high flows which are dangerous to life or property. The parties agree to consult on flood control proposals and will develop operational guidelines by mutual consent which are consistent with this Agreement and which will protect the resources of Zion National Park.

3. A ground water protection zone shall be established as shown in Appendix C for the drainage basins of the

East and North Forks, located up gradient and within 2 miles of the park boundary. Development of ground water within this zone shall be limited to a diversion rate of 35 gallons per minute (gpm) or less per well, shall withdraw no more than 15 AFY per well, and is subject to the overall limitations on depletions contained in Articles II.C.1. and ILDA., respectively.

C. North Fork of the Virgin River and Certain Other Streams

1. Subject to the limitations contained herein, the United States' subordination extends to new diversions and depletions from surface and ground water sources of up to but not to exceed a total depletion of 6,000 AFY, with no more than 2,500 AFY occurring from surface water, within the composite comprising the drainage basin of the North Fork above the southern boundary of Zion National Park near Springdale, Utah, and the portions of the drainage basins of Ash Creek, La Verkin Creek, North Creek, and Shunes Creek located upstream of Zion National Park (see Appendix D), distributed as described below.

a) There may be up to 3,750 AFY of new depletion in the drainage basin of the Upper North Fork (North Fork Virgin River above the confluence with Deep Creek), Crystal Creek, Deep Creek, and Kolob Creek, with no more than 1,000 AFY occurring in each the Upper North Fork and Crystal Creek, no more than 2,000 AFY in Kollob Creek, and no more than 750 AFY in Deep Creek (excluding Crystal Creek) with a maximum of 250 AFY being taken from surface water in Deep Creek, resulting from the new development of water resources, except that

i) if the Washington District develops a project which diverts Crystal Creek flows to Kolob Reservoir (Water Right Number 81-355, A29398 or other subsequent application filed to cover this project) and such diversions exceed 1,000 AFY, then no other new depletions within the Crystal Creek drainage are allowed. All depletion of water attributable to the Crystal Creek/Kolob Reservoir project shall be charged against the overall depletion limit of 6,000 AFY for the drainage basin of the North Fork Virgin River and other streams set forth in Article 11.C. 1.,

ii) the maximum diversion rate from Crystal Creek to Kolob Reservoir shall not exceed 50 cfs,

iii) the average annual diversion from Crystal Creek to Kolob Reservoir shall not exceed 4,000 acre-feet (AF) less any amounts exchanged to ground water development, based on a 5-year moving average,

iv) the maximum annual diversion from Crystal Creek shall not
exceed 6,000 AF, less any amounts exchanged to ground water development,

v) the active storage capacity of Kolob Reservoir shall not be increased beyond its present capacity by more than 4,000 AF,

vi) the flow of Crystal Creek immediately below its confluence with Spanish Hollow shall be maintained at no less than 0.5 cfs when diversions are being made from Crystal Creek,

vii) new surface water diversions from Deep Creek and its tributaries downstream of the confluence of Deep Creek and Crystal Creek shall not cumulatively exceed 1 cfs,

viii) new surface water diversions on the Upper North Fork shall not exceed the lesser of a) one-half of the existing flow, measured immediately upstream of the diversion, or b) that rate of diversion which maintains a flow of 2 cfs in the channel immediately below the diversion,

ix) the regulated discharge from Kolob Reservoir shall not exceed 35 cfs, except for matters involving dam safety.

b) There may be up to 750 AFY of new depletion per drainage, with no more than 250 AFY per drainage from surface water, from La Verkin Creek, North Creek, and Orderville Canyon, and up to 250 AFY of new depletion per drainage from surface and groundwater combined, from Camp Creek, Clear Creek, Goose Creek, Echo Canyon, Shunes Creek, and Taylor Creek.

c) No new reservoirs upstream of the Park with individual total storage capacities of more than 20 AF shall be constructed in any of the drainages covered by Article II.C., with the exception of the proposed enlargement of Kolob Reservoir.

d) New reservoirs upstream of the Park with individual total storage capacities which are less than or equal to 20 AF and located in any of the drainages covered by Article II.C. shall not be limited as to number but shall be subject to the overall limitation upon depletion contained in Article II.C.1.

D. East Fork of the Virgin River

1. Subject to the limitations contained herein, the United States' subordination also extends to new diversions and depletions from surface and ground water sources in the East Fork upstream or up gradient of the eastern boundary of Zion National Park, of up to but not to exceed a total depletion of 5,000 AFY (see Appendix D), with no more than 3,250 AFY occurring from surface water, as set forth more specifically below.

a) One or more new reservoirs with cumulative active storage capacity of up to but not to exceed 6,750 AF may be constructed on Stout Creek, Lydia's Canyon, Muddy Creek or Cove Canyon (not both), East Fork above Stout Canyon, and on other tributaries of the East Fork upstream of Glendale (see Appendix E).
b) The number of new reservoirs at the locations described in Article II.D.l.a) above, having individual total storage capacities greater than 20 AF, shall not exceed 10.
c) New reservoirs with individual total storage capacities which are less than or equal to 20 AF shall not be limited as to number but shall be subject to the overall limitation upon depletion in Article II.D.1.
2. New surface water diversions on the East Fork or its tributaries shall not cumulatively exceed 60 cfs.
3. The existing flow or 2 cfs, whichever is less, shall be maintained immediately below any new surface water diversion to reservoirs constructed on streams defined in Article II.D.l.a).
4. The existing flow or 1 cfs (including seepage), which ever is less, shall be maintained immediately below any new reservoir constructed on streams defined in 11.D.1.a).
5. Cumulative releases from new reservoirs constructed on streams defined in II.D.l.a) above, shall not increase the flow measured at the U.S. Geological Survey (USGS) gage on the East Fork Virgin River near Springdale (USGS No. 09404900), by more than 25 cfs during any 7-day period and shall not exceed the long-term monthly average at the Springdale gage by more than 15 cfs. As measured at said gage, the maximum instantaneous flow attributable to releases from such reservoirs shall not exceed 50 cfs, except for matters involving dam safety.
6. Surface water diversions to new reservoirs described in II.D.l.a) above shall not occur except during the period from November 1 to May 31, subject to the by-pass flow requirements described above.

Article III: Other Provisions
A. During the month of March each year, a meeting will be scheduled between Zion National Park and the Washington District to discuss forecasted runoff, water levels in Kolob Reservoir and the anticipated schedule and duration for that year's reservoir releases. Other details concerning Kolob Reservoir releases will be worked out by separate agreement, if necessary.
B. This Agreement shall be effective immediately upon the completion of a land exchange between the U.S. Bureau of Land Management (BLM) and the Washington District, whereby the Washington District acquires title to BLM public lands at the site of the proposed Sand Hollow Reservoir.
C. If any federal legislative or administrative action hereafter prevents the State of Utah from permitting development and use of water in any drainage or subdrainage subject to the subordination of the United States' federal reserved water right for Zion National Park herein contained, the undeveloped remainder of the water herein listed as available for future development in such drainage or subdrainage shall be made available in one or more other drainages covered by this Agreement. In the event of such federal legislative or administrative action, the parties hereto shall attempt to agree as to the drainage or drainages in which any such relocated quantity may be developed and how the limitations of the United States' subordination will be modified to facilitate the transfer of such water, provided that such development must occur within the drainages herein identified, and that no party will unreasonably withhold consent to such relocation.
D. The subordination to listed quantities and locations of future water development shall not be effective to the extent and upon proof that specific wells have caused, are causing, or may cause specific and significant adverse impacts to an identifiable resource or resources of Zion National Park. This notwithstanding, the provisions of this paragraph shall not apply to any groundwater rights presently perfected or approved under State law, with priority dates prior to January 1, 1996.
E. If any provision of this Agreement is found to be unlawful and of no effect, the remaining provisions shall remain in effect and fully binding on the parties, and if necessary, the parties hereto shall resume negotiations to revise any such unlawful provision.
F. Upon a proper showing of necessity, the provisions of this Agreement may be modified, with proper notice and concurrence of the Court, only upon the mutual consent of the parties to this Agreement, which consent shall not be unreasonably withheld.
G. Because of the unique nature of Zion National Park, nothing in this Agreement shall constitute an admission, waiver or precedent as to any party for any other federal reserved water right claim in the State of Utah.
H. Nothing in this Agreement shall be construed or interpreted to:
1. in any way affect the water rights of the United States in the Virgin River Basin for agencies and interests other than Zion National Park;

2. establish any standard to be used for the quantification of federal reserved water rights in any other judicial or administrative proceeding;
3. limit in any way the rights of the parties or any person to litigate any issue or question not resolved by this Agreement;
4. restrict the power of the United States to reserve water in the future, or to acquire additional rights to the use of water under the laws of the State of Utah; or
5. restrict the power of the State of Utah or the State Engineer in allocating, administering or distributing the waters of the State.

I. Upon becoming effective, this Agreement will be the subject of a separate proposed determination of water rights issued by the State Engineer specifically covering the portion of the Virgin River Basin encompassing Zion National Park, and the parties hereto will cooperate to obtain an interlocutory decree covering same. If the parties hereto are not successful in securing such interlocutory decree, this Agreement shall nevertheless remain binding as among the parties hereto until a final decree issues covering these water rights. The water rights of the United States, as set forth and quantified herein, shall be protected under State law in the same manner as any water right originating under State law, without losing its character as or the attributes of a federal reserved water right as provided under federal law.

J. The provisions of this Agreement, and particularly the provisions of Article 11 hereof, shall be taken into consideration by the State Engineer in acting upon applications, under State law, for new appropriations or change applications upstream or up gradient of Zion National Park and shall be afforded the same consideration in such proceedings as state appropriative rights; however, the United States shall have the primary responsibility for protecting its own rights and for filing appropriate protests in any proceedings before the State Engineer.

K. Upon entry of a decree covering the water rights of the United States for Zion National Park, the East Entrance Well and the Taylor Creek Well, described in Appendix F, will be administered with priority dates of June 13, 1930, and January 22, 1937, respectively, pursuant to the terms of Article I.A., and the State appropriative water rights thereon will be withdrawn.

L. Upon written request from the United States, the State Engineer will provide information regarding new diversions and total depletions of water in the respective drainages above the Park pursuant to Article 11 of this Agreement.

M. Depletion amounts attributable to specific diversions, as well as to usage and storage patterns, shall be determined by procedures approved by the parties hereto.

N. This Agreement is executed in quintuplicate. Each of the five copies bearing original signatures shall be deemed an original.

Article IV: Definitions

Acre-foot - The amount of water necessary to cover one acre of land to a depth of one foot, equivalent to 43,560 cubic feet or 325,851 gallons.

Active Storage Capacity - The volume of water available for release from a reservoir between the bottom of the outlet and the bottom of the spillway. This shall not include any storage designated as dead storage or a conservation pool.

Annual - Period of time which begins on October 1 and ends on September 30 (water year).

Depletion - The amount of water which is consumptively used by any action or process or otherwise removed from a drainage basin and not returned thereto.

Diversion - The removal of water from its natural source by means of a dam, ditch, canal, flume, bypass, pipeline, conduit, well, pump, or other act of man, that results in a decrease in the amount of water in the source at the point of such removal.

Existing Flow - Annual, monthly and daily flows which exist as of the effective date of this Agreement, which reflect historical diversions and depletions associated with existing perfected water rights and approved applications (except for Water Right No. 81-355, A29398 on Crystal Creek), as determined from available stream gage records and accepted hydrologic methods.

Ground Water - Water beneath the surface of the earth in pores, crevices, and space s in rock and soil, under saturated conditions and in sufficient quantities to supply water to wells, springs, seeps, rivers, streams, creeks, and natural lakes. New - After January 1, 1996.

Reservoir - A man-made impoundment for storing water from which water may be withdrawn for beneficial purposes. Impoundments constructed solely for flood control or sediment retention are specifically excluded.

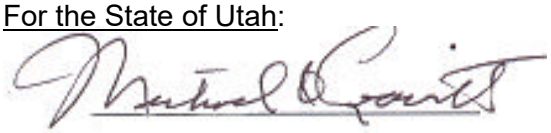
Surface Water - Water on the surface of the earth in rivers, streams, creeks, channels, lakes, reservoirs and other water bodies. Wells within the 500-year floodplain of the East and North Forks of the Virgin River, Camp Creek, Clear Creek, Crystal Creek, Deep Creek, Echo Canyon, Goose Creek, Kolob Creek, La Verkin Creek, Orderville Canyon, Shunes Creek, or Taylor Creek, which are less than 100 feet in depth, shall be considered to draw from surface water.

Year - A calendar year commencing January 1 and ending December 31. It being resolved and agreed to as delineated above, the undersigned parties express their mutual agreement hereto this 4th day of December, 1996.

Home **Back** **Appendicies** **Signature Page**

It being resolved and agreed to as delineated above, the undersigned parties express their mutual agreement hereto this 4th day of December, 1996.

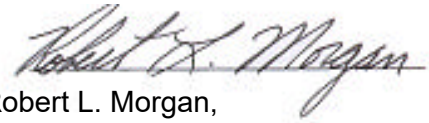
For the State of Utah:



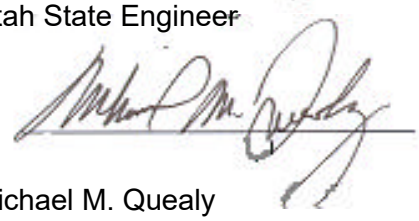
Michael O. Leavitt
Governor, State of Utah



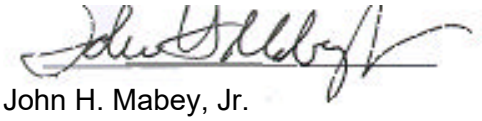
Ted Stewart
Director, Utah Department of Natural Resources



Robert L. Morgan,
Utah State Engineer



Michael M. Quealy
Chief, Natural Resources
Attorney General's Office

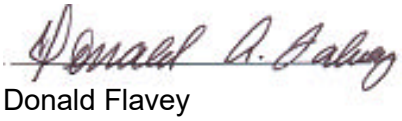


John H. Mabey, Jr.
Assistant Attorney General

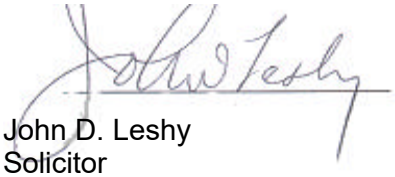
For the United States:



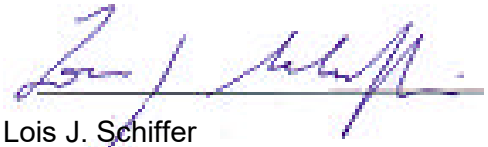
Bruce Babbitt
Secretary of the Interior



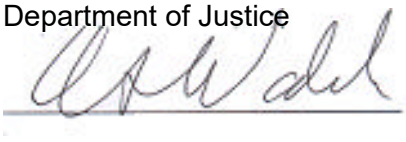
Donald Flavey
Superintendent, Zion National Park



John D. Leshy
Solicitor
Department of Interior

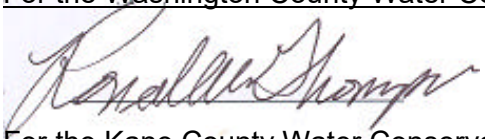


Lois J. Schiffer
Assistant Attorney General
Department of Justice



Andrew F. Walch
Department of Justice

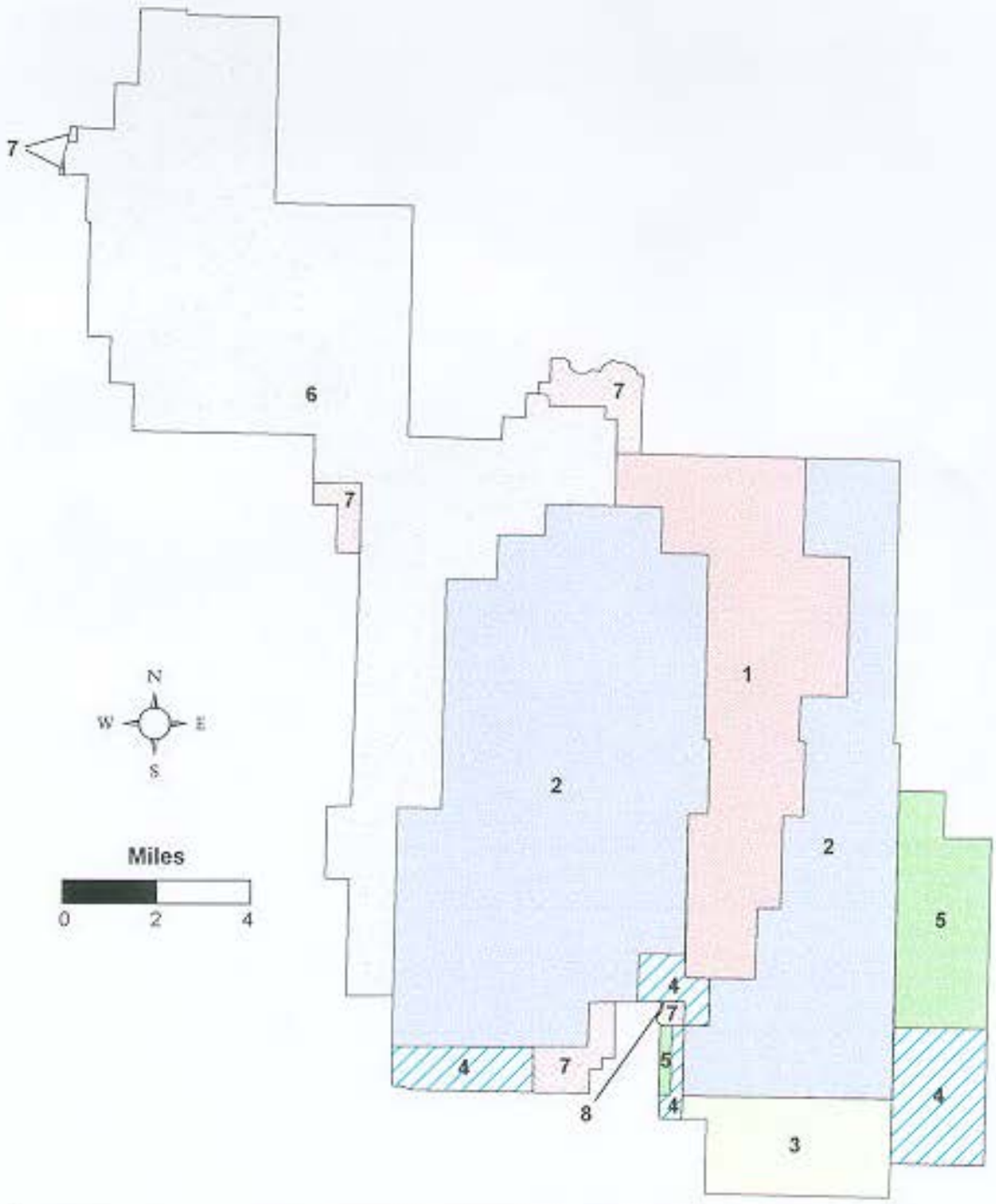
For the Washington County Water Conservancy District:



For the Kane County Water Conservancy District:



APPENDIX A
DATES OF LAND RESERVATIONS
ZION NATIONAL PARK



LEGEND: Lands Reserved from the Public Domain

1	National Monument withdrawal by Presidential Proc. 877, dated July 31, 1909 (36 Stat. 2498). Designated a National Park by the Act of November 19, 1919 (41 Stat. 356).
2	National Monument withdrawal by Presidential Proc. 1435, dated March 18, 1918 (40 Stat. 1760). Designated a National Park by the Act of November 19, 1919 (41 Stat. 356).
3	National Monument withdrawal by Executive Order 4181, dated March 24, 1925. Designated a National Park by the Act of June 13, 1930 (46 Stat. 582).
4	National Monument withdrawal by Executive Order 5037, dated January 28, 1929. Designated a National Park by the Act of June 13, 1930. (46 Stat. 582)
5	Withdrawal for National Park by the Act of June 13, 1930 (46 Stat. 582).
6	National Monument withdrawal by Presidential Proc. 2221, dated January 22, 1937 (50 Stat. 1809). Designated a National Park by Act of July 11, 1956 (70 Stat. 527).
7	Added to and made part of the National Park by the Act of February 20, 1960 (74 Stat. 4).
8	Added to and made part of the National Park by the Act of October 21, 1976 (90 Stat. 2732).

APPENDIX B
STATE APPROPRIATIVE WATER RIGHTS
ZION NATIONAL PARK

WUC No.	Right Evidenced BY:	Priority Date	Diversion Works	Water Source	Legal Location (Salt Lake Basin & Meridian)	Type of Use	Period of Use	Diversion Rate (cfs)	Irrigated Acres in Original Decree	Volume of Use-(acre-feet)
81-1128	CERT. a222, Award No. 66 of the Virgin River Decree	1877	[Zion Canyon Water System]* CRAWFORD DITCH GIFFORD DITCH OAK CK. SPG. AREA BIRCH CK. SPG. AREA SINAWAVA SPRINGS SCOUT LKOUT PIPELINE UPPER GROTTO SPG. A. LOWER GROTTO SPG. WYLIE RETRT. SPG. A.	North Fk. Virgin R. North Fk. Virgin R. Oak Ck. Springs Birch Ck. Springs Sinawava Spg. Scout Lookout Spg. Upper Grotto Spg. Lower Grotto Spg. Wylie Retreat Spg.	N.50 deg. 29'E. 1998 ft. from NE Cor., See. 21, T41S, R10W N.41deg.28'45" E. 4233.80 ft. from NE Comer, Sec.21, T41S, R1OW S.86deg.23'W. 8633.70 ft. from NE Comer, Sec. 21, T41 S, R10W N.21deg.56'E. 9151.95 ft. from NE Comer, Sec. 21, T41S, R10W N.18deg.43'E. 27901.20 ft. from NE Comer, Sec. 21, T41 S, R10W N.16deg.59'E. 25095.34 ft. from NE Comer, Sec. 21, T41S, R10W N.29deg.47'E. 17059.55 ft. from NE Comer, Sec. 21, T41S, R10W N.31deg.39'E. 18223.11 ft. from NE Comer, Sec. 21, T41S, R10W N.32deg.25'25" E. 13167.50 ft. from NE Comer, Sec. 21, T41S, R10W	MUNICIPAL	01/01-12/31	1.21	66.7	266.8
81-1124	CERT. a224, Award No. 63 of the Virgin River Decree	1881	[Zion Canyon Water SystLm]* Same As Cert. a222	Same As Cert. a222	Same As Cert. a222	MUNICIPAL	01/01-12/31	0.53	29.4	117.6
81-1129	CERT. a223, Award No. 65 of the Virgin River Decree	1894	[Zion Canyon Water System]* Same As Cert. a222	Same As Cert. a222	Same As Cert. a222	MUNICIPAL	01/01-12/31	0.53	29.0	116
81-117	A10618 a1657 CERT. a221	05/31/29	[Zion Canyon Water System]* Same As Cert. a222	Same As Cert. a222	Same As Cert. a222	MUNICIPAL	01/01-12/31	0.01	—	3.15
81-3608	Award No. 67 of the Virgin River Decree	1880	FLANIGAN DITCH	North Fk. Virgin R.	S. 550 ft. and E. 950 ft. from the NW Comer, Sec. 22, T41N, R10W	IRRIGATION	01/01-12/31	1.38	75.9	303.6

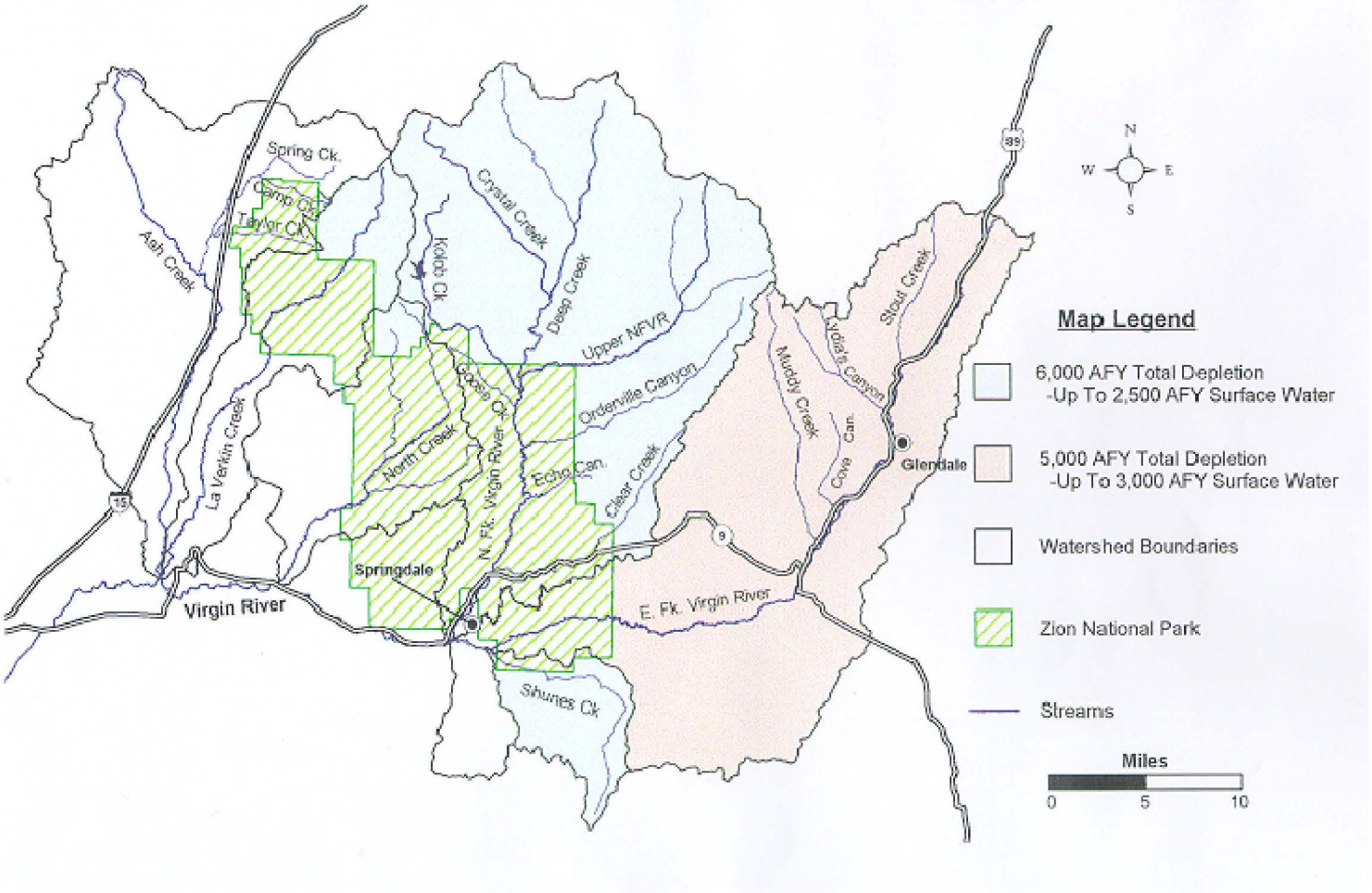
81-728	DILIGENCE CLAIM No. 1031	1900		EARL SPRING	S. 340 ft. and E. 900 ft. from NW Comer, Sec. 9, T40S, R1 I W	DOMESTIC & STOCK WATER	03/01-11/30	0.092	—	1.73
81-113	A8113 CERT. 1197	05/24/19		UNNAMED SPRING	S. 957 ft. and W. 841.5 ft. from NE Comer, Sec. 5, T40S, R1 1W	DOMESTIC	01/01-12/31	0.0002	—	0.14
81-327	A28355 NPR	07/18/56	10 INCH DIAMETER WELL 68 FEET DEEP	SPENDLOVE WELL	N. 1700 ft. and W. 600 ft. from SE Comer, Sec. 8, T40S, R1 1W	DOMESTIC	03/01-11/30	0.015	—	0.34
81-514	A34269 a10851 Cert. 10754	05/03/62	8 INCH DIAMETER WELL 925 FEET DEEP	EAST ENTRANCE WELL	S.75 deg.54'20" W., 6382 ft. from N 1/4 cor Sec. 21 T41 S, R9W	IRRIGATION, STOCKWATER, DOMESTIC & OTHER	01/01-12/31	0.0223	—	10
81-1373	A36328a a7522 Cert. 9697	08113164	7 INCH DIAMETER WELL 367 FEET DEEP	HAMILTON WELL	S.2810.7 ft. and E. 1857.4 ft. from E 1/4 cor Sec. 8, T40S, R1 1W	IRRIGATION & DOMESTIC	01/01-12/31	—	0.25	1.73
	A36782 Approved Proof filed 10/14/92	02/23165	6 IN H DIAMETER WELL 206 FEET DEEP	TAYLOR CREEK WELL	N. 3348 ft. and E. 2873 ft. from SW Comer, Sec. 29, T38S, R 1 2W	DOMESTIC & OTHER	01/01-12/31	0.0688	—	7.94

Total Volume: 829 acre-fee

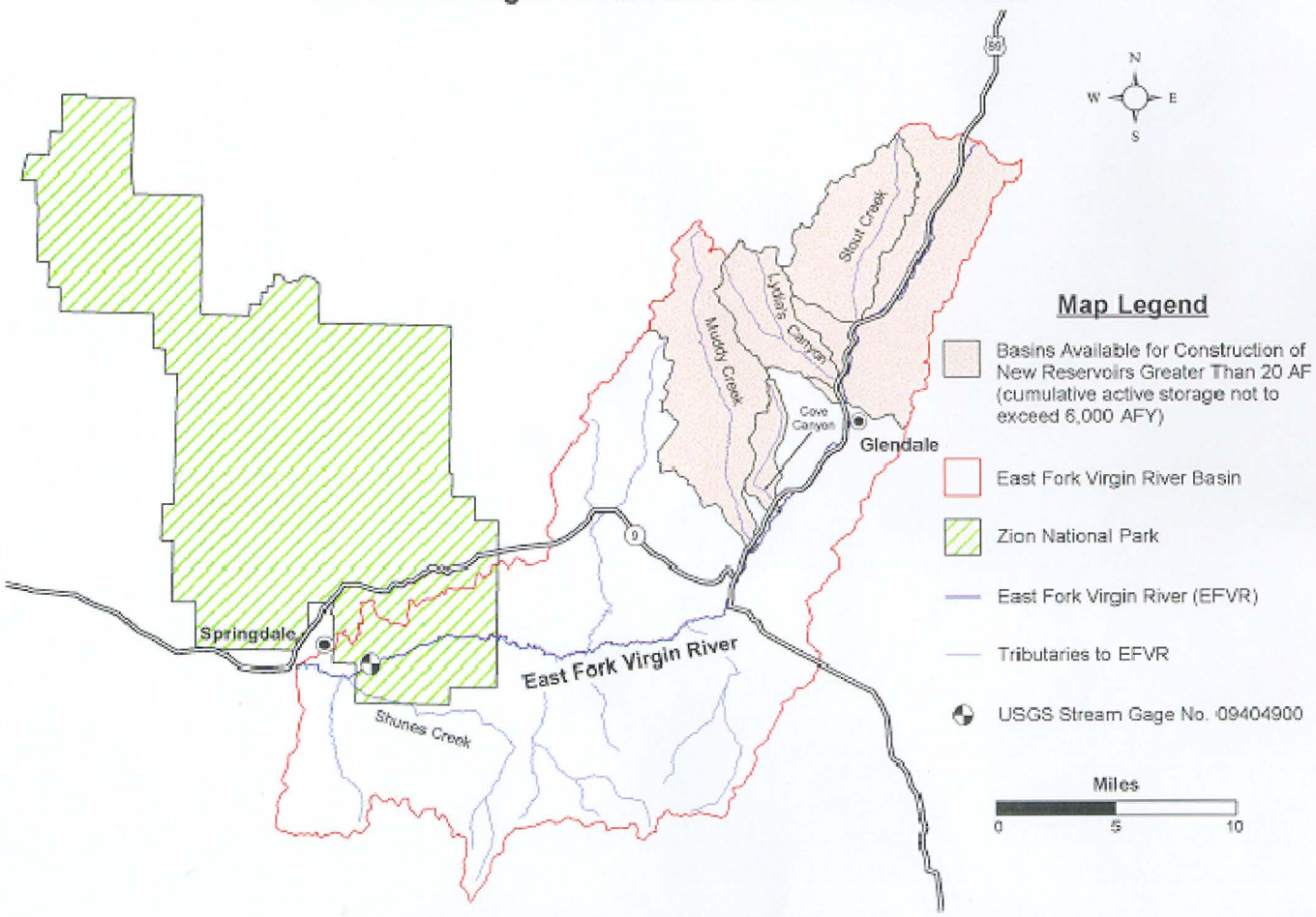
Water is diverted from various sources and comingled in the ZION CANYON WATER SYSTEM. The water rights, as described in each of the individual certificates, entities the United States to "...divert the water at any, each, or all of the... described points of diversion..."
Water Right Volumes are calculated using the following assumptions: -a water duty of 4 ac-ft per acre is used for irrigable land -a value of 0.45 ac-ft per year per family of four is used for domestic use -a value of 10 gallons per visitor is used for use by park visitors (EPA -570-9-82-004) -a value of 2.8 ac-ft per one-hundred head of livestock is used for stockwater use

APPENDIX D

Allowable Depletion Levels for the East and North Forks of the Virgin River, and North, La Verkin and Ash Creeks, Draining Above, and Through, Zion National Park



APPENDIX E
Basins Available for Construction of New Reservoirs (Greater Than 20 Acre-Feet)
East Fork Virgin River Above Zion National Park



APPENDIX F DIVERSION WORKS ASSOCIATED WITH FEDERAL RESERVED WATER RIGHTS
ZION NATIONAL PARK

Water Source	Diversion Works	Priority Date	Legal Location Type of Use (Salt Lake Basin & Meridian)	Period of Use	Diversion Rate (cfs)
EAST ENTRANCE WELL	8 INCH DIAMETER WELL 925 FEET DEEP	06/13/30	S.75 deg.54'20"W 63 ft. from N 1/4 cor Sec. 21 T41S, R9W IRRIGATION, STOCKWATER, DOMESTIC & OTHER	01/01-12/31	0.0223
TAYLOR CREEK WELL	6 INCH DIAMETER WELL 206 FEET DEEP	01122/37	N. 3348 ft. and E. 2873 ft. from SW Corner, Sec. 29, T38S, R12V\ IRRIGATION, DOMESTIC & OTHER	01/01-12/31	0.0688

Colorado River Compact, 1922

The States of Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming, having resolved to enter into a compact under the Act of the Congress of the United States of America approved August 19, 1921 (42 Statutes at Large, page 171), and the Acts of the Legislatures of the said States, have through their Governors appointed as their Commissioners:

W.S. Norviel for the State of Arizona,
W.F. McClure for the State of California,
Delph E. Carpenter for the State of Colorado,
J.G. Scrugham for the State of Nevada,
Stephen B. Davis, Jr., for the State of New Mexico,
R.E. Caldwell for the State of Utah,
Frank C. Emerson for the State of Wyoming,

who, after negotiations participated in by Herbert Hoover appointed by The President as the representative of the United States of America, have agreed upon the following articles:

ARTICLE I

The major purposes of this compact are to provide for the equitable division and apportionment of the use of the waters of the Colorado River System; to establish the relative importance of different beneficial uses of water, to promote interstate comity; to remove causes of present and future controversies; and to secure the expeditious agricultural and industrial development of the Colorado River Basin, the storage of its waters, and the protection of life and property from floods. To these ends the Colorado River Basin is divided into two Basins, and an apportionment of the use of part of the water of the Colorado River System is made to each of them with the provision that further equitable apportionments may be made.

ARTICLE II

As used in this compact-

(a) The term "Colorado River System" means that portion of the Colorado River and its tributaries within the United States of America.

(b) the term "Colorado River Basin" means all of the drainage area of the Colorado River System and all other territory within the United States of America to which the waters of the Colorado River System shall be beneficially applied.

(c) The term "States of the Upper Division" means the States of Colorado, New Mexico, Utah, and Wyoming.

(d) The term "States of the Lower Division" means the States of Arizona, California, and Nevada.

(e) The term "Lee Ferry" means a point in the main stream of the Colorado River one mile below the mouth of the Paria River.

(f) The term "Upper Basin" means those parts of the States of Arizona, Colorado, New Mexico, Utah, and Wyoming within and from which waters naturally drain into the Colorado River System above Lee Ferry, and also all parts of said States located without the drainage area of the Colorado River System which are now or shall hereafter be beneficially served by waters diverted from the System above Lee Ferry.

(g) The term "Lower Basin" means those parts of the States of Arizona, California, Nevada, New Mexico, and Utah within and from which waters naturally drain into the Colorado River System below Lee Ferry, and also all parts of said States located without the drainage area of the Colorado River System which are now or shall hereafter be beneficially served by waters diverted from the System below Lee Ferry.

(h) The term "domestic use" shall include the use of water for household, stock, municipal, mining, milling, industrial, and other like purposes, but shall exclude the generation of electrical power.

ARTICLE III

(a) There is hereby apportioned from the Colorado River System in perpetuity to the Upper Basin and to the Lower Basin, respectively, the exclusive beneficial consumptive use of 7,500,000 acre-feet of water per annum, which shall include all water necessary for the supply of any rights which may now exist.

(b) In addition to the apportionment in paragraph (a), the Lower Basin is hereby given the right to increase its beneficial consumptive use of such waters by one million acre-feet per annum.

(c) If, as a matter of international comity, the United States of America shall hereafter recognize in the United States of Mexico any right to the use of any waters of the Colorado River System, such waters shall be supplied first from the waters which are surplus over and above the aggregate of the quantities specified in paragraphs (a) and (b); and if such surplus shall prove insufficient for this purpose, then, the burden of such deficiency shall be equally borne by the Upper Basin and the Lower Basin, and whenever necessary the States of the Upper Division shall deliver at Lee Ferry water to supply one-half of the deficiency so recognized in addition to that provided in paragraph (d).

(d) The States of the Upper Division will not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75,000,000 acre-feet for any period of ten consecutive years reckoned in continuing progressive series beginning with the first day of October next succeeding the ratification of this compact.

(e) The States of the Upper Division shall not withhold water, and the States of the Lower Division shall not require the delivery of water, which cannot reasonably be applied to domestic and agricultural uses.

(f) Further equitable apportionment of the beneficial uses of the waters of the Colorado River System unapportioned by paragraphs (a), (b), and (c) may be made in the manner provided in paragraph (g) at any time after October first, 1963, if and when either Basin shall have reached its total beneficial consumptive use as set out in paragraphs (a) and (b).

(g) In the event of a desire for a further apportionment as provided in paragraph (f) any two signatory States, acting through their Governors, may give joint notice of such desire to the Governors of the other signatory States and to The President of the United States of America, and it shall be the duty of the Governors of the signatory States and of The President of the United States of America forthwith to appoint representatives, whose duty it shall be to divide and apportion equitably between the Upper Basin and Lower Basin the beneficial use of the unapportioned water of the Colorado River System as mentioned in paragraph (f), subject to the legislative ratification of the signatory States and the Congress of the United States of America.

ARTICLE IV

(a) Inasmuch as the Colorado River has ceased to be navigable for commerce and the reservation of its waters for navigation would seriously limit the development of its Basin, the use of its waters for purposes of navigation shall be subservient to the uses of such waters for domestic, agricultural, and power purposes. If the Congress shall not consent to this paragraph, the other provisions of this compact shall nevertheless remain binding.

(b) Subject to the provisions of this compact, water of the Colorado River System may be impounded and used for the generation of electrical power, but such impounding and use shall be subservient to the use and consumption of such water for agricultural and domestic purposes and shall not interfere with or prevent use for such dominant purposes.

(c) The provisions of this article shall not apply to or interfere with the regulation and control by any State within its boundaries of the appropriation, use, and distribution of water.

ARTICLE V

The chief official of each signatory State charged with the administration of water rights, together with the Director of the United States Reclamation Service and the Director of the United States Geological Survey shall cooperate, ex-officio:

(a) To promote the systematic determination and coordination of the facts as to flow, appropriation, consumption, and use of water in the Colorado River Basin, and the interchange of available information in such matters.

(b) To secure the ascertainment and publication of the annual flow of the Colorado River at Lee Ferry.

(c) To perform such other duties as may be assigned by mutual consent of the signatories from time to time.

ARTICLE VI

Should any claim or controversy arise between any two or more of the signatory States: (a) with respect to the waters of the Colorado River System not covered by the terms of this compact; (b) over the meaning or performance of any of the terms of this compact; (c) as to the allocation of the burdens incident to the performance of any article of this compact or the delivery of waters as herein provided; (d) as to the construction or operation of works within the Colorado River Basin to be situated in two or more States, or to be constructed in one State for the benefit of another State; or (e) as to the diversion of water in one State for the benefit of another State; the Governors of the States affected, upon the request of one of them, shall forthwith appoint Commissioners with power to consider and adjust such claim or controversy, subject to ratification by the Legislatures of the States so affected.

Nothing herein contained shall prevent the adjustment of any such claim or controversy by any present method or by direct future legislative action of the interested States.

ARTICLE VII

Nothing in this compact shall be construed as affecting the obligations of the United States of America to Indian tribes.

ARTICLE VIII

Present perfected rights to the beneficial use of waters of the Colorado River System are unimpaired by this compact. Whenever storage capacity of 5,000,000 acre-feet shall have been provided on the main Colorado River within or for the benefit of the Lower Basin, then claims of such rights, if any, by appropriators or users of water in the Lower Basin against appropriators or users of water in the Upper Basin shall attach to and be satisfied from water that may be stored not in conflict with Article III.

All other rights to beneficial use of waters of the Colorado River System shall be satisfied solely from the water apportioned to that Basin in which they are situate.

ARTICLE IX

Nothing in this compact shall be construed to limit or prevent any State from instituting or maintaining any action or proceeding, legal or equitable, for the protection of any right under this compact or the enforcement of any of its provisions.

ARTICLE X

This compact may be terminated at any time by the unanimous agreement of the signatory States. In the event of such termination all rights established under it shall continue unimpaired.

ARTICLE XI

This compact shall become binding and obligatory when it shall have been approved by the Legislatures of each of the signatory States and by the Congress of the United States. Notice of approval by the Legislatures shall be given by the Governor of each signatory State to the Governors of the other signatory States and to the President of the United States, and the President of the United States is requested to give notice to the Governors of the signatory States of approval by the Congress of the United States.

IN WITNESS WHEREOF, the Commissioners have signed this compact in a single original, which shall be deposited in the archives of the Department of State of the United States of America and of which a duly certified copy shall be forwarded to the Governor of each of the signatory States.

DONE at the City of Santa Fe, New Mexico, this twenty-fourth day of November, A.D. One Thousand Nine Hundred and Twenty-two.

W. S. NORVIEL
W. F. McCLURE
DELPH E. CARPENTER
J. G. SCRUGHAM
STEPHEN G. DAVIS, JR.
R. E. CALDWELL
FRANK C. EMERSON

Approved:
HERBERT HOOVER

BIOLOGICAL ASSESSMENT

Cove-East Fork Virgin River Watershed Plan

Kane and Washington Counties, Utah

Prepared for:

Natural Resources Conservation Service

125 South State Street

Salt Lake City, Utah 84138

Prepared by:

Ron Bolander

Eocene Environmental Group, Inc.

579 West Galena Park Place, Unit 102

Draper, Utah 84020

August 2026

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1.0 INTRODUCTION

The Natural Resources Conservation Service (NRCS), in association with the Kane County Water Conservancy District (KCWCD) and Washington County Water Conservancy District (WCWCD) as project sponsors, is preparing a Watershed Plan-Environmental Impact Statement (Plan-EIS) for proposed improvements in the East Fork Virgin River (EFVR) Watershed.

The NRCS, KCWCD, and Alpha Engineering (Alpha) contracted Eocene Environmental Group, Inc. (Eocene; formerly Transcon Environmental, Inc.) to prepare the Plan-EIS and analyze the project for anticipated impacts to natural and human resources. This includes an analysis of potential impacts to federally listed threatened, endangered, and proposed species protected under the Endangered Species Act (ESA) as well as avian species protected under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA). In accordance with Section 7 of the ESA, this Biological Assessment (BA) was prepared to evaluate the potential impacts that implementing this Proposed Action may have on federally listed threatened, endangered, and proposed species, their habitat, and any designated critical habitat that may be present.

The purpose of this Proposed Action is to provide the Glendale, Mt. Carmel, and Orderville irrigation companies additional water storage capacity to meet present and future agricultural water demands during dry summer months; add a new, local, water-based recreational opportunity; and provide additional water to the WCWCD for agricultural and municipal and industrial (M&I) use.

2.0 PROPOSED ACTION

2.1 Project Location

The Proposed Action is in Kane County and Washington County, Utah, as shown in Figure 1 (Vicinity Map) in Appendix A.

2.2 Project Description

The NRCS, KCWCD, and WCWCD are proposing to construct a new reservoir and associated facilities to provide irrigation and agricultural water to local users in the Orderville, Glendale, Mt. Carmel, and Hurricane, Utah, areas during the summer months. Water from the reservoir would also be used for undetermined M&I use in Washington County year-round.

The reservoir would be constructed in compliance with Article II Section D of the Zion National Park (ZNP) Water Rights Settlement Agreement of 1996 (ZNP Agreement; Agreement 1996), as summarized below:

- One or more new reservoirs with cumulative active storage capacity of up to but not exceeding 6,750 acre-feet may be constructed in certain tributaries as outline in Article II Section D of the ZNP Agreement

- New surface water diversions on the EFVR or its tributaries shall not cumulatively exceed 60 cubic feet per second (cfs)

- The existing flow or 2 cfs, whichever is less, shall be maintained immediately below any new surface water diversion constructed on streams defined in section 11.D.1a) of the ZNP Agreement

- The existing flow or 1 cfs (including seepage), whichever is less, shall be maintained immediately below any new reservoir constructed on streams defined in section 11.D.1a) of the ZNP Agreement

- Cumulative releases from new reservoirs constructed on streams identified above shall not increase the flow measured at the USGS gauge on the EFVR near Springdale (USGS No. 09404900) by more than 25 cfs during any 7-day period and shall not exceed the long-term monthly average at Springdale gauge by more than 15 cfs; as measured at said gauge, the maximum instantaneous flow attributable to releases from such reservoirs shall not exceed 50 cfs except for matters involving dam safety

- Surface water diversions to new reservoirs described above shall not occur except during the period from November 1 and May 31, subject to the bypass flow requirements described above

Additionally, water would be used for unspecified M&I uses in Washington County. No facility construction or new surface disturbance would occur in Washington County resulting from this Proposed Action. Sections 2.2.1, 2.2.2, and 2.2.3 of this BA describe the project measures, operation, and maintenance and replacement needs.

2.2.1 Project Measures (Construction)

Project construction would include the following components, also shown in Figure 2 (Reservoir Detail Plan), Figure 3 (Glendale Irrigation Pipeline Replacement), Figure 4 (Mt. Carmel Pipeline Construction), and Figure 5 (Recreation Area) in Appendix A:

- A single 6,055-acre-foot capacity reservoir, with principal and auxiliary spillways; approximately 700 feet of a concrete encased steel pipeline would extend from the reservoir to connect to the existing Orderville irrigation pipeline
- Homogeneous earth-fill dam (90 feet by 1,900 feet) with an internal filter/drain
    - The proposed dam would be designed to meet current NRCS and Utah Dam Safety regulations (Utah Code Chapter 73-5a) and engineering standards
- Replacement of approximately 1.7 miles of pipeline in the Glendale irrigation system
- Approximately 4.55 miles of new pipeline in the Mt. Carmel field irrigation area
- A booster pump station to provide pressurized water for the Mt. Carmel irrigation Company (MCIC)
- Approximately 3.2 miles of gravel road to access the reservoir and surrounding properties
- A 4.1-acre outdoor recreational site including a boat ramp, two pit toilets, a pavilion, and 20 recreational vehicle site facilities (including a barbecue grill, table, and fire pit); no utilities would be extended to the recreation facilities
- Construction would require staging large, earth-moving machinery, a portable gravel pit operation, water, and multiple personnel
    - Staging areas for dam construction would be located within the footprint of the reservoir. An additional 200- to 300-foot buffer downstream of the dam would be used for instrumentation and additional staging
- Construction would begin after all necessary permits are obtained and plans are finalized. Construction of the reservoir, pipelines, associated recreation facilities, and access roads is estimated to take up to 15 months to complete. Three borrow sites would be used (Esplin, Lamb, Tait) to provide material (gravel and riprap) for dam construction
- A fish screen at the proposed reservoir intake with a 1-inch maximum pore opening would prevent fish and debris from entering the pipeline to the Orderville hydroelectric power plant.

Approximately 259 acres of permanent ground disturbance would occur where the proposed reservoir, dam, primary and auxiliary spillways, access roads, pipelines, and recreational features would be constructed. Approximately 5.7 acres of this disturbance would be from using the borrow pit sites. Approximately 64 acres of temporary ground disturbance would occur during replacement of the existing pipeline, installation of new pipelines, and contingency disturbance area for construction equipment siting. Three existing borrow sites would be used to provide

material for construction. The Tait and Lamb pits would provide gravel, while the Esplin pit would provide riprap. The Tait and Lamb pits are located on private land near Mt. Carmel and Mt. Carmel Junction, and the Esplin pit is located near the Glendale Bench Road on private land. These borrow sites are shown on Figure 1 (Vicinity Map) in Appendix A and Photos 2, 3, and 4 in Appendix C.

The Washington County portion of the project would include the following actions:

- The increased water yield in the river system provided by the proposed Cove Reservoir would be used to supplement water supply to the Hurricane Canal Company (HCC) service area and for undetermined M&I demand. Water would be diverted to the reservoir in compliance with the ZNP agreement during the non-irrigation season, November 1 - May 31. Water could be released from the reservoir at any time but would most likely occur in the summer for agricultural use, and in the winter for M&I use.

- Water flows to Washington County from the Proposed Action would comply with the ZNP Agreement (Agreement 1996)

- No surface disturbance would result from implementation of the Proposed Action in the Washington County portion of the Proposed Action

- The additional water would be provided to existing agricultural fields; no new lands would be converted to agricultural use

2.2.2 Operation

Operation activities are the activities performed to achieve the goals of the project. Water from the reservoir would provide irrigation and agricultural water for the Orderville, Glendale, Mt. Carmel, and Hurricane areas, as well as provide M&I water for Washington County for approximately 100 years after project construction. The project is anticipated to have a 100-year life before major pipeline repair would be required.

Routine maintenance and replacement actions would be required for the life of the proposed project. O&M measures that would be implemented include regular inspection and maintenance of the dam and associated components; grading of the spillways, as necessary, to maintain access and functionality; annual inspection of the pipeline air valves to ensure that they are functioning properly; annual cleaning of the pipelines; regular inspection and maintenance of the recreation area and boat ramp to ensure hard surfaces and erosional protection and to keep the site free of debris; and regular operation and maintenance of reservoir levels by agreement between the WCWCD and the KCWCD.

Water would be diverted from the EFVR at the Orderville Diversion and conveyed by pipeline to the proposed reservoir (See Appendix A, Figure 2 [Reservoir Plan]). A channel maintenance flow regime of 70 percent of existing bankfull flows (approximately 33 cfs) would be maintained in the 3.2-mile reach between the Orderville Irrigation Company (OIC) diversion and the Mt. Carmel Irrigation Company (MCIC) Diversion for a 10-day period each spring (between March and June). If stream flows are less than 33 cfs, all flows would be allowed to pass through the reach for the 10-day period. Only the OID agricultural water right of 4.7 cfs would be diverted. The MCIC would continue to divert 6.58 cfs for agricultural purposes. Water for Long Valley agricultural

purposes would be diverted from the reservoir during the summer months. Water committed to Washington County for agricultural and M&I purposes would generally be released during the summer months, and water for M&I purposes would generally be released during the winter months, based on demand. Releases to Washington County would comply with the ZNP Agreement (Agreement 1996).

Water would be released from the proposed reservoir back into the EFVR through the existing Orderville hydroelectric power plant. A fish screen installed at the proposed reservoir intake with a 1-inch maximum pore opening would prevent fish and debris from entering the pipeline to the Orderville hydroelectric power plant. The hydroelectric facility utilizes two Turgo Impulse turbines, which focus the water through small nozzles at high pressure and velocity into the turbine. The combination of the small nozzle size, high velocity, and sudden pressure drop would make it highly unlikely that any fish that would survive.

2.2.3 Maintenance and Replacement

Maintenance and replacement actions would include the performance of actions needed to keep the proposed reservoir and associated facilities safe and functioning as planned. This would include preventing deterioration and repairing damage or replacement of structures if one or more of the components fail. Damage to any of the completed structures caused by normal deterioration, droughts, flooding, or vandalism is considered maintenance.

The structures would be inspected by the KCWCD on a regularly scheduled basis as well as during, or immediately following, major storms, earthquakes, or other occurrences that may adversely affect the structures and appurtenant works. It is anticipated that routine maintenance would include maintaining water levels, grading the spillway as necessary, annual cleaning of the pipeline system, erosional protection, and excessive vegetation cleanup.

2.3 Applicant-Committed Conservation Measures

The following applicant-committed conservation measures will be implemented as part of the Proposed Action. These measures have been summarized from the Cove-EFVR Watershed Plan-EIS and apply to the management and protection of the listed and proposed species as well as migratory birds and bald and golden eagles that may be impacted by project development. The full set of committed measures is found in the Plan-EIS. These measures have been taken from and are similar to those implemented for other NRCS–funded Utah projects. The impact analysis and effects determinations made in this BA assume that all these measures will be fully implemented as part of project development.

2.3.1 General Measures

- Implementation of the Proposed Action would comply with all applicable federal and state laws and regulations as well as local zoning and building ordinances during all phases of the project

- Construction activities would be limited to the smallest extent possible within the Action Area

- During construction activities, vehicle parking and material stockpiles would be located within designated staging areas

- Construction personnel would adhere to state and NRCS fire prevention and suppression requirements; construction personnel will always have fire tools and extinguishers available

- Disturbed areas not used as part of the reservoir dam, recreation site, road or dam infrastructure would be restored to preconstruction conditions after construction was completed

- Borrow sites would be cleaned, recontoured, and any debris removed, per instructions of the owner

- An Emergency Action Plan would be developed prior to construction of the Proposed Action

- Additional measuring devices would be installed to record flows into and out of the Cove Reservoir. Metering devices would be installed to record flows through the existing Orderville hydroelectric power plant that will release water rights owned by the WCWCD back into the EFVR as well as water-right shortages being delivered from the reservoir to the Mt. Carmel and Orderville irrigation companies. These meter records would also be filed annually with the Utah State Division of Water Rights

2.3.2 USFWS Threatened, Endangered, and Proposed Animal Species

- Any unexpected encounters with a protected species would be immediately reported to the Utah Division of Wildlife Resources (UDWR), United States Fish and Wildlife Service (USFWS), and NRCS

- All trash at the construction site will be cleaned up daily to minimize any interest in the area by the California condor during construction
- Coordination would be maintained with WCWCD regarding construction activities and potential impacts to downstream Virgin River habitat

- Native milkweed (*Asclepias spp.*) and other monarch butterfly (*Danaus plexippus*) pollinator-friendly native plant species would be included in reclamation seed mixes per NRCS and USFWS guidance

- Disturbance of any encountered milkweed habitat would be avoided to the extent possible

2.3.3 Plants and Animals

- The minimum vegetation necessary would be removed for construction or maintenance activities.

- Areas disturbed during construction activities would be restored to preconstruction conditions. This would be accomplished by grading to match natural contours and

stabilizing through establishment of ground cover. These areas would be reestablished by seeding with an herbaceous plant seed mixture and revegetation with NRCS-approved plant species to match the surrounding native plant community.

- An NRCS-approved, weed-free, native seed mix would be used where seeding is required.
- Established cottonwood trees in riparian areas would be left in place for fish and wildlife habitat.
- A detailed weed control plan would be provided by the NRCS for approval before construction.
- All equipment would be cleaned of soil, seeds, vegetation matter, and other debris prior to entering or reentering the project area to avoid any introduction of non-native plants or weeds.
- Vegetation would be monitored periodically for the potential establishment of noxious weeds.
- Use of herbicides would comply with NRCS requirements.
- A post-construction period weed control plan would be developed by KCWCD.
- Any use of herbicides would comply with all federal and state requirements.
- Prior to stocking the proposed reservoir with fish, a management plan will be developed to ensure that non-native fish species do not escape from the reservoir into the EFVR. The management plan would meet nonnative stocking and control requirements. Cooperating Agencies would have an opportunity to review this plan prior to its implementation.
- Any fish stocking in the reservoir would adhere to state and federal regulations and would be under the responsibility of the Utah Division of Wildlife Resources
- Any unexpected encounters with a protected species would be immediately reported to UDWR, USFWS, and NRCS.
- Coordination with WCWCD regarding construction activities and potential impacts to downstream Virgin River habitat would be maintained
- All open pits or trenches would be monitored throughout construction to prevent entrapment of wildlife
- Excavated holes more than 2 feet deep would be covered at the close of each day or provided with one or more escape ramps. Alternatively, fencing may be erected around open pits or trenches.
- Before pits or trenches are filled, they would be inspected for trapped animals. If found, they would be moved by a qualified biologist approved by the UDWR and NRCS.

- No rodenticides would be used on the project site.

- No mature riparian trees would be removed during construction activities unless approved by the Utah Division of Wildlife Resources and NRCS.

- No machinery would be permitted in the EFVR except for along existing roadways.

- Refuse and trash, including stakes and flags, would be removed and properly disposed of on a regular basis.

2.3.4 Migratory Birds/Bald and Golden Eagles

- Where possible, construction activities, including habitat alteration and noise, would be conducted outside of Utah's migratory bird primary nesting season (April 1–July 15). In Utah, the migratory bird nesting season can extend from January 1 to August 31 (especially for raptors). Therefore, a preconstruction survey for nesting birds would be conducted by a qualified biologist approved by the UDWR and NRCS no more than 5 days prior to the beginning of on-site work. If an active nest is identified, a no-activity buffer, as approved by the UDWR and NRCS, would be established around the nest site and would remain in place until the young have fledged and/or the nest becomes non-active (USFWS 2002a). Follow-up surveys to confirm that all young have successfully fledged would be conducted by a qualified biologist prior to construction in that area.

- After such surveys are performed and disturbance occurs, no additional disturbance during the avian breeding season would occur without first conducting an additional avian survey.

- If the existing topography limits line-of-sight between an active nest and construction activities, spatial and seasonal buffers may be reduced.

- Should an active migratory bird nest be discovered, the appropriate UDWR and NRCS agency biologist would be notified, and an appropriate buffer would be established around the nest until the migratory bird nesting period is over or young have fledged.

3.0 ACTION AREA

The Action Area is defined as the area that could be directly or indirectly affected by a federal action (50 CFR 402.02). It includes sites where all permanent and temporary areas of ground disturbance would occur as well as species-specific buffers, as described in Section 3.3. The Action Area analyzed in this BA includes the areas where permanent disturbance would occur (Long Valley) and the downstream areas, (Parunuweap Canyon and Washington County). The length of the Action Area is approximately 50 river miles along the EFVR and the mainstem Virgin River, where water would be diverted at the Quail Creek Reservoir diversion for agricultural and M&I uses. See Figure 6 (Action Area in Long Valley) and Figure 7 (Action Area in Washington County) in Appendix A for maps of the Action Area.

3.1 Long Valley

The Action Area in Long Valley begins near Glendale, Utah, and extends along the EFVR, past Orderville (the proposed reservoir site) to Mt. Carmel Junction. The two gravel borrow sites (Lamb and Tait pits) are located immediately east of the EFVR near Mt. Carmel. The rip rap borrow site (Esplin pit) is located approximately 7 miles east of Glendale near Glendale Road.

3.2 Parunuweap Canyon and Washington County

Parunuweap Canyon is located between the Long Valley and the Washington County portions of the Action Area. It primarily consists of the BLM administered Parunuweap Canyon Wilderness Study Area (WSA) and the ZNP managed designated wilderness. The 30,800-acre Parunuweap Canyon WSA is located immediately east of and adjoins ZNP. The Zion Wilderness was designated by congress in 2009 and comprises approximately 83 percent of ZNP. A ribbon of green marks the EFVR's approximately 10-mile course through the WSA (BLM 2025) and 7 miles through the arid southernmost portion of the Zion Wilderness (ZNP 2025a).

The remaining portion of the Action Area extends approximately 50 miles downstream via the EFVR and mainstem Virgin River to the Quail Creek Reservoir diversion. At this site, water from the reservoir would be diverted to existing agricultural fields serviced by the HCC. Water would also be used for unspecified Washington County M&I uses.

3.3 Action Area Buffers

For the analysis of listed and proposed species, the Action Area includes species-specific buffers. These buffer distances are determined based on activities proposed to occur within the project footprint (i.e., the immediately impacted area) that may cause impacts extending beyond the footprint (e.g., noise, vibration, dust, etc.). These buffers were determined based on anticipated levels of construction-related disturbance, including noise, dust, and ground vibrations produced by vehicles and heavy equipment. In the Long Valley portion of the Action Area, species-specific buffers include:

- Bird Species: 0.5 miles
- Fish Species: 0.25 miles

- Other species: 300 feet

In the Parunuweap Canyon and Washington County portions of the Action Area, no surface disturbance would occur. There would be negligible changes to water depth and width (discussed in Section 5.0), and therefore, the Action Area extends to a 100-foot buffer of the EFVR to account for the riparian area surrounding the river. No impact would occur outside of this area.

3.4 Habitat Characteristics of the Action Area

Characteristics of the Action Area are summarized below. A detailed discussion is found in the Plan-EIS. The Action Area includes a mix of developed residential land, disturbed grasslands, grazing pastures, and native vegetation communities as described below.

3.4.1 Community Types

Dominant ecological systems in the survey area include inter-mountain basins big sagebrush, Colorado plateau pinyon-juniper woodland, introduced upland vegetation-shrub, shrub land, inter-mountain basins greasewood flat, rocky mountain lower montane riparian woodland and shrub land, Mogollon chaparral, disturbed/successional–shrub regeneration, and pasture/hay (USGS 2018). Species observed within or adjacent to the survey area were characteristic of these ecosystems and included a mix of native and non-native trees, shrubs, forbs, and grasses.

3.4.2 Aquatic and Surface Water Resources

All areas where ground or surface disturbance would occur from project implementation were surveyed in 2018, 2019, and 2021. Surveys identified two small artificial wetlands, 10 intermittent or perennial streams, and five ephemeral streams (Eocene 2025).

The EFVR intersects the Action Area but is outside of any surface disturbance areas. It is located approximately 0.24 miles west of the Tait borrow pit site, 0.16 miles west of the Lamb borrow pit site, and would be approximately 0.67 miles east of the proposed reservoir site. The EFVR flows downstream from Mt. Carmel Junction through Parunuweap Canyon WSA managed by the Bureau of Land Management (BLM) and Zion National Park where it meets with the North Fork of the Virgin River near Rockville, Utah. The river, now known as the Virgin River, continues downstream through Washington County. A mature riparian area that is adaptable to significant changes to river flow habitat is located adjacent to the stream. The riparian area of the Virgin River supports cottonwood trees and a diversity of herbaceous plants and grasses. Nearby, saturated wetlands make nice habitat for cattails, willows, aquatic plants, and rushes (ZNP 2025d). See Figure 1 (Vicinity Map), Figure 6 (Action Area in Long Valley), and Figure 7 (Action Area in Washington County) in Appendix A.

EFVR surface flows vary throughout the year, primarily in response to spring runoff or intense storm events, during which the river carries high sediment loads. From 1967 to 2020, the average monthly discharge of the river, measured at the 09404450 Glendale USGS Gauge, ranged from a high of 33.8 cfs in April to a low of 9.9 cfs in August (Alpha 2026).

Kanab Creek runs near the Esplin borrow pit site but would not be affected by borrow pit activities. Photo 5 in Appendix C shows the Esplin borrow pit site and its relation to Kanab Creek.

3.4.3 Vegetation

Vegetation found at the proposed reservoir/pipeline site consists of a greasewood-salt scrub association that transitions into sagebrush-perennial grassland habitat and, eventually, into a pinyon-juniper woodland on slopes. Agricultural land is also present. Much of the project area is in a disturbed condition with several roads and trails present, and the existing vegetation reflects a sub-climax ecological state.

A mature, generally sparse, riparian area accompanies the EFVR where it traverses the Long Valley portion of the Action Area. Dominant riparian vegetation in this area consists of tamarisk (*Tamarix chinensis*), Russian olive (*Elaeagnus angustifolia*), and cottonwood trees (*Populus spp.*). Understory consists of various shrubs, forbs, and grasses.

In Parunuweap Canyon and Washington County, riparian species along the EFVR and Virgin River include a dense layer of willow (*Salix spp.*), cane (*Phragmites spp.*), cottonwood trees, rushes (*Juncus spp.*), and a diversity of other herbaceous plants and grasses. Invasive species, such as tamarisk and Russian olive, are present (ZNP 2025d). As with the Long Valley portion of the Action Area, this riparian zone is adapted to large changes in flows resulting from flooding, spring runoff, etc. (Lisa Church, personal communication May 2025).

Common vegetation species located in the Action Area are identified in Table 1. Additionally, species listed under the Utah Noxious Weed Act along with other invasive species have been observed within, or likely occur within, the Action Area. These are identified in Table 2. These invasive species usually occur on disturbed areas where native vegetation has been significantly or totally removed (e.g., roadsides, livestock trails, and flood-damaged areas). Noxious weeds and invasive plant species often exclude other vegetation, reducing species diversity and ecosystem stability.

Table 1. Common Vegetation*

Common Name	**Scientific Name**
rabbitbrush	*Chrysothamnus spp.*
blackbrush	*Coleogyne ramosissima*
bluebunch wheatgrass	*Pseudoroegneria spicata*
bottlebrush squirreltail	*Elymus elimoides*
cattail	*Typha latifolia*
cottonwood	*Populus spp.*
Great Basin sagebrush	*Artemisia tridentata*
Indian ricegrass	*Achnatherum hymenoides*
Mormon tea	*Ephedra viridis*
narrowleaf willow	*Salix exigua*
needle-and-thread grass	*Hesperostipa comata*

Common Name	Scientific Name
purple three-awn	*Aristida purpurea*
saltbush	*Atriplex spp.*
two-needle pinyon pine	*Pinus edulis*
Utah juniper	*Juniperus osteosperma*
**Joanna's thistle	*Cirsium joannae*

*The Utah Natural Heritage Program (UNHP) Online Species Search Report did not identify any plant species of greatest conservation within a 2-mile radius of the Action Area (UDWR 2024; UDWR 2025a)

**A State of Utah species of greatest conservation need, identified by the NPS.

Table 2. Noxious and Invasive Species

Common Name	Scientific Name
cheatgrass	*Bromus tectorum*
Russian olive	*Elaeagnus angustifolia*
Russian thistle	*Salsola spp.*
tamarisk	*Tamarix spp.*
cane	*Phragmites spp.*
tall whitetop	*Lepidium latifolium*
Scotch thistle	*Onopordum acanthium*
Canada thistle	*Cirsium arvense*
Spotted knapweed	*Centaurea stoebe*

3.4.4 Recreation

The Action Area contains recreation opportunities such as hiking, wildlife viewing, and landmark sight-seeing. Stunning canyon vistas and unique hiking opportunities are present. Landmarks in the Parunuweap Canyon WSA include Harris Mountain and Elephant Butte. Wildlife, including mule deer, mountain lions, rattlesnakes, and birds are common. The EFVR flows through the WSA. By following the EFVR, hikers can traverse over ten miles through the canyon to the east side of ZNP (BLM 2008; BLM 2025).

3.4.5 Wildlife

Common wildlife species located in the Action Area are identified in Table 3. In addition to these species, several additional species of small mammals, including voles, squirrels, chipmunks, mice, birds, and bats, are also likely present.

Table 3. Wildlife

Common Name	Scientific Name
*Arizona toad	*Bufo microscaphus*
badger	*Taxidea taxus*
*bald eagle	*Haliaeetus leucocephalus*
*band-tailed pigeon	*Patagioenas fasciata*
bobcat	*Lynx rufus*
*burrowing owl	*Athene cunicularia*
chuckar	*Alectoris chukar*
cottontail rabbit	*Sylvilagus ssp.*
coyote	*Canis latrans*
*desert sucker	*Pantosteus clarkii*
*ferruginous hawk	*Buteo regalis*
*flammulated owl	*Psiloscops flammeolus*
*flannelmouth sucker	*Catosomus latipinnis*
gartersnake	*Thamnophis elegans*
*Gila monster	*Heloderma suspectum*
*golden eagle	*Aquila chrysaetos*
gopher snake	*Pituophis catenifer*
jack rabbit	*Lepus californicus*
*kit fox	*Vulpes marotis*
*Lewis's woodpecker	*Melanerpes lewis*
mitered vertigo	*Vertigo modesta concinnula*
mourning dove	*Zenaida macroura*
mule deer	*Odocoileus hemionus*
*northern leopard frog	*Lithobates pipiens*
*peregrine falcon	*Falcon perefrinus*
raccoon	*Procyon lotor*
*Virgin spinedace	*Lepidomeda mollispinis*
weasel	*Mustela frenata*
western toad	*Anaxyrus boreas*
*Yuma myotis	*Myotis yumanensis*

Common Name	Scientific Name
*speckled dace	*Rhinichthys osculus*

*Species of Greatest Conservation Need identified in the UNHP Online Species Search Report (2024). These species are also identified in the Utah Wildlife Action Plan (UDWR 2025a).

Invasive animal species also inhabit the Action Area and are shown in Table 4 (NRCS 2012). Administrative Rule R657-60 identifies regulations and procedures designed to prevent and control the spread of aquatic invasive species in Utah. No surveys have been conducted for invasive animal species within the project area, but it can be assumed that some of these species are present.

Table 4. Invasive Animal Species*

Common Name	Scientific Name
Bullfrog	*Rana catesbeiana*
European starling	*Sturnus vulgaris*
fathead/rosy red minnow	*Pimephales promelas*
mosquitofish	*Gambusia affinis*
muskrat	*Ondatra zibethicus*
New Zealand mudsnail	*Potamopyrgus antipodarum*
Nutria	*Myocastor coypus*
quagga mussel	*Dreissena rostiformis bugensis*
Red fox	*Vulpes vulpes*
raccoon	*Procyon lotor*
red shiner	*Cyprinella lutrensis*
red swamp crayfish	*Procambrus clarkia*
white-tailed deer	*Odocoileus virginianus*
Zebra mussel	*Dreissena polymorpha*
non-native non-sport fish	N/A

(NRCS 2012) *This is a general list taken from the NRCS website, and it is unlikely that several of these species are present.

3.4.6 Migratory Bird Species and Bald and Golden Eagles

The USFWS IPaC site identified 16 MBTA and BGEPA species as potentially occurring within the Action Area, identified in Table 5 (USFWS 2025). These species are included in this BA for

informational purposes only, and no impact analysis is included. The IPaC and UNHP documents are included in Appendix B.

Table 5. Migratory Birds and Bald and Golden Eagles*

Common Name	Scientific Name
*bald eagle	*Haliaeetus leucocephalus*
black-shinned sparrow	*Spizella atrogularis*
broad-tailed hummingbird	*Selasphorus platycercus*
California gull	*Larus californicus*
Cassins's finch	*Haemorhous cassinii*
Clark's nutcracker	*Nucifraga columbiana*
evening grosbeak	*Coccothraustes vespertinus*
*golden eagle	*Aquila chrysaetos*
Grace's warbler	*Setophaga graciae*
lesser yellowlegs	*Tringa flavipes*
*Lewis's woodpecker	*Melanerpes lewis*
long-eared owl	*Asio otus*
olive-sided flycatcher	*Contopus cooperi*
pinyon jay	*Gymnorhinus cyanocephalus*
Virginia's warbler	*Vermivora virginiae*
western grebe	*Aechmophorus occidentalis*

*Identified in the IPaC and UNHP Online Species Search Report (2024)

4.0 FEDERALLY LISTED AND PROPOSED SPECIES AND DESIGNATED CRITICAL HABITAT CONSIDERED

This BA addresses the potential effects that could result from implementation of the Proposed Action on species and their habitat (including designated critical habitat) listed as threatened, endangered, or as proposed for listing under the ESA. The USFWS IPaC site (Section 7 consultation) identified 13 ESA–listed or proposed for listing species that may occur within the Action Area or otherwise be affected by the development of the Proposed Action (USFWS 2025). These species are discussed in Table 6. The USFWS IPaC website, USFWS Environmental Conservation Online System website, and the UNHP Database were also reviewed to obtain information on listed and proposed species that may occur within 2 miles of the Action Area (USFWS 2024b; USFWS 2025; UNHP 2024).

The UNHP database identified the records of two species (southwestern willow flycatcher [SWFL] and Mojave desert tortoise) with known occurrences within 2 miles of the Action Area (UNHP 2024). The IPaC and UNHP documents are included in Appendix B. To date, informal consultation and conferencing with the USFWS has been conducted via in-person meetings, video conferences, telephone calls, and email.

Eocene biologists conducted field visits during October 2018 and October 2023 (Esplin Pit site) to verify desktop review findings and assess potential habitat for listed, proposed, MBTA, and BGEPA species within the Action Area (Transcon 2019; Eocene 2025). Only those species with habitat within the Action Area or those that may be affected by Proposed Action have been carried forward in this BA for further analysis. All temporary and permanent areas of disturbance associated with development of the Proposed Action would be contained within the Long Valley portion of the Action Area, as depicted in Figure 6 (Action Area in Long Valley) in Appendix A.

Table 6. ESA–Listed and Proposed Species Summary

Species	Status	Species Info and Potential to Affect	Designated Critical Habitat within Action Area?
Bird Species California condor (*Gymnogyps californianus*)	Experimental Non-Essential (Threatened in ZNP)	The California condor utilizes a variety of habitats for foraging and nesting, including caves and ledges of steep rocky terrain (USFWS 2013a). The Action Area is located within the experimental non-essential range of the California condor (FR 1996). Experimental non-essential species are treated as threatened within ZNP. The species is present in ZNP and may visit other parts of the Action Area (ZNP 2025b). However, no surface disturbance would occur within known occupied California condor habitat. UNHP data did not identify any known occurrences of the species in the Action Area (UNHP 2024).	No. None present within the Action Area.
Bird Species Mexican spotted owl (*Strix occidentalis lucida*)	Threatened	In Utah, the Mexican spotted owl (MSO) inhabits isolated mountain ranges and narrow canyons (USFWS 2013b; ZNP 2025c). Occupied designated critical habitat is present within the Action Area in the Parunuweap Canyon WSA and ZNP (FR 2004). Protected Activity Centers (PACs) for the MSO are also present in the ZNP portion of the Action Area (ZNP 2025c). No surface disturbance would occur within MSO habitat, and minor streamflow changes would not affect riparian habitat. UNHP data did not identify any known occurrences of the species in the Action Area (UNHP 2024).	Yes
Bird Species Southwestern willow flycatcher (*Empidonax traillii extimus*)	Endangered	The SWFL breeds in riparian vegetation and nests where willows or tamarisk are present. Occupied habitat exists downstream in the Parunuweap Canyon WSA, and ZNP, within the Action Area (USFWS 2002b). However, no surface disturbance would occur within SWFL habitat, and minor streamflow changes would not affect riparian habitat. UNHP data identified the presence of the SWFL within 2 miles of the Action Area (UNHP 2024).	No. None present within the Action Area.

Species	Status	Species Info and Potential to Affect	Designated Critical Habitat within Action Area?
Bird Species Western yellow-billed cuckoo (*Coccyzus americanus*)	Threatened	The western yellow-billed cuckoo (WYBC) breeds in riparian habitat with wide floodplains and dense willow-cottonwood or mesquite forests. They rarely occupy areas less than 325 feet wide. No suitable breeding habitat is present in the Parunuweap Canyon WSA and ZNP areas within the Action Area (FR 2014). Potential suitable stop-over habitat for migrating WYBC may be present in these areas. No surface disturbance would occur within WYBC habitat, and minor streamflow changes would not affect riparian habitat. UNHP data did not identify any known occurrences of the species in the Action Area (UNHP 2024).	No. None present within the Action Area.
Reptile Species Desert tortoise (*Gopherus agassizii*)	Threatened	The desert tortoise inhabits deserts, grasslands, and rocky hillsides, typically in desert shrub areas below 5,500 feet. The Upper Virgin River Recovery Unit extends from the Quail Creek Reservoir diversion to Springdale, Utah, outside of the Action Area (USFWS 2011). UNHP data identified the presence of the desert tortoise within 2 miles of the Action Area (UNHP 2024).	No. None present within the Action Area.
Fish Species Virgin River chub (*Gila seminuda*)	Endangered	The Virgin River chub is found below 4,500 feet in deep runs or pools with low to medium velocities, and in-stream cover over sandy substrate (USFWS 1995a). In Utah, the Virgin River supports Virgin River chub populations from the Arizona state line to the La Verkin Creek confluence. Virgin River chub has also colonized habitat upstream of Pah Tempe Springs following the establishment of population maintenance flows below Quail Creek Diversion. Virgin River chub distribution currently extends upstream to the old diversion structure in Timpoweap Canyon (2 miles upstream from Pah Tempe Springs, and 4 miles upstream from the La Verkin Creek confluence (PLPCO 2025). UNHP data did not identify any known occurrences of the species in the Action Area (UNHP 2024).	No. None present within the Action Area.

Species	Status	Species Info and Potential to Affect	Designated Critical Habitat within Action Area?
Fish Species Woundfin (*Plagopterus argentissimus*)	Endangered	The woundfin is found in swift, turbid, warm streams over sand. Adult woundfin prefer depths of 8–18 inches and avoid quieter pools (USFWS 1995a). Occupied habitat exists below the Quail Creek Reservoir Diversion. In Utah, designated critical habitat exists approximately 4.8 river miles downstream from the Diversion beginning at the confluence of La Verkin Creek to the Utah-Arizona state line (FR 2000) (PLPCO 2025). UNHP data did not identify any known occurrences of the species in the Action Area (UNHP 2024).	No. None present within the Action Area.
Insect Species Monarch Butterfly (*Danaus plexippus*)	Proposed Threatened	Adult monarch butterflies feed on various flowers but only breed where milkweed is present. Monarch caterpillars have been observed within portions of the proposed Action Area, primarily in ZNP; however, breeding is unlikely within the Long Valley portion of the Action Area due to a lack of milkweed presence. UNHP data did not identify any known occurrences of the species in the Action Area (UNHP 2024). The Cove Reservoir area is likely a flyover area for migrating monarch butterflies but is not a known overwintering site.	No. No Critical Habitat has been designated.
Insect Species Suckley's cuckoo bumble bee (*Bombus suckleyi*)	Proposed Endangered	Suckley's cuckoo bumble bee is an obligate social parasite, dependent on host bumble bees for much of its life cycle. The species has a broad historical distribution across North America, and it has been found in various habitat types including prairies, grasslands, meadows, and woodlands. Occurrence records were found at elevations ranging from approximately 6,000 to 10,500 feet. In the western portion of the range, Suckley's cuckoo bumble bee observations extend from the Yukon, to Arizona, and east to Minnesota. However, the species has not been observed within the western United States since 2016 (USFWS 2024a). It is unlikely that the species is found within the Action Area. UNHP data did not identify any known occurrences of the species in the Action Area (UNHP 2024).	No. No Critical Habitat has been designated

Species	Status	Species Info and Potential to Affect	Designated Critical Habitat within Action Area?
Plant Species Jones cycladenia (*Cycladenia humilis var. jonesii*)	Threatened	Jones cycladenia is found in sparsely vegetated desert scrub between 4,000–6,660 feet, typically on steep slopes with gypsiferous, saline soils of the Wasatch, Cutler, Summerville, and Chinle formations (USFWS 2021). No suitable habitat exists in the Action Area. UNHP data did not identify any known occurrences of the species in the Action Area (UNHP 2024).	No. No Critical Habitat has been designated.
Plant Species Shivwits milk-vetch (*Astragalus ampullarioides*)	Endangered	Shivwits milk-vetch grows at elevations of 3,018–4,367 feet on soft clay soils linked to the Petrified Forest member of the Chinle Formation. Occupied habitat is restricted to six isolated populations in Washington County, none of which are near the Action Area (USFWS 2006). UNHP data did not identify any known occurrences of the species in the Action Area (UNHP 2024).	No. None present within the Action Area
Plant Species Siler's pincushion cactus (*Pediocactus sileri*)	Threatened	Siler pincushion is endemic to the Arizona/Utah border in Kane and Washington County, Utah, and grows in gypsiferous and calcareous soils from the Moenkopi, Chinle, and Kaibab Formations (USFWS 2008). No occupied habitat exists in the Action Area. UNHP data did not identify any known occurrences of the species in the Action Area (UNHP 2024).	No. No Critical Habitat has been designated.

Species	Status	Species Info and Potential to Affect	Designated Critical Habitat within Action Area?
Plant Species Ute ladies'-tresses (*Spiranthes diluvialis*)	Threatened	The Ute ladies-tresses is found in wet meadows near springs, lakes, or streams at elevations of 4,300–7,000 feet (USFWS 1995b). While the Action Area is in a Ute ladies'-tresses Analytical Unit, habitat as described above is not present (USFWS 2023). Further, no surface disturbance would occur within any riparian habitat. UNHP data did not identify any known occurrences of the species in the Action Area (UNHP 2024). A general habitat assessment was conducted in the vicinity of the proposed reservoir and borrow pits. No Ute ladies'-tresses suitable habitat was located. The proposed reservoir site is located in dry, terrestrial habitat. Nearby riparian areas along the EFVR are generally woody, lack understory, and are often dry during summer low flow and do not meet Ute ladies'-tresses habitat requirements.	No. No Critical Habitat has been designated.

Based on the analysis in Table 4, it has been determined that the Proposed Action would have **No Effect** on the following species or their designated critical habitat:

- Western yellow-billed cuckoo
- Desert tortoise
- Suckley's cuckoo bumble bee
- Jones cycladenia
- Shivwits milk-vetch
- Siler's pincushion cactus
- Ute ladies'-tresses

The Action Area is located within the monarch butterfly's migrating fly zone, and native flowering plants are present in the area. Therefore, it is possible that the species could be found migrating through the area. The potential for effect is negligible due to the considerable size of the monarch butterfly habitat and the limited duration of construction activities. Therefore, a determination of Not Likely to Jeopardize has been made for this species due to insignificant effects. Because the potential for effect is so low, the monarch butterfly is not discussed further in this document.

The California condor, MSO, SWFL, Virgin River chub, and woundfin are carried forward for detailed analysis in this BA due to the presence of designated critical habitat within the Action Area (for MSO), the possibility of minor streamflow changes (California condor, SWFL), or their presence in the Virgin River (for Virgin River chub and woundfin).

4.1 California Condor

4.1.1 Status

The Action Area is generally located within the experimental non-essential range of the condor (USFWS 2024c). However, the species is listed as Threatened within ZNP (FR 1996). The Washington County Portion of the Action Area, which includes the EFVR and 100-foot buffer, runs through the ZNP.

4.1.2 Habitat Characteristics

California condors use a variety of habitats for foraging, roosting, and nesting. The birds roost on large trees or snags or on rocky outcrops and cliffs. Nests are located in caves and ledges of steep rocky terrain or in cavities and broken tops of old-growth conifers created by fire or wind. This habitat is not present in the portion of the Action Area where the reservoir would be located, near Orderville. It is present in the Action Area where no surface disturbance would occur, at Parunuweap Canyon, Mineral Gulch, and ZNP. Foraging habitat includes more open areas such as grassland and savannah vegetation types. Use of various foraging locations tends to be seasonal and extensive, as feeding opportunities are often widely distributed across the condor's range (USFWS 2013a). California condors do not kill for food but are obligate scavengers, depending

primarily on large mammalian carcasses such as deer and cattle. The proximity to water sources for drinking and bathing is an important component of condor habitat, as condors regularly drink from and bathe in freshwater pools. Suitable pools must provide easy access and takeoff and be situated within a convenient distance to foraging areas (USDA 2026a; Frixione, et. al. 2026).

4.1.3 Environmental Baseline

The California condor was reintroduced to the Vermillion Cliffs area in Northern Arizona in 1996. Releases in the area still occur. The condor has expanded its range into southern Utah and flies back and forth between Utah and Arizona on a regular basis (UDWR 2025b). The California condor is found in ZNP and Mineral Gulch due to the presence of favorable habitat (ZNP 2025a).

Due to the variety of habitats that condors utilize and their large home range, individual condors regularly move through the Action Area. The condor is known to nest within ZNP and would be expected to continue to nest in the area. Sightings are rare, but approximately 70 condors live wild in Utah and Arizona and are commonly sighted in the ZNP area (ZNP 2025b). They have also been seen above the Vermillion Cliffs of Grand Staircase Escalante National Monument (Bryce Canyon Country 2026). Condors have been known to roost and nest in Mineral Gulch. Mineral Gulch is located approximately 6 miles east of ZNP and drains into Parunuweap Canyon (part of the Action Area), near the Barracks. However, no condors are known to occur where surface disturbance would occur in the Long Valley portion of the Action Area.

4.1.4 Survey Methods/Results

California condor surveys were not conducted for this BA. However, condors in the area are tracked via GPS so locations can be verified. Because no project-specific surveys were conducted, occupancy is assumed for the Parunuweap Canyon and Mineral Gulch portions of the Action Area (including ZNP). The remainder of the Action Area does not contain the habitat requirements necessary for the California condor.

4.1.5 Designated Critical Habitat

No critical habitat has been designated for the California condor in Utah.

4.2 Mexican Spotted Owl

4.2.1 Status

The MSO was listed as a federally threatened species in 1993 (FR 1993). In Utah, populations are disjunct and located in isolated mountain ranges or steep rocky canyon systems, such as Parunuweap Canyon in Kane and Washington Counties (UDWR 2025a).

4.2.2 Habitat Characteristics

Nesting and roosting occur in both forested and rocky canyon habitats. The MSO occupies a variety of habitats in various parts of its range. In Utah, nesting habitat is primarily steep, rocky canyons where nests are found in caves or on cliff ledges in steep-walled canyons, as found in Parunuweap Canyon (UDWR 2025a). Mexican spotted owls appear to use a wider variety of cover types for foraging than for roosting or nesting. MSOs forage in a variety of habitats:

managed and unmanaged forests, pinyon-juniper woodlands, mixed-conifer and ponderosa pine forests, cliff faces and terraces between cliffs, and riparian zones (USFWS 2012).

MSO's forage primarily at night, starting at sunset and continuing until just before sunrise. MSO's feed on a variety of prey, including small mammals, particularly mice, voles, and woodrats, and will also take birds, bats, reptiles and arthropods (USFWS 2012).

4.2.3 Environmental Baseline

The MSO occurs in disjunct habitats, including forested mountains and canyonlands throughout the United States and Mexico. In Utah (Colorado Plateau Ecological Management Unit [EMU]), it is primarily found in the southern and eastern parts of the state on the Colorado Plateau, where it is a rare permanent resident (UDWR 2025a).

Recreation is a primary land use within the Colorado Plateau EMU. Activities such as hiking, camping, hunting, rock climbing, mountain biking, and off-road vehicle use occur in MSO habitat within the EMU. Forest and fire management are also important land activities. In the BLM-ZNP Parunuweap Canyon area, the potential for non-motorized recreation to affect owl presence and recovery is compounded by the terrain, with owls established in narrow canyons having less opportunity to move away from human activity. Other land uses, such as timber cutting and energy development, do not occur within Parunuweap Canyon WSA and Zion National Park portion of the Action Area (USFWS 2004).

4.2.4 Survey Methods/Results

MSO surveys were not conducted for this BA. Therefore, occupancy is assumed for the Parunuweap Canyon portion of the Action Area. The remainder of the Action Area does not contain the habitat requirements necessary for the MSO.

4.2.5 Designated Critical Habitat

The USFWS designated critical habitat for the MSO in 2004 (FR 2004). Designated Critical Habitat Unit CP-11 is in Iron, Washington, and Kane Counties. A portion of this habitat unit includes BLM and ZNP–administered lands in Parunuweap Canyon. The portion of Designated Critical Habitat Unit CP-11 located adjacent to the EFVR in the canyon lies within the Action Area.

MSO designated critical habitat primary constituent elements (PCEs) related to canyon habitat consist of one or more of the following: presence of water (often providing cooler and often higher humidity than the surrounding areas); clumps or stringers of mixed-conifer, pine-oak, pinyon-juniper, and/or riparian vegetation; canyon walls containing crevices, ledges, or caves; a prey base; and a high percent of ground litter and woody debris (USFWS 2013b). These PCEs are present in Parunuweap Canyon. ZNP data shows that suitable MSO habitat extends beyond the designated critical habitat. Additionally, within the Action Area, the MSO-Designated Critical Habitat contains at least two PACs, as defined in the MSO Recovery Plan (USFWS 2012). These PACs are located along the EFVR in Parunuweap Canyon (Appendix A, Figure 8). A PAC is a minimum of 600 acres surrounding a 100-acre core area that includes a nest or roosting site. PACs are established for the purpose of protecting nest and roosting areas (USFWS 2012). The most protective MSO management prescriptions occur within PACs.

4.3 Southwestern Willow Flycatcher

4.3.1 Status

The SWFL was listed as a federally threatened species in 1995 (FR 1995). In Utah, the SWFL is found only in riparian areas in the southernmost portion of the State (Washington, Kane, and San Juan Counties) (UDWR 2025a).

4.3.2 Habitat Characteristics

Nesting sites are found in riparian habitat including dense stands of willows and cottonwood trees. In some areas, nonnative tamarisk and Russian olive trees are interspersed with native willows. The SWFL rarely nests in dense stands of these species (UDWR 2025a) and rarely occupies habitat areas less than 325 feet wide. SWFL have only been documented nesting in stands with a width of 10 meters or more, although they will use narrower, linear habitat, such as that found in Parunuweap Canyon, during migration. Hydrological conditions play an important role in where SWFL choose to nest; they will nest along lentic water such as slow-moving stream reaches, at river backwaters, in swampy abandoned channels, and in oxbows and margins of impounded water (USFWS 2002b).

4.3.3 Environmental Baseline

Habitat required for nesting (as described above) is not found within the Parunuweap Canyon portion of the Action Area. However, it is likely used during migration. Riparian habitat in the Long Valley portion of the Action Area is sparse and would not likely meet SWFL habitat requirements.

4.3.4 Survey Methods/Results

No SWFL surveys were conducted for this project.

4.3.5 Designated Critical Habitat

In Utah, designated critical habitat extends along the Virgin River from the Utah-Arizona state line to immediately below the Quail Creek Reservoir. Designated critical habitat does not extend into the Action Area.

4.4 Virgin River Chub

4.4.1 Status

The Virgin River chub was listed as endangered by the USFWS on August 24, 1989 (FR 1989). The Virgin River, upstream of the La Verkin Creek confluence, supports abundant Virgin River chub populations. Virgin River chub has also colonized habitat upstream of Pah Tempe Springs since the establishment of population maintenance flows below Quail Creek Reservoir Diversion and currently occupies habitat between Pah Tempe Springs and the Quail Creek Diversion. Virgin River chub distribution currently extends upstream to the old diversion structure in Timpoweap Canyon (2 miles upstream from Pah Tempe Springs, and 4 miles upstream from the La Verkin

Creek confluence) (PLPCO 2025). Currently, only the Virgin River population is listed as endangered (FR 2000).

4.4.2 Habitat Characteristics

The Virgin River chub is found in aquatic habitat below 4,500 feet above sea level in deep runs or pools with low to medium velocities containing boulders, undercut banks, root snags, or other instream cover over sandy substrate (FR 2000). This rare, medium-sized minnow grows to an average length of 8 inches but can grow up to 18 inches (USFWS 1995). They are opportunistic, omnivorous feeders; juveniles will primarily feed on animal macro invertebrates, transitioning to algae and debris as they reach adulthood (NatureServe 2024). These fish rely on the mainstem channel maintaining water throughout the year as well as uplands that are seasonally inundated during spring flow (FR 2000). Maintaining this floodplain is crucial to the bio productivity of the river system and nutrient supply available to the species. Seasonal flooding also provides areas of warmer, less turbulent waters and cover from predators (FR 2000).

4.4.3 Environmental Baseline

The Virgin River chub is an extremely rare minnow, occurring only in the Virgin River system of southwestern Utah, southern Nevada, and northwestern Arizona. In Utah, the species is restricted to limited areas of the main-stem Virgin River from the Arizona state line upstream to the confluence with La Verkin Creek. Virgin River chub has also colonized habitat upstream of the La Verkin Creek confluence following the establishment of population maintenance flows below Quail Creek Diversion. Virgin River chub distribution currently extends upstream to the old diversion structure in Timpoweap Canyon (2 miles upstream from Pah Tempe Springs, and 4 miles upstream from the La Verkin Creek confluence (PLPCO, 2025). Refer to Figure 1 (Vicinity Map) in Appendix A for a map of Pah Tempe Springs in relation to the Action Area The Virgin River chub is threatened by habitat loss and the introduction of nonnative fish, particularly red shiner. Dams, reservoirs, water diversions, and stream dewatering have also damaged or destroyed its habitat (USFWS 1995a; UDWR 2025a).

4.4.4 Survey Methods/Results

Virgin River chub surveys were not conducted for this BA.

4.4.5 Designated Critical Habitat

The area designated as critical habitat for the Virgin River chub is the mainstem Virgin River and its 100-year floodplain, extending from the confluence with La Verkin Creek, Utah to Halfway Wash, Nevada (USFWS 1995). No designated critical habitat is present within the Action Area, as it does not extend upstream past the Virgin River-La Verkin Creek confluence approximately 4.8 river miles downstream from the Action Area. See Figure 8 (Listed Species Designated Critical Habitat) in Appendix A for a figure of Virgin River chub–designated critical habitat in the Action Area.

Virgin River chub–designated critical habitat PCEs include a sufficient quantity and quality of water, river channels, side channels, secondary channels, backwaters, springs, and other areas that provide access to these habitats; areas with slow to moderate velocities and deep runs or pools that are predominately sand substrates, particularly habitats which contain boulders or

other instream cover; an adequate food supply; and a balanced predation and competition component (FR 2000).

4.5 Woundfin

4.5.1 Status

The woundfin was listed as endangered by the USFWS on October 13, 1970 (FR 1970). This is a small (less than 4 inches long) species of minnow of the American Cyprinidae family and is the only species in the genus Plagopterus. The woundfin was once found throughout much of the lower Colorado and Gila River basins, including the Colorado River from Yuma, Arizona up to the Virgin River in Nevada and Utah, and in the Gila River from Yuma to the Salt River confluence (USFWS 1995a). Currently, this highly specialized species is believed to have been extirpated from its historical range and is restricted to the Virgin River from Pah Tempe Springs near La Verkin, Utah downstream to Lake Mead, Nevada. Recent studies have expanded woundfin occupied habitat in Utah. The woundfin is now known to regularly occupy habitat upstream from the La Verkin Creek confluence approximately 1.6 miles to the Hurricane Hydro Electric Plant inflow (PLPCO, 2025).

4.5.2 Habitat Characteristics

Woundfin are found in warm, swift, flowing, highly mineralized, and turbid waters with constantly shifting sandy or gravelly substrate (USFWS 1995a). Adults' frequent depths of 8–18 inches (deeper if turbidity levels are low) and are rarely found in quieter pools. Juveniles inhabit slow, deep backwaters with sandy substrates. Woundfin are omnivores, utilizing a variety of food sources, including algae, detritus, tamarisk seeds, and insects (USFWS 1995a). They rely on the mainstem channel maintaining water during the year as well as uplands that are seasonally inundated during spring flow (FR 2000). Maintaining this floodplain is crucial to the bio productivity of the river system and nutrient supply available to the species. Seasonal flooding also provides areas of warmer, less turbulent waters and cover from predators (FR 2000).

4.5.3 Environmental Baseline

The biggest threats to this species include the introduction of fish barriers (e.g., dams and diversions), decline in water quality within designated critical habitat, reduction of base flows due to drought and water withdrawal, and competition from the invasive red shiner (USFWS 2009). Building dams and associated reservoirs, water diversion structures, canals, laterals, aqueducts, and the dewatering streams cause loss or degradation of habitat. The decline in both species' range and population numbers is due to the physical reduction in available habitats within the various river systems caused by these water projects (USFWS 1995a; UDWR 2025a).

Occupied habitat was thought not to extend upstream from the Virgin River—La Verkin Creek confluence due to the presence of the Pah Tempe Springs, which acts as a barrier to any potential upstream movement. However, recent woundfin studies found that the species regularly occupies habitat upstream of the La Verkin Creek confluence, and its distribution now extends upstream to the Hurricane Hydro Electric Plant inflow approximately 1.6 miles upstream from the La Verkin Creek confluence.

4.5.4 Survey Methods/Results

Woundfin surveys were not conducted for this BA.

4.5.5 Designated Critical Habitat

The area designated as critical habitat for the woundfin is the mainstem Virgin River and its 100-year floodplain, extending from the confluence with La Verkin Creek, Utah to Halfway Wash, Nevada. No designated critical habitat is present within the Action Area, as it does not extend upstream past the Virgin River-La Verkin Creek confluence approximately 4.8 river miles downstream from the Action Area (FR 2000).

Woundfin designated critical habitat PCEs include a sufficient quantity and quality of water; presence of river channels, side channels, and secondary channels; backwaters, springs, and other areas that provide access to these habitats; runs and pools adjacent to riffles that have sand and sand/gravel substrates; deeper and slower water movement for young of the year; and shoreline margins and backwater habitats with growths of filamentous algae (FR 2000).

4.6 Monarch Butterfly

4.6.1 Status

The monarch butterfly has been proposed for listing as a threatened species. In December 2020, the USFWS published results of a 12-month finding, stating that listing the monarch butterfly as an endangered or threatened species is warranted but precluded by higher priority actions (FR 2020). In 2024, the USFWS issued a FR notice proposing to list the monarch butterfly as threatened and designate critical habitat for the species (FR 2024)

4.6.2 Habitat characteristics

Adult monarch butterflies feed on various flowers but only breed where milkweed is present. Monarch caterpillars have been observed within portions of the proposed study area, primarily in ZNP; however, breeding is unlikely within the Long Valley portion of the study area due to a lack of milkweed presence. UNHP data did not identify any known occurrences of the species in the study area (UNHP 2024). The Cove Reservoir area is likely a flyover area for migrating monarch butterflies but is not an over-wintering site.

4.6.3 Environmental Baseline

The primary drivers affecting the health of the two monarch butterfly migratory populations are loss and degradation of habitat (from conversion of grasslands to agriculture, widespread use of herbicides, senescence and incompatible management of overwintering sites in California, urban development, and drought), continued exposure to insecticides, and effects of climate variations (USFWS, 2024). Monarch adults arrive in Utah where they are most abundant from July through October. An adult monarch can lay up to 500 eggs, but they prefer to lay only one egg per plant. The eggs hatch in 3 to 12 days, revealing the distinctive black-, white-, and yellow-banded caterpillars. The caterpillars then go through five instars of development before building a chrysalis in which they change into an adult monarch butterfly. In late summer and early fall, most adults in Utah fly south or west, heading to California to overwinter (NRCS 2019).

4.6.4 Survey Methods/Results

No surveys were conducted for the monarch butterfly as part of this proposed action.

4.6.5 Designated Critical Habitat

No designated critical habitat has been proposed for the monarch butterfly in Utah (FR 2024).

5.0 WATER MODEL RESULTS

This chapter summarizes water-modeling results used to evaluate whether the proposed reservoir diversions and releases would alter EFVR flow, channel conditions, riparian habitat, or listed species habitat within the action area.

The proposed reservoir would store excess water during high-flow periods and release it during low-flow periods to meet irrigation and water conservancy demands. Although the timing of flows would change, modeled flow alterations would be small compared to natural seasonal variability of EFVR flows (Alpha 2026). Yearly monitoring would continue to be required to regulate water flows in the EFVR.

5.1 Water Diversions

Per the ZNP Agreement, water would be diverted from the EFVR at the Orderville Diversion and delivered by pipeline to the proposed reservoir between November 1 and May 31. No diversions are allowed outside of this period. During the summer months, up to 4.7 cfs would be diverted for OIC agricultural use, while MCIC would continue to divert up to 6.58 cfs (Agreement 1996).

The use of EFVR water by the GIC, OIC, and the MCIC is monitored on a regular basis. The three companies divert water from the EFVR at different locations. A weir is present at each diversion site with gages to read water elevation. Additionally, each weir is equipped with an electronic flow meter that sends information to a website to provide remote monitoring. The data collected from these flow meters are used to determine the total amount of water diverted. Additionally, the Utah State Water engineer collects money from the GIC, OIC, and the MCIC to fund a water commissioner. The commissioner is responsible for monitoring the diversions and making certain that companies are using the correct amount of water according to their water right.

5.2 Water Releases

Releases from the reservoir would be timed to supplement low, natural flows. Water for Long Valley agricultural purposes would be released into the EFVR during the summer months, when natural flows are lowest. Water committed to Washington County for agricultural and M&I purposes could be released any time during the year to meet demand but would most likely be during the summer months for agricultural needs and during the fall and winter months for M&I needs.

The ZNP Agreement allows releases of up to 25 cfs for a 1-week period or 15 cfs continually (Agreement 1996). Releases would be managed to optimize irrigation efficiency and to meet M&I demands.

5.3 Water Modeling Results

5.3.1 Annual Changes

Modeling shows that reservoir operations would cause minor changes to EFVR flows. On an annual basis, modeled changes in EFVR flows were small, ranging from a decrease of 1.8 cfs under low-flow conditions to an increase of 0.9 cfs under high-flow conditions (Table 7). Larger

short-term operational changes may occur during specific release or diversion periods, as discussed in section 5.3.2.

Current seasonal EFVR flows can vary from less than 40 cfs to more than 2,000 cfs, representing a range of more than 1,960 cfs or approximately a 4,900 percent increase from 40 cfs. By comparison, modeled project-related annual average changes are less than 2 cfs (Alpha 2026).

Tables 7 through 9 summarize the modeled changes in flow, depth, and width (Alpha 2026).

Table 7. Projected Annual Changes to EFVR Flow

Scenario	Low-Flow Condition	High-Flow Condition
Pre-Project Flow	34.8 cfs	82.2 cfs
Post-Project Flow	33.0 cfs	83.1 cfs
Change	-1.8 cfs	+0.9 cfs
Percent Change	5.17% decrease	1.09% increase

Table 8. Projected Annual Changes to EFVR Depth

Scenario	Low-Flow Condition	High-Flow Condition
Pre-Project Depth	1.13 ft	1.71 ft
Post-Project Depth	1.10 ft	1.72 ft
Change	-0.03 ft	+0.01 ft
Percent Change	2.65% decrease	0.58% increase

Table 9. Projected Annual Changes to EFVR Width

Scenario	Low-Flow Condition	High-Flow Condition
Pre-Project Width	19.32 ft	22.31 ft
Post-Project Width	19.37 ft	22.36 ft
Change	+0.05 ft	+0.05 ft
Percent Change	0.25% increase	0.22% increase

These results show that changes in flow (-5.17% to +1.09%), depth (-2.65% to +0.5%), and width (+0.25% to +0.22%) would be minor. Downstream tributaries such as Meadow Creek in Mineral Gulch would not be affected, because they are hydrologically independent of EFVR baseflow and the project would not alter tributary inflow, sediment supply, or confluence hydraulics (UDWRe 2000). Because the project would not include construction, diversion, or flow modifications within the Meadow Creek watershed, and because modeled changes are limited to EFVR

mainstream flows, no effect to Meadow Creek inflow, sediment supply, or confluence hydraulics is anticipated.

5.3.2 Monthly Changes

An analysis was completed by Alpha to evaluate anticipated changes in river flow on a monthly basis associated with the Project. The analysis evaluated river flows at the Mount Carmel and Springdale gauges during average, driest, and wettest hydrologic conditions for each month of the year. Detailed results of the analysis are provided in the Water Model Report. A summary of findings at each gauge is provided below.

At the Mount Carmel Gauge, average monthly changes typically range from approximately -57 percent to +59 percent corresponding to a change in flow ranging from -11 cfs to +2.5 cfs in the months of November and July, respectively.

During driest conditions, the project produces the largest relative changes. Without WCWCD delivery, reductions of approximately -70 percent to well over +3,400 percent occur, corresponding to a change in flow ranging from -11.9 cfs to +3.4 cfs in the months of December and August, respectively.

Under wettest conditions, river flows generally remain similar to existing conditions, with changes ranging from approximately -16 percent to increases of +149 percent, corresponding to a change in flow ranging from -4.2 cfs to +97 cfs in the months of November and May, respectively.

When the assumed 15 cfs WCWCD delivery is included, average monthly flows increase substantially. Average conditions show increases ranging from approximately +22 percent to well above +471 percent. Driest conditions exhibit the largest relative increases, with December exceeding +18 percent and August exceeding 18,400 percent due to the relatively small existing flows.

Table 10. Projected Monthly Changes in Flow at the Mt. Carmel Gauge (09404700)

Scenario	Without WCWCD Delivery	With WCWCD Delivery
Average Conditions Percent Change	-57% to +59%	+22% to +471%
Average Conditions Change in Flow	-11 cfs to +2.5 cfs	+4.1 cfs to +16.5 cfs
Driest Conditions Percent Change	-70% to +3,400%	+18% to +18,400%
Driest Conditions Change in Flow	-11.9 cfs to +3.4 cfs	+3.1 cfs to +18.5 cfs
Wettest Conditions Percent Change	-16% to +149%	+7%t to +292%

Scenario	Without WCWCD Delivery	With WCWCD Delivery
Wettest Conditions Change in Flow	-4.2 cfs to +97 cfs	+6.8 cfs to +27.7 cfs

Because of additional watershed inflows between Mount Carmel and Springdale, the relative changes at the Springdale gauge are generally smaller.

Without WCWCD delivery, average monthly flows at the Springdale gauge range from approximately -20 percent to +16 percent. Driest conditions range from -27 percent to +13 percent. Wettest conditions range from approximately -6 percent to +68 percent.

With the assumed 15 cfs WCWCD delivery, average monthly flows at Springdale increase approximately +7 percent to +41 percent. Driest conditions increase approximately +7 percent to +60 percent, while wettest conditions increase approximately +4 percent to +78 percent.

Table 11. Projected Monthly Changes in Flow at the Springdale Gauge (09405500)

Scenarios	Without WCWCD Delivery	With WCWCD Delivery
Average Conditions Percent Change	-20% to +16%	+7% to + 41%
Average Conditions Change in Flow	-10.9 cfs to +12.2 cfs	+4.1 cfs to +17 cfs
Driest Conditions Percent Change	-27% to +13%	+17% to + 60%
Driest Conditions Change in Flow	-11.9 cfs to +4.8 cfs	+3.1 cfs to +17.7 cfs
Wettest Conditions Percent Change	-6% to +68%	+4% to +78%
Wettest Conditions Change in Flow	-4.2 cfs to +97 cfs	+6.8 cfs to +112 cfs

Modeled decreases occur primarily during the authorized diversion season, when flows are generally higher and ecological water stress is lower. Modeled increases occur primarily during summer low-flow periods, when surface water availability and riparian vegetation stress are more limiting. This seasonal redistribution is the basis for concluding that the project would have only minor impacts on downstream flows.

The percent change in flows is higher when looking at the monthly change compared to the annual change because the Project would shift water timing from naturally low-demand seasons

to periods when ecological needs are higher. Although some monthly percent changes appear large, particularly during dry low-flow periods, these percentages reflect small baseline flows; the absolute change in cfs remains within the modeled operational range and does not exceed authorized release limits.

5.4 Impacts on Riparian Vegetation and Habitat

The EFVR riparian corridor is adapted to substantial natural variation in streamflow, including episodic flood events, spring runoff, and seasonal low flow periods. As described in Section 5.3, modeled project-related changes in flow, depth, and width would remain small relative to the river's existing natural variability, and no downstream reach of the EFVR would be dewatered as a result of the proposed project.

Reservoir operations would primarily change the timing of water availability rather than altering overall flow magnitude. Water would generally be diverted when flows are higher and released during lower-flow periods when irrigation demand and ecological water stress are greatest. Although modeled predictions in flow show a reduction in winter baseflows during some scenarios, these reductions would occur when evapotranspiration rates and plant water demands are low and riparian vegetation is dormant or less physiologically active. Winter flows would remain sufficient to maintain hydrologic connectivity and would not eliminate the seasonal high-flow events needed to recharge shallow alluvial groundwater, redistribute sediment, and support riparian recruitment. Consequently, the anticipated reductions would not be expected to cause a sustained decline in soil moisture or groundwater availability within the riparian corridor. Modeled summer releases would increase baseflows during the period when riparian vegetation is most vulnerable to drought stress and high evapotranspiration demand. Research indicates that increasing summer flows can support riparian vegetation (Höller et. al. 2025). Even small increases in summer flow can disproportionately improve riparian conditions by extending soil moisture availability and reducing drought stress (Stromberg et al. 2007; Rood et al. 2005).

Mature overstory species, such as cottonwood and Russian olive, are generally supported by alluvial groundwater rather than direct uptake from short-term surface flows. Their deep root systems would not be affected by the minor changes in streamflow (Zimmerman et al. 2023). Because the project would not dewater the EFVR and modeled changes in surface flow would be minor, the project is not expected to alter groundwater conditions supporting mature riparian vegetation. As a result, the project is not expected to adversely affect existing riparian overstory structure or associated habitat functions.

No new agricultural development is proposed as part of the project, and the project would not involve direct disturbance or vegetation removal within existing EFVR riparian habitat. Project effects would be limited to modeled changes in EFVR flow timing and magnitude. Because those changes would remain within the natural range of variability, would not cause dewatering, and would not decrease summer baseflows during low-flow conditions, adverse effects to riparian vegetation and riparian habitat are not anticipated.

5.5 Water Model Summary

Modeled annual changes in EFVR flow, depth, and width are small relative to existing seasonal variability. The project would not dewater downstream reaches, would not eliminate riparian recruitment areas, and would generally increase summer baseflows during the period of greatest

vegetation water stress. Therefore, reservoir operations are not expected to adversely affect riparian vegetation structure, aquatic-riparian habitat connectivity, or listed-species habitat associated with EFVR flow conditions. Species-specific analyses are provided in

6.0 Effects Analysis

6.1 California Condor

6.1.1 Construction Impacts

6.1.1.1 Species

California condors are known to inhabit Parunuweap Canyon and surrounding area in ZNP. Construction activities and related surface disturbance would only occur at the proposed reservoir site near Orderville in the Long Valley portion of the Action Area. No condors have been observed in this portion of the Action Area. However, at least two nesting sites are located within 8 miles of the town of Orderville. No surface disturbance would occur in the EFVR, and no changes in EFVR downstream flows would occur during construction. Construction activities would be short term (15 months) and would not occur where California condors are found in Parunuweap Canyon, Mineral Gulch, and ZNP. Implementation of committed conservation measures such as regular daily site cleaning would further reduce any potential effect. Therefore, project construction activities are not likely to jeopardize the continued existence of the California condor outside of ZNP and would have **No Effect** on the condor inside ZNP boundaries.

6.1.1.2 Habitat

Known California occupied condor habitat in the Action Area is restricted to Parunuweap Canyon and surrounding area in ZNP. Construction activities would only occur at the proposed reservoir site near Orderville. No surface disturbance or changes in EFVR streamflow would occur in Parunuweap Canyon; accordingly, construction activities are not likely to jeopardize the continued existence of the California condor as a result of habitat effects outside of ZNP and would have **No Effect** on the condor inside ZNP boundaries.

6.1.1.3 Designated Critical Habitat

No critical habitat has been designated for the California condor in Utah. Therefore, construction-related activities are not likely to jeopardize the continued existence of California condor designated critical habitat outside of ZNP and would have **No Effect** on condor-designated critical habitat inside ZNP boundaries.

6.1.2 Operational Impacts

6.1.2.1 Species

The EFVR corridor provides habitat for California condors, including roosting areas and water sources used for bathing and drinking. Operational activities would result in minor changes in streamflow, as described in Chapter 5.0. The proposed Project would not remove trees or alter riparian structure, would not reduce summer flows, would not eliminate existing water access

points, and would cause only minor changes in flow compared to the natural variation. Therefore, minor impacts would occur to prey availability and water quality, and the Proposed Action is not likely to jeopardize the continued existence of the condor outside of ZNP and **May Affect, but is Not Likely to Adversely Affect** California condors or their habitat due to insignificant or discountable impacts inside ZNP boundaries.

6.1.2.2 Habitat

The EFVR flows through occupied California condor habitat in Parunuweap Canyon (ZNP 2025b). Although no surveys were conducted for the condor, occupancy is assumed. The proposed Project would have no ground disturbance in Parunuweap Canyon and would not alter riparian vegetation. Additionally, operational activities would result in minor changes in streamflow, as described above in Chapter 5.0, which is also not anticipated to alter the surrounding riparian vegetation. Because no effects to the riparian zone are anticipated and because condors utilize a large area beyond the immediate riparian zone, it has been determined that the Proposed Action is not likely to jeopardize the continued existence of the condor outside of ZNP and **May Affect, but is Not Likely to Adversely Affect** the California condor as a result of insignificant or discountable impacts on its habitat inside ZNP boundaries.

6.1.2.3 Designated Critical habitat

No critical habitat has been designated for the California condor in Utah. Therefore, operational related activities are not likely to jeopardize the continued existence of California condor-designated critical habitat outside of ZNP and would result in **No Effect** to the condor designated critical inside ZNP boundaries.

6.1.3 Maintenance Impacts

6.1.3.1 Species

California condors are known to inhabit and nest in Parunuweap Canyon and the surrounding area in ZNP but are not known to occur at the proposed reservoir site near Orderville where routine maintenance activities would occur. No new surface disturbance or construction related activities would be associated with routine maintenance. Any unanticipated changes in streamflow during maintenance would be temporary and minor, and no impacts on downstream riparian vegetation would be anticipated. As a result, no harm or harassment would occur to the condor as a result of maintenance activities. Therefore, it has been determined that routine maintenance activities associated with the Proposed Action are not likely to jeopardize the continued existence of the California condor outside of ZNP and would result in **No Effect to** California condor inside ZNP boundaries.

6.1.3.2 Habitat

California condor habitat in the Action Area is not present at the proposed reservoir site. However, at least two nesting sites are located within 8 miles of the town of Orderville. These nests are located outside of the Project Area. No surface disturbance resulting from maintenance actions would occur downstream from the reservoir where condors are known to occur. Any unanticipated changes in streamflow during maintenance would be temporary and minor, and no impacts to downstream riparian vegetation or other habitat would be anticipated. No effects

would occur beyond the EFVR 100-foot buffer or immediate riparian zone (See Section 3.3). Therefore, it has been determined that the maintenance actions resulting from implementation of the Proposed Action are not likely to jeopardize the continued existence of the condor outside of ZNP and **May Affect, but is Not Likely to Adversely Affect** the California condor as a result of insignificant or discountable impacts on its habitat inside ZNP boundaries.

6.1.3.3 Designated Critical Habitat

No critical habitat has been designated for the California condor in Utah. Therefore, routine maintenance related activities are not likely to jeopardize the continued existence of California condor-designated critical habitat outside of ZNP and would result in **No Effect** to condor-designated critical habitat inside ZNP boundaries.

6.2 Mexican Spotted Owl

6.2.1 Construction Impacts

6.2.1.1 Species

MSOs in the Action Area are restricted to Parunuweap Canyon and the surrounding area. Construction activities would only occur at the proposed reservoir site near Orderville in the Long Valley portion of the Action Area. No MSOs occur in this portion of the Action Area. No surface disturbance would occur in the EFVR, and no changes in EFVR downstream flows would occur during construction. Construction activities would be short term (15 months) and would not occur where MSOs are found. Therefore, construction activities would have **No Effect** on the MSO.

6.2.1.2 Habitat

MSO habitat in the Action Area is restricted to Parunuweap Canyon and the surrounding area. No surface disturbance or changes in streamflow would occur in the canyon; accordingly, construction activities would have **No Effect** on MSO habitat.

6.2.1.3 Designated Critical Habitat

MSO–designated critical habitat is located on BLM– and ZNP–administered lands in the Parunuweap Canyon portion of the Action Area (See Appendix A; Figure 8[Listed Species Designated Critical habitat]). PCEs, including the presence of water (often providing cooler and often higher humidity than the surrounding areas); clumps or stringers of mixed-conifer, pine-oak, pinyon-juniper, and/or riparian vegetation; canyon walls containing crevices, ledges, or caves; and a high percent of ground litter and woody debris (USFWS 2013) associated with MSO-designated critical habitat would not be affected during construction, because there would be no surface disturbance or changes in streamflow within any designated critical habitat. Additionally, two PACs, as described in Section 4.2, are located within MSO-designated critical habitat in Parunuweap Canyon. These PACs would not be affected by construction activities at the proposed reservoir site, as no surface disturbance or changes in streamflow would occur within or near the PACs. No conflicts with USFWS-recommended management measures for PACs or PAC core areas would occur. Therefore, construction activities would have **No Effect** on MSO–designated critical habitat including the PACs.

6.2.2 Operational Impacts

6.2.2.1 Species

The EFVR corridor provides habitat for MSOs, including roosting areas and water sources used for bathing and drinking. Operation activities would result in minor changes in stream flow, as described in Chapter 5.0. The proposed Project would not remove trees or alter riparian structure, would not reduce summer flows, would not eliminate existing water access points, and would cause only minor changes in flow compared to the natural variation. Therefore, minor impacts would occur to prey availability and water quality, and no harm or harassment would occur to MSOs. Accordingly, it has been determined that the Proposed Action **May Affect, but is Not Likely to Adversely Affect** MSO due to insignificant or discountable impacts.

6.2.2.2 Habitat

The EFVR flows through MSO occupied habitat in Parunuweap Canyon (FR 2004). Although no surveys were conducted for the MSO, occupancy is assumed. The proposed Project would have no ground disturbance in Parunuweap Canyon and would not alter riparian vegetation. Additionally, operational activities would result in minor changes in streamflow, as described in Chapter 5.0, which is also not anticipated to alter the surrounding riparian vegetation. Because no effects to the riparian zone are anticipated and because MSOs utilize a large area beyond the immediate riparian zone, it has been determined that the Proposed Action **May Affect, but is Not Likely to Adversely Affect** MSOs as a result of insignificant or discountable impacts on MSO habitat.

6.2.2.3 Designated Critical Habitat

MSO designated critical habitat is located on BLM and ZNP administered lands in the Parunuweap Canyon portion of the Action Area (See Appendix A; Figure 8). No surface disturbance would occur in designated critical habitat. It is anticipated that impacts to designated MSO critical habitat PCEs (including the presence of water [often providing cooler and often higher humidity than the surrounding areas]); clumps or stringers of mixed-conifer, pine-oak, pinyon-juniper, and/or riparian vegetation; canyon walls containing crevices, ledges, or caves; and a high percent of ground litter and woody debris (USFWS 2013) would be negligible based on minor changes in streamflow as discussed in Section 6.2.2.1. Additionally, no conflicts with USFWS-recommended management measures for PACs or PAC core areas, such as deferring activities during the MSO breeding season or planned fire management, would occur. Therefore, it has been determined that the Proposed Action **May Affect, but is Not Likely to Adversely Affect** designated critical habitat and PACs based on insignificant or discountable impacts.

6.2.3 Maintenance Impacts

6.2.3.1 Species

No MSOs occur where the proposed reservoir would be sited near Orderville in Long Valley where maintenance activities would occur. Therefore, no harm or harassment would occur to MSOs as a result of maintenance activities. No maintenance activities would occur where MSOs are known to occur in Parunuweap Canyon or other areas in ZNP within the Action Area, and no downstream effects from maintenance activities are anticipated. Any unplanned changes in

streamflow would be temporary and minor, and no effects to riparian vegetation are anticipated. No effects would occur beyond the EFVR 100-foot buffer or riparian zone. Because no MSOs are present where maintenance activities would occur and no effects are anticipated in downstream MSO habitat, it has been determined that maintenance activities associated with the Proposed Action would have **No Effect** on the species.

6.2.3.2 Habitat

MSO habitat in the Action Area is restricted to Parunuweap Canyon. Any unplanned changes in streamflow would be temporary and minor, and no effects on riparian vegetation are anticipated. No effects would occur beyond the EFVR 100-foot buffer or riparian zone (See Section 3.3). Therefore, it has been determined that the Proposed Action **May Affect, but is Not Likely to Adversely Affect** MSOs based on insignificant or discountable impacts on habitat during maintenance activities.

6.2.3.3 Designated Critical Habitat

MSO–designated critical habitat is found in the Parunuweap Canyon portion of the Action Area. Maintenance actions would be confined to the proposed reservoir site and adjacent irrigation pipelines and would not result in any surface disturbance in the canyon. It is anticipated that impacts to PCEs (specifically, presence of water and riparian vegetation) would be negligible based on unanticipated temporary and minor changes in streamflow during maintenance activities. Additionally, two PACs, as described in Section 4.2, are located within MSO-designated critical habitat in Parunuweap Canyon. These PACs would also not be affected by maintenance activities at the proposed reservoir site, as no downstream surface disturbance would occur. Additionally, no conflicts with USFWS-recommended management measures for PACs or PAC core areas would occur. USFWS PAC or PAC core area management recommendations, such as deferring activities during the MSO breeding season or planned fire management, would not be affected maintenance activities. Therefore, it has been determined that the Proposed Action **May Affect, but is Not Likely to Adversely Affect** critical habitat, including PACs, based on insignificant or discountable impacts associated with maintenance activities.

6.3 Southwestern Willow Flycatcher

6.3.1 Construction Impacts

6.3.1.1 Species

SWFL presence in the Action Area are restricted to Parunuweap Canyon. Construction activities would only occur at the proposed reservoir site near Orderville in Long Valley. No SWWLs occur in this portion of the Action Area due to a lack of habitat. No surface disturbance would occur in the EFVR that would affect any riparian habitat, and no changes in EFVR downstream flows would occur during construction. Construction activities would be short term (15 months) and would not occur where SWFLs are found. Therefore, construction activities would have **No Effect** on the SWFL.

6.3.1.2 Habitat

SWFL habitat in the Action Area is restricted to Parunuweap Canyon. Surface disturbing activities would only occur at the proposed reservoir site near Orderville in the Long Valley portion of the Action Area. No riparian area would be disturbed during construction. No changes in streamflow would occur in the EFVR in Parunuweap Canyon; Therefore, no changes to SWFL habitat resulting from construction activities would occur. As a result, construction activities would have **No Effect** on the SWFL as a result of habitat impacts.

6.3.1.3 Designated Critical Habitat

No designated critical habitat is located within the Action Area.

6.3.2 Operational Impacts

6.3.2.1 Species

The minor change in streamflow resulting from project development would not result in a significant adverse effect on or loss of SWFL habitat. Water from the reservoir would result in only minor changes in flow amounts and would not alter riparian vegetation beyond that which has been occurring for several years, as discussed in Chapter 5. No effects would occur beyond the EFVR 100-foot buffer (See Section 3.3). Therefore, no harm or harassment would occur to SWFLs as a result of reservoir related streamflow changes; accordingly, it has been determined that the Proposed Action **May Affect, but is Not Likely to Adversely Affect** SWFLs or their habitat due to insignificant or discountable impacts.

6.3.2.2 Habitat

The EFVR flows through SWFL suitable migration habitat in Parunuweap Canyon. Since no surveys were conducted for the SWFL, migration occupancy is assumed. Operational activities would result in minor changes in streamflow as described in Chapter 5.0, and it is anticipated that impacts to riparian vegetation resulting from reservoir operations would be negligible; therefore, it has been determined that the Proposed Action **May Affect, but is Not Likely to Adversely Affect** SWFL habitat as a result of insignificant or discountable impacts on habitat.

6.3.2.3 Designated Critical Habitat

No SWFL designated critical habitat is located within the Action Area.

6.3.3 Maintenance Impacts

6.3.3.1 Species

No SWFL habitat occurs at the proposed reservoir site near Orderville in the Long Valley portion of the Action Area where maintenance activities would occur. No harm or harassment would occur to SWFLs as a result of maintenance activities as none would occur near any riparian habitat. Therefore, it has been determined that maintenance activities associated with the Proposed Action would have **No Effect** on SWFL.

6.3.3.2 Habitat

SWFL habitat in the Action Area is restricted to Parunuweap Canyon. Any changes in streamflow resulting from maintenance activities would be temporary and minor, and impacts on riparian vegetation are anticipated to be negligible. Therefore, it has been determined that the Proposed Action **May Affect, but is Not Likely to Adversely Affect** SWFL habitat based on insignificant or discountable impacts on habitat during maintenance activities.

6.3.3.3 Designated Critical Habitat

No SWFL designated critical habitat is located within the Action Area.

6.4 Virgin River Chub/Woundfin

6.4.1 Construction Impacts

6.4.1.1 Species

Surface disturbance associated with the reservoir, pipelines, and recreation facilities development would last approximately 15 months. Virgin River chub and woundfin habitat is located approximately 55 river miles downstream from the construction site in Long Valley. No surface disturbance would occur in the EFVR, and there would be no changes in streamflow or water quality; therefore, no harm or harassment would occur to the Virgin River chub or woundfin as a result of construction activities. Therefore, it has been determined that construction activities associated with the Proposed Action would have **No Effect** to the Virgin River chub or woundfin.

6.4.1.2 Habitat

Virgin River chub and woundfin habitat is located approximately 55 river miles downstream from the construction site in Long Valley. Habitat does not occur upstream from the Quail Creek Reservoir Diversion in Washington County. No surface disturbance associated with construction activities would occur in the EFVR, and no changes in streamflow levels would occur during construction. Therefore, it has been determined that construction activities associated with the Proposed Action would have **No Effect** on Virgin River chub and woundfin habitat.

6.4.1.3 Designated Critical Habitat

Virgin River chub and woundfin–designated critical habitat is located approximately 4.8 miles downstream from the Action Area in Washington County. No surface disturbance associated with construction activities would occur in the EFVR, and no changes in streamflow levels would occur during construction. No PCEs associated with Virgin River chub or woundfin–designated critical habitat would be affected. Therefore, it has been determined that construction activities associated with the Proposed Action would have **No Effect** on Virgin River chub and woundfin–designated critical habitat.

6.4.2 Operational Impacts

6.4.2.1 Species

No surface disturbance would result from operational activities. Operations associated with the Proposed Action would result in minor changes in downstream streamflow as discussed in Chapter 5.0. Since there is no Virgin River chub or woundfin habitat upstream from the diversion, no harm or harassment would occur to the Virgin River chub or woundfin as a result of operational activities. Should an unanticipated reduction event occur, it would be short term in duration, and the streamflow reduction amount would be negligible. The ZNP Agreement ensures water quality would benefit from the Proposed Action by maintaining controlled flow rates that prevent excessive sedimentation, nutrient loading, or changes in water temperature that could degrade the river's water quality and aquatic habitats. The change in water flow is not expected to introduce pollutants or alter the river's chemistry in a way that would impact the Virgin River chub or woundfin. Based on these factors, it has been determined that operational activities associated with the Proposed Action **May Affect, but is Not Likely To Adversely Affect** the Virgin River chub and woundfin due to insignificant or discountable effects.

6.4.2.2 Habitat

Habitat for the Virgin River chub and woundfin is located immediately downstream from Quail Creek Reservoir diversion in Washington County. While operational activities would result in minor changes in streamflow levels above the diversion, the amount of water diverted for use by the Hurricane Canal Company would not exceed that released from the proposed reservoir. Should an unanticipated streamflow reduction event occur, it would be short term in duration, and the reduction would be negligible. Therefore, no harm or harassment would occur to Virgin River chub or woundfin habitat as a result of operational activities. Based on these factors, it has been determined that operational activities associated with the Proposed Action **May Affect, but is Not Likely To Adversely Affect** the Virgin River chub/woundfin or their occupied habitats due to insignificant or discountable effects.

6.4.2.3 Designated Critical Habitat

Designated critical habitat for the Virgin River chub and woundfin begins approximately 4.8 miles downstream from the Quail Creek Reservoir diversion (FR 2000). While operation activities associated with the Proposed Action would result in minor changes in downstream streamflow above the diversion (Alpha 2026), the amount of water diverted for use by the Hurricane Canal Company would not exceed that released from the proposed reservoir. Should an unanticipated streamflow reduction occur, it would be short term in duration, and the reduction would be negligible. None of the Virgin River chub- or woundfin-designated critical habitat PCEs (FR 2000) would be affected. Based on these factors, it has been determined that the Proposed Action operation activities **May Affect, but are Not Likely To Adversely Affect** Virgin River chub-/woundfin-designated critical habitat due to insignificant or discountable effects.

6.4.3 Maintenance Impacts

6.4.3.1 Species

Maintenance actions would not result in any surface disturbance to the Virgin River chub or woundfin. It is not anticipated that any impacts to PCEs (e.g., water quality and quantity) would occur as the amount of water diverted for use by the Hurricane Canal Company would not exceed that released from the proposed reservoir. Should an unanticipated streamflow reduction occur, it would be short term in duration, and the reduction would be negligible. Therefore, it has been determined that the Proposed Action **May Affect, but is Not Likely to Adversely Affect** either species based on insignificant or discountable impacts associated with maintenance.

6.4.3.2 Habitat

Habitat for the Virgin River chub and woundfin is located immediately downstream from the Quail Creek Reservoir diversion in Washington County. While maintenance activities would result in minor changes in streamflow levels above the diversion, the amount of water diverted for use by the Hurricane Canal Company would not exceed that released from the proposed reservoir. Should an unanticipated streamflow reduction event occur, it would be short term in duration, and the reduction would be negligible. Therefore, no harm or harassment would occur to Virgin River chub or woundfin habitat as a result of maintenance activities. Based on these factors, it has been determined that operational activities associated with the Proposed Action **May Affect, but is Not Likely To Adversely Affect** the Virgin River chub/woundfin or their occupied habitats due to insignificant or discountable effects.

6.4.3.3 Designated Critical Habitat

Designated critical habitat for the Virgin River chub and woundfin begins approximately 4.8 miles downstream from the Quail Creek Reservoir diversion (FR 2000). While maintenance activities associated with the Proposed Action would result in minor changes in downstream streamflow above the diversion (Alpha 2026), the amount of water diverted for use by the Hurricane Canal Company would not exceed that released from the proposed reservoir. Should an unanticipated streamflow reduction occur, it would be short term in duration, and the reduction would be negligible. None of the Virgin River chub- or woundfin-designated critical habitat PCEs (FR 2000) would be affected. Based on these factors, it has been determined that the Proposed Action maintenance activities **May Affect, but are Not Likely To Adversely Affect** Virgin River chub-/woundfin-designated critical habitat due to insignificant or discountable effects.

6.5 Monarch Butterfly

6.5.1 Construction Impacts

6.5.1.1 Species

Monarch butterflies likely migrate through the Action Area. They are known to inhabit Parunuweap Canyon and the surrounding area in ZNP. Construction activities and related surface disturbance would only occur at the proposed reservoir site near Orderville in the Long Valley portion of the Action Area where monarch butterfly presence is limited. No surface disturbance would occur in the EFVR, and no changes in EFVR downstream flows where milkweed plants are

mostly found would occur during construction. Construction activities would be short term (15 months) and surface disturbance would be limited in size. Implementation of committed conservation measures would further reduce any potential effect to the monarchs. Therefore, project construction activities are not likely to jeopardize the continued existence of the monarch butterfly.

6.5.1.2 Habitat

Adult monarch butterflies feed on various flowers but only breed where milkweed is present. Monarch caterpillars have been observed within portions of the proposed study area, primarily in ZNP; however, breeding is unlikely within the Long Valley portion of the study area due to a lack of milkweed presence, although monarch butterflies likely migrate through the area. No surface disturbance would occur within the EFVR or downstream from the proposed reservoir site. UNHP data did not identify any known occurrences of the species in the study area (UNHP 2024). The Cove Reservoir area is likely a flyover area for migrating monarch butterflies but is not an over-wintering site. Construction of the reservoir would likely provide a small amount of habitat. Therefore, project construction activities are not likely to jeopardize the continued existence of the monarch butterfly based on habitat impacts discussed above.

6.5.1.3 Designated Critical Habitat

No monarch butterfly proposed designated critical habitat is located within the Action Area.

6.5.2 Operational Impacts

6.5.2.1 Species

Minor changes in streamflow resulting from project operations would not result in an adverse effect on or loss of monarch butterfly habitat. Water from the reservoir would result in only minor changes in flow amounts and would not alter riparian vegetation beyond that which has been occurring for several years, as discussed in Chapter 5. No effects would occur beyond the EFVR 100-foot buffer (See Section 3.3). A minor amount of habitat would be created as riparian habitat becomes established around the reservoir. Because no monarch butterfly habitat would be lost, it has been determined that the Proposed Action is not likely to jeopardize the continued existence of the monarch butterfly due to insignificant or discountable impacts.

6.5.2.2 Habitat

As previously discussed, potential monarch butterfly habitat occurs in much of the Action Area but is mostly concentrated in Parunuweap Canyon and ZNP where various flowers, including milkweed, are present. Breeding is unlikely within the Long Valley portion of the study area due to a lack of milkweed presence. Any changes in streamflow would be minor, and no effects on riparian vegetation are anticipated. No effects would occur beyond the EFVR 100-foot buffer or riparian zone (See Section 3.3). Therefore, project construction activities are not likely to jeopardize the continued existence of monarch butterfly habitat due to insignificant or discountable impacts on habitat during operational activities.

6.5.2.3 Designated Critical Habitat

No monarch butterfly proposed designated critical habitat is located within the Action Area.

6.5.3 Maintenance Impacts

6.5.3.1 Species

Monarch butterfly habitat is limited at the proposed reservoir site near Orderville in the Long Valley portion of the Action Area where maintenance activities would occur. No harm or harassment would occur to monarchs as a result of maintenance activities as none would occur near any riparian habitat where milkweed plants are most likely to occur. Therefore, it has been determined that maintenance activities associated with the Proposed Action are not likely to jeopardize the continued existence of monarch butterfly habitat due to insignificant or discountable impacts during maintenance activities.

6.5.3.2 Habitat

Monarch butterfly habitat in the Action Area is focused on Parunuweap Canyon ZNP. Any changes in streamflow resulting from maintenance activities would be temporary and minor, and impacts on riparian vegetation would be negligible. Therefore, it has been determined that maintenance activities associated with the Proposed Action are not likely to jeopardize the continued existence of monarch butterfly habitat due to insignificant or discountable impacts during maintenance activities.

6.5.3.3 Designated Critical Habitat

No monarch butterfly proposed designated critical habitat is located within the Action Area.

7.0 CONCLUSION AND DETERMINATION OF EFFECTS

Table 12 summarizes the determinations of effect for the Proposed Action.

Table 12. Summary of Effects

Species	Status	Species Effects Determination	Critical Habitat Effects Determination
California condor	Experimental Non-Essential	Not Likely to Jeopardize the Continued Existence outside of ZNP; May Affect, but is Not Likely to Adversely Affect within ZNP	Not designated
Desert tortoise	Threatened	No Effect	Designated critical habitat is not located in the Action Area
Jones cycladenia	Threatened	No Effect	Not designated
Monarch Butterfly	Proposed Threatened	Not Likely to Jeopardize the Continued Existence	Not designated

Species	Status	Species Effects Determination	Critical Habitat Effects Determination
Suckley's cuckoo bumble bee	Proposed Endangered	No Effect	Not designated
Mexican spotted owl	Threatened	May Affect, but is Not Likely to Adversely Affect	May Affect, but is Not Likely to Adversely Affect
Shivwits milk-vetch	Endangered	No Effect	Designated critical habitat is not located in the Action Area
Siler's pincushion cactus	Threatened	No Effect	Not designated
Southwestern willow flycatcher	Endangered	May Affect, but is Not Likely to Adversely Affect	Designated critical habitat is not located in the Action Area
Ute ladies'-tresses	Threatened	No Effect	Not designated
Virgin River chub	Endangered	May Affect, but is Not Likely to Adversely Affect	May Affect, but is Not Likely to Adversely Affect
Woundfin	Endangered	May Affect, but is Not Likely to Adversely Affect	May Affect, but is Not Likely to Adversely Affect
Western yellow-billed cuckoo	Threatened	No Effect	No Effect

7.1 California Condor

In summary, an overall determination of No Jeopardy outside of ZNP and **May Affect, but is Not Likely to Adversely Affect** within ZNP has been determined for the California condor for the following reasons:

- A portion of Parunuweap Canyon and surrounding contains California condor habitat and is within the Action Area. Since no condor surveys have been conducted for this project, occupancy is assumed, and condors are known to be present within ZNP and the surrounding area. However, condors are not known to occur at the proposed Cove Reservoir site.

- No surface disturbance resulting from Cove Reservoir construction, operational, and maintenance activities would occur in occupied condor habitat.

- Changes in summer and winter stream flows in the EFVR resulting from Cove Reservoir operations would be minor, and adverse impacts to the surrounding riparian vegetation

are not anticipated. No effects would occur beyond the EFVR or surrounding riparian vegetation.

- No riparian vegetation overstory, such as cottonwood trees, would be lost due to Cove Reservoir construction, operational, or maintenance activities.

- No condor bathing or drinking sites would be lost. The proposed reservoir may provide a new bathing or drinking site for condors.

- No effects to California condor habitat would occur when diversions to the proposed reservoir are not occurring.

- No diversions would occur during the summer months when riparian vegetation is most stressed.

- No new dry periods in the EFVR would result from diversions or proposed reservoir operations.

7.2 Mexican Spotted Owl

In summary, an overall determination of **May Affect, but is Not Likely to Adversely Affect** has been determined for the MSO and designated critical habitat for the following reasons:

- A portion of Parunuweap Canyon is located within MSO–designated critical habitat and is within the Action Area. Additionally, two PACs are present. Since no MSO surveys have been conducted for this project, occupancy is assumed.

- No surface disturbance resulting from Cove Reservoir construction, operation, or maintenance activities would occur in MSO habitat, including designated critical habitat.

- Changes in summer and winter flows in the EFVR resulting from Cove Reservoir operations would be minor and would not affect riparian or other habitat within occupied MSO habitat in Parunuweap Canyon. The current natural EFVR flow variations would be 100 times the range of effect from reservoir releases. No effects would occur beyond the 100-foot buffer or riparian zone.

- Impacts to designated critical habitat PECs (specifically presence of water, prey base, and riparian vegetation) would not be affected. The two PACs would also not be affected, as no conflicts with USFWS-recommended management measures for PACs or PAC core areas would occur.

- No effects to MSO habitat would occur when diversions to the proposed reservoir are not occurring.

- No diversions would occur during the summer months when riparian vegetation is most stressed.

- No new dry periods in the EFVR would result from diversions or proposed reservoir operations.

7.3 Southwestern Willow Flycatcher

In summary, an overall determination of **May Affect, but is Not Likely to Adversely Affect** has been determined for the SWFL for the following reasons:

- A portion of Parunuweap Canyon contains SWFL migratory habitat and is within the Action Area. Since no SWFL surveys have been conducted for this project, migratory occupancy is assumed.
- No surface disturbance resulting from construction and maintenance activities would occur in SWFL habitat.
- Changes in summer and winter stream flows in the EFVR resulting from Cove Reservoir operations would be minor and not affect riparian or other habitat within SWFL habitat in Parunuweap Canyon.
- No effect to SWFL–designated critical habitat would occur as none is located within the Action area.
- No diversions would occur during the summer months when riparian vegetation is most stressed.
- No new dry periods in the EFVR would result from diversions or proposed reservoir operations.

7.4 Virgin River Chub/Woundfin

In summary, an overall determination of **May Affect, but is Not Likely to Adversely Affect** has been determined for the Virgin River chub and woundfin and designated critical habitat. The following reasons were used for these determinations:

- Occupied habitat is not located within the Action Area as habitat does not extend above the Quail Creek Reservoir Diversion.
- Designated critical habitat for both species is not located in the Action Area.
- Studies demonstrate that the effect of an additional 15 to 25 cfs flow from the proposed reservoir during flood stage or during normal streamflow conditions would be minor and that the natural variation of the river is approximately 100 times the range of effect from reservoir releases. The amount of water diverted for use by the Hurricane Canal Company would not exceed that released from the proposed reservoir.
- Should an unplanned lapse occur, the difference in water amounts downstream from the diversion would be negligible and short term.
- No impacts to water quality are anticipated.

7.5 **Monarch Butterfly**

In summary, an overall determination of **Not Likely to Jeopardize** has been made for the monarch butterfly for the following reasons:

- Large size of monarch butterfly habitat outside of the Action Area
- Limited duration of construction activities
- Limited amount of surface disturbance
- Creation of a small amount of habitat created by the reservoir

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CULTURAL RESOURCES INVENTORY REPORT

Kane County Water Conservancy District's Cove Reservoir Project
Kane County, Utah

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For submittal to:

United States Department of Agriculture, Natural Resources Conservation Service, Utah State Office
United States Department of the Interior, Bureau of Land Management Kanab Field Office
State of Utah School and Institutional Trust Lands Administration
Utah Division of State History

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December 2019

TRANSCON environmental

For Official Use Only: Disclosure of Site Locations Prohibited (43 C.F.R. § 7.18).

ABSTRACT

Project Title: U18TN0544 Kane County Water Conservancy District's Cove Reservoir Project

Report Title and Date: Cultural Resources Inventory Report, U18TN0544 Kane County Water Conservancy District's Cove Reservoir Project, Kane County, Utah December 2019

Cooperating Agencies: United States Department of Agriculture, Natural Resources Conservation Service (NRCS), Utah State Office
Bureau of Land Management (BLM) Kanab Field Office
State of Utah School and Institutional Trust Lands Administration (SITLA)

Project Numbers: Transcon Environmental, Inc. (Transcon) Project Number: D38-02
Utah Division of State History Project Number: U18TN0544

Permit Numbers: BLM Permit: 18UT81313
Public Lands Policy Coordination Office: Lindsey M. Evenson PLCPO No. 177

Project Description: The NRCS and Kane County Water Conservancy District (KCWCD) are proposing to construct the new Cove Reservoir within the existing Glendale, Mt. Carmel, and Orderville irrigation systems. This proposed reservoir would be located immediately southwest of Orderville, Utah, off Cove Road. Additional improvements would include the construction of approximately 1.5 miles of new pipeline, the Glendale hydroelectric power plant, and 0.2 mile of new power line, and 0.7 acre of utility corridor along U.S. Highway 89 (US-89) and Cove Road; these improvements would be located west of US-89 and the East Fork of the Virgin River in Glendale, Utah. The Project also proposes the potential use of six previously disturbed borrow pits—Lambs Pit, County Pit, Tait Pit, Bald Knolls Community Pit, Bald Knolls Community Pit Expansion, and Black Knoll Rip-Rap Pit—for Project-related construction needs; no disturbance outside the previously disturbed areas is proposed at these borrow pit locations with the exception of new pits being developed at Bald Knolls Community Pit Expansion and Black Knoll Rip-Rap Pit.

The proposed Project will include a block survey of the proposed reservoir and hydroelectric power plant locations and four borrow pits, a linear survey of the new pipeline, power line, and utility corridor locations, and a spot check/survey of two borrow pit locations. KCWCD retained Transcon to conduct this analysis; the cultural resources survey and resulting report were conducted in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended.

Location: The Project area is generally located west of US-89 in Glendale and southwest of Orderville, Utah. The survey area measures approximately 791.68 acres and is located within Township 40 South, Range 5 West, Section 28; Township 40 South, Range 6 West, Sections 25, 26, 27, and 34; Township 40 South, Range 7 West, Sections 23, 26, and 27; and Township 41 South, Range 7 West,

Sections 5, 6, 17, 19, 30, and 31 of the Salt Lake Baseline and Meridian. The Project crosses the Bald Knoll, Orderville, Glendale, and Mount Carmel, Utah 7.5-minute U.S. Geological Survey topographic quadrangles.

Acreage and Jurisdiction:

The Project area of potential effect (APE) measures approximately 791.68 acres and crosses BLM Kanab Field Office-managed lands (152.18 acres), SITLA-managed lands (70.33 acres), and privately-owned lands (569.17 acres). The survey was conducted in 15-meter-wide transects throughout the Project area (including both block and linear survey areas), with the exception of the Lambs Pit, which is located on private property and was "spot" checked for any potential areas that may be previously undisturbed and may contain significant cultural resources; the County Pit and Tait Pit, also located on private property, were surveyed in 15-meter transects at the request of the NRCS and BLM Kanab Field Office. No portion of the Project area was left unsurveyed, due to prior survey efforts.

Personnel and Dates of Fieldwork:

A total of 32 person-days of field effort were spent on the Project. Original surveys between October 1 through 8 and October 10 through 13, 2018; supplemental surveys on the project occurred between June 12 through 14, July 10, and September 19, 2019. The survey was conducted by Transcon archaeologists Brent Larsen, Jennifer Bannick, and Nicole Jacobson.

Register-eligible Properties:

42KA6331, 42KA8785, 42KA8904, and 42KA8974

Register-ineligible Properties:

42KA8900, 42KA8901, 42KA8902, 42KA8903, 42KA8972, and 42KA8973

Comments:

A total of 9 new cultural resource sites (42KA8785, 42KA8900, 42KA8901, 42KA8902, 42KA8903, 42KA8904, 42KA8972, 42KA8973, and 42KA8974), 1 previous cultural resource sites (42KA6331), and 15 isolated occurrences (IOs) were identified and recorded within the Project APE. Of the 10 total sites located within the project APE, 4 sites (42KA6331, 42KA8785, 42KA8904, and 42KA8974) are recommended Eligible for listing on the National Register of Historic Places (NRHP) under Criterion D for their information potential; the remaining 6 sites and all 15 IOs are recommended Not Eligible for listing on the NRHP under any Criteria.

It is recommended that implementation of the Project would result in *No Adverse Effect to Historic Properties*, if certain protective measures are followed (see *Survey and Summary Results* for details). If any previously undetected or unreported cultural features or deposits are encountered during future Project-related activities, these activities must be discontinued in the immediate area of the feature(s), and an NRCS archaeologist, BLM archaeologist, or SITLA archaeologist, where appropriate, must be consulted to evaluate their nature and significance.

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INTRODUCTION

Transcon Environmental, Inc. (Transcon) conducted a Class III (intensive pedestrian) cultural resources survey of approximately 791.68 acres adjacent to U.S. Highway 89 (US-89) and Glendale Bench Road in the vicinity of Glendale and southwest of Orderville, in Kane County, Utah. Fieldwork was conducted between October 1 through 8 and October 10 through 13, 2018 with supplemental fieldwork being conducted between June 12 through 14, July 10, and September 19, 2019. The survey was requested by the United States Department of Agriculture, Natural Resources Conservation Service (NRCS), Utah State Office and Kane County Water Conservancy District (KCWCD) to determine if any significant cultural resources, which could be affected by the proposed Kane County Water Conservancy District's Cove Reservoir Project (Project), are present within the Project area. Important cultural resources may include historic or prehistoric archaeological sites or objects; historically or architecturally significant structures, buildings, or landscapes; and traditional cultural places that are or could be considered Eligible for inclusion in the National Register of Historic Places (NRHP).

Project Description

The NRCS and KCWCD are proposing to construct the Project within the existing Glendale, Mt. Carmel, and Orderville irrigation systems. This proposed reservoir would be located immediately southwest of Orderville, Utah, off Cove Road. Additional improvements would include the construction of approximately 1.5 miles of new pipeline, the Glendale hydroelectric power plant (hydroplant), 0.2 mile of new power line, 0.7 acre of utility corridor along US-89 and Cove Road; these improvements are located west of US-89 and the East Fork of the Virgin River in Glendale, Utah. The Project also proposes the use of six borrow pits—Lambs Pit, County Pit, Bald Knolls Community Pit, Bald Knolls Community Pit Expansion, Black Knoll Rip-Rap Pit, and Tait Pit—for Project-related construction needs; no disturbance outside the previously disturbed areas is proposed at these borrow pit locations with the exception of the Bald Knoll Community Pit Expansion and Black Knoll Rip Rap Pit, which will have new disturbance. An additional borrow pit location—Lava Pit—was evaluated for the proposed project by the NRCS and will not be further discussed in this report. The proposed Project includes a block survey of the proposed reservoir, proposed new hydroplant, and borrow pit locations with new development proposed; a linear survey of the new pipeline, new power line, and road improvement locations; and a spot check/survey of the borrow pit locations with no new disturbance proposed. In addition, the Bureau of Land Management (BLM) Kanab Field Office requested a full block survey of the County Pit borrow pit location (on BLM-managed lands). The previously constructed Orderville hydroplant and the existing pipeline locations were not reevaluated as part of this Project.

The proposed Project area is located primarily along US-89, with one borrow pit (Bald Knolls) located along Glendale Bench Road in Kane County, Utah. The proposed new pipeline parallels US-89 between milepost (MP) 89.4 and MP 87.9, the proposed hydroplant is located west of US-89 by MP 87.9, access to the proposed Cove Reservoir is along Cove Road between MP 84.9 and MP 85, the County Pit can be accessed east of US-89 on a dirt road from MP 84.3, Lamb's Pit is accessed east of US-89 from a dirt road at MP 81.4, and Bald Knolls Community Pit is accessed from a dirt road off Glendale Bench Road, which is east of US-89 at MP 90.

The Project area of potential effect (APE) measures approximately 791.68 acres and crosses BLM Kanab Field Office-managed lands (152.18 acres), State of Utah School and Institutional Trust Lands Administration (SITLA)-managed lands (70.33 acres), and privately-owned lands (569.17 acres). The survey was conducted in 15-meter-wide transects throughout the Project area (including both block and linear areas), with the exception of the Lambs Pit, which was spot checked for any potential areas that may have been previously undisturbed. The County Pit and Tait Pit were completely surveyed under a block

survey, as requested by the NCRS and BLM Kanab Field Office. No portion of the Project area was left unsurveyed, due to prior survey efforts.

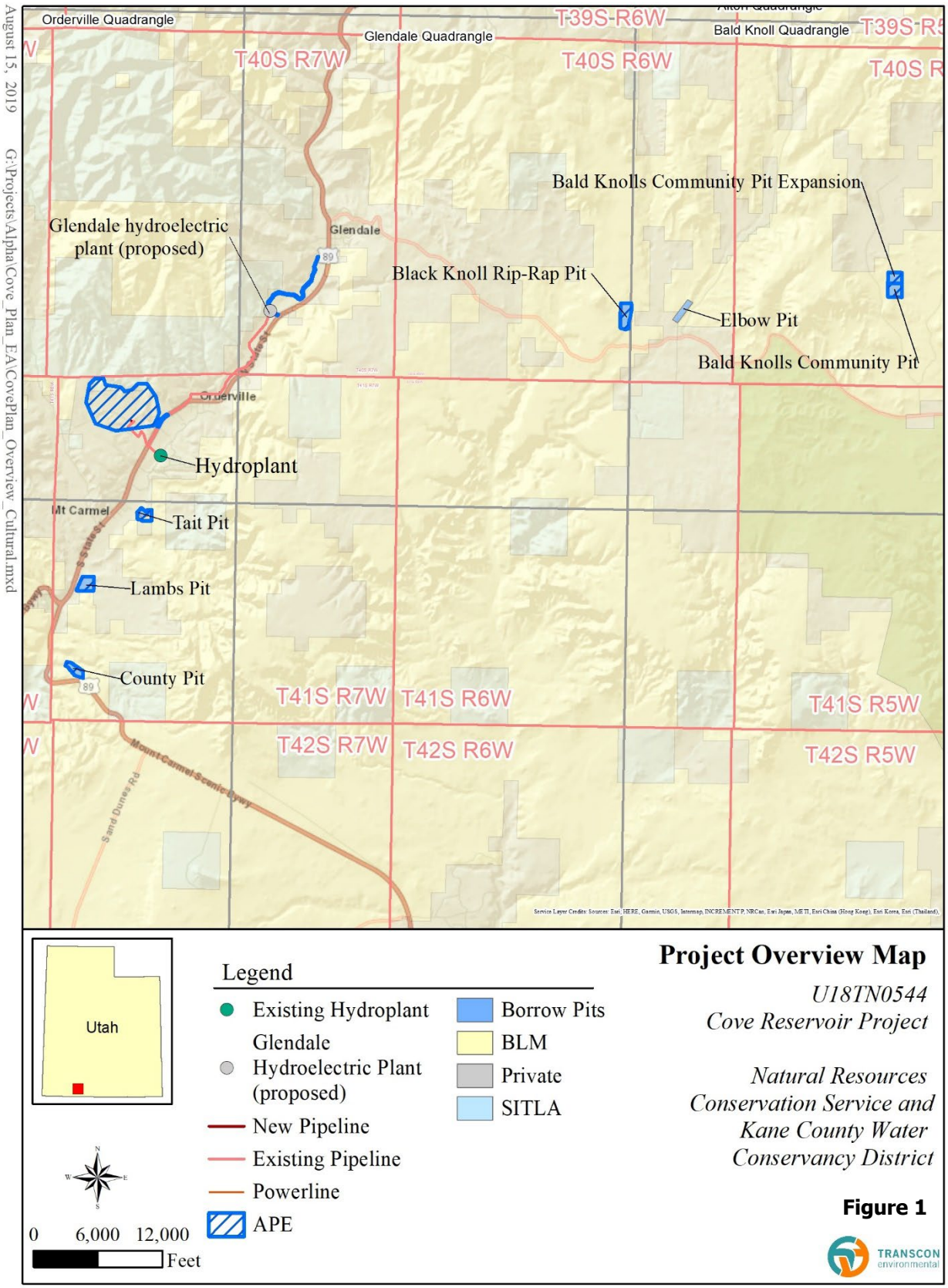
KCWCD retained Transcon to conduct a cultural resources analysis. The cultural resources survey and this resulting report have been completed as part of that analysis and were conducted in compliance with Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended. The NRCS Utah State Office served as the lead federal agency for the Project. The survey was conducted under a BLM fieldwork authorization dated September 28, 2018 and a SITLA fieldwork authorization dated September 28, 2018; additionally, a supplemental BLM fieldwork authorization was signed May 23, 2019 for additional project areas (borrow pits) on BLM-manged lands outside the original project APE (**Appendix A**). The cultural resources survey was conducted between October 1–8 and 10–13, 2018 with supplemental fieldwork being conducted between June 12 through14, 2019, July 10, and September 19, 2019 for a total of 32 person-days of fieldwork. Lindsey M. Evenson served as Principal Investigator, Brent Larsen served as the Field Director, and Jennifer Bannick and Nicole Jacobson served as the Project Archaeologists.

Project Location

The Project area is generally located west of US-89 in Glendale and southwest of Orderville, in Kane County, Utah. The survey area measures approximately 791.68 acres and is located within Township 40 South, Range 5 West, Section 28; Township 40 South, Range 6 West, Sections 25, 26, 27, and 34; Township 40 South, Range 7 West, Sections 23, 26, and 27; and Township 41 South, Range 7 West, Sections 5, 6, 17, 19, 30, and 31 of the Salt Lake Baseline and Meridian. The Project crosses the Bald Knoll, Orderville, Glendale, and Mount Carmel, Utah 7.5-minute U.S. Geological Survey topographic quadrangles.

The Project area is generally located along US-89 near Orderville and Mt. Caramel, with three borrow pits (Bald Knolls, Bald Knolls Expansion, and Black Knoll) located along Glendale Bench Road in Kane County, Utah. The proposed new pipeline parallels US-89 south from MP 89.4–MP 87.9 and the proposed hydroplant is located west of US-89 at MP 87.9. Access to the proposed Cove Reservoir is along Cove Road between US-89 MP 84.9–MP 85 and the County Borrow Pit can be accessed east of US-89 from a dirt road at MP 84.3. Lamb's Pit is accessed east of US-89 from a dirt road at MP 81.4 and Tait Pit can be accessed east of US-89 from a dirt road near MP 83, while Bald Knolls Community Pit, Bald Knolls Community Pit Expansion, and Black Knoll Rip-Rap Pit can be accessed from a dirt road off of Glendale Bench Road located east of US-89 at MP 90.

The Project area is located on land under the jurisdiction of the BLM Kanab Field Office, SITLA, and private ownership. **Figure 1** shows the proposed Project development features, APE, and land jurisdictions.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Orderville Quadrangle
Glendale Quadrangle
Bald Knoll Quadrangle
T39S-R6W
T40S R7W
T40S R6W
Bald Knolls Community Pit Expansion
Glendale hydroelectric plant (proposed)
Glendale
Black Knoll Rip-Rap Pit
Elbow Pit
Bald Knolls Community Pit
Orderville
Hydroplant
Mt Carmel
Tait Pit
Lambs Pit
County Pit
T41S R7W
T41S R6W
T41S R5W
T42S R7W
T42S R6W
T42S R5W
Mount Carmel Scenic Hwy
Sand Dunes Rd
Utah
Legend
Existing Hydroplant
Glendale Hydroelectric Plant (proposed)
New Pipeline
Existing Pipeline
Powerline
APE
Borrow Pits
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Project Overview Map
U18TN0544
Cove Reservoir Project
Natural Resources Conservation Service and Kane County Water Conservancy District
Figure 1
TRANSCON environmental

ENVIRONMENTAL SETTING

The proposed Project area is located within the Grand Staircase subdivision of the Colorado Plateau physiographic region of southwestern Utah, immediately south of the Basin and Range–Colorado Plateau Transition Zone (Stokes 1977). The Grand Staircase subdivision is characterized by a series of slopes, cliffs and terraces that extend from the Grand Canyon in Arizona culminating in the High Plateaus of southern Utah. This region is further characterized by many unique linear cliffs that are distinctly colored and display several different geologic ages (Stokes 1977). Major drainage systems in the Project area include the East Fork of the Virgin River and Muddy Creek, as well as unnamed washes, springs, and dry washes.

The Project area begins south of Mt. Carmel at the County Borrow Pit, encompasses a large area west of Orderville at the proposed reservoir site (**Figure 2**), extends along the East Fork of the Virgin River at the area of the proposed new pipeline, and terminates northeast of Glendale by the Bald Knolls Community Pit. The topography of the region is characterized by steep slopes, cliff faces, and various rock formations and is situated in a distinctive geological area surrounded by the Coral Pink Sand Dunes State Park to the south, Zion National Park to the west, Cedar Breaks National Monument to the northwest, the Grand Staircase-Escalante National Monument (GSENM) to the east, and Bryce Canyon National Park to the northeast. Most of the Project extends along the Sevier Fault; Triassic and Jurassic rock formations are exposed in the region across the anticline, including the Glen Canyon Group of Moenave Formation, Kayenta Formation, and Navajo Sandstone. There are also Cretaceous rock formations west of the Sevier Fault in the Project area, including the Wahweap and Straight Cliffs formations, Dakota Sandstone and Cedar Mountain Formation, and the Jurassic Carmel Formation (Williams et al. 2014).



Figure 2. Project overview looking southeast within the proposed Cove Reservoir basin.

The proposed new pipeline section of the Project area is located within Long Valley along the Mt. Carmel Scenic Byway, which lies west of Glendale Bench and the White Cliffs. The proposed reservoir section of the Project area is located west of the town of Orderville adjacent to Cove Canyon and Deer Hollow, and

Bald Knolls community Pitt is located just above the Skutumpah Terrace. Elevations in the Project area range from 5230 feet above sea level (asl) near Lamb's Pitt to 6542 feet asl in the vicinity of Bald Knolls Community Pit. Elevations in the proposed new pipeline area range from 5600 to 5721 asl.

Vegetation found in the Project area consists of greasewood-salt scrub and transitions into sagebrush-perennial grassland habitat and, eventually, into pinyon-juniper woodlands in the higher elevations. The area of the proposed new pipeline meanders along the East Fork of the Virgin River, and portions of this section of the Project cross though agricultural fields and along a riparian environment with tamarisk, Russian olive, and cottonwood trees found in abundance.

CULTURAL HISTORY

Professional investigations of the Project area were initiated in the 1940s. Since that time, the cultural history of Utah and of the Project vicinity has been reviewed by a number of authors, including general and more area-specific overviews (Steward 1938; Wormington 1957; Marwitt 1970; Jennings 1978; Aikens and Madsen 1989; Copeland and Fike 1988; Cordell 1997; Madsen and Simms 1998). Studies have included extensive excavations of prehistoric sites and, since the 1970s, cultural resource management surveys.

Prehistory

The first period of significant human occupation within southeastern Utah occurred around approximately 13,000 BP, towards the end of the Pleistocene, when the climate was cooler and moister than at present (Jennings 1989). During this Paleoindian period, the region was characterized by extensive marshlands and shallow lakes, as well as woodlands at lower elevations; these conditions supported the presence of large game mammals such as giant bison, mammoth, camel, and ground sloth (Grayson 1993). Artifacts associated with this period are dominated by lanceolate and fluted lanceolate projectile points, such as Clovis, Folsom, and Lake Mojave (Cordell 1997).

In the Southwest, the subsequent Archaic period is loosely used to define the period of time between the end of the Pleistocene and the widespread adoption of agriculture (Cordell 1997). The Archaic period is characterized by populations infilling the landscape and becoming more reliant on plant foods. The following Archaic occupation began in this region sometime around 6500 BC with the extinction of the megafauna and lasted until the beginning of the first millennium AD. In Utah this occupation is often subdivided into the Early (6500 to 3500 BC), Middle (3500 to 1500 BC), and Late (1500 BC to AD 1) Archaic periods; these last two are characterized by a gradual occupation of wooded upland environments and the abandonment of many lower, lacustrian locations.

Archaic peoples followed a seasonal round of hunting and gathering, utilizing a wide range of plants and smaller animals as well as processed seeds and tubers. Archaeological sites representing Archaic occupations can often be differentiated from later sites by an absence of cultigens, pottery, and small arrow points. Important new technologies during this period included nets, traps, atlatls, and milling stones. Obsidian from sources west of the Project area was used and widely traded. Numerous Archaic sites have been identified in the region; these site locations are often associated with good viewpoints, the availability of raw material suitable for stone tool manufacture, and pinyon groves.

By the first millennium AD, Formative cultures were present in south-central Utah. The Formative period (1500 BC to AD 500) is identified by maize agriculture, ceramics, and greater sedentism, often involving permanent or semi-permanent housing. Formative period sites in the vicinity of the Project area tend to be associated with the Fremont culture to the west on the fringes of the Great Basin and east in the Escalante area; sites associated with the Anasazi culture are present south and southeast.

Most Formative village sites are associated with well-watered areas of good soil at low-to-moderate elevations. None of these are represented within the Project area. However, the agriculturally oriented Fremont culture also used higher altitude areas for hunting and resource collection. The remnants of the Fremont culture are often limited and can be confused with non-Formative uses of the area. Between AD 1200 and 1500 there was a gradual abandonment of the region by Formative groups, possibly due to drought or warfare.

Beginning around AD 1300 throughout the Colorado Plateau, small triangular arrow points (Desert Side-notched and Cottonwood Triangular) became more common, as did a distinctive brown ware pottery ("Intermountain Brown ware" or "Shoshonean Ware"). The appearance of these ceramics and projectile

point types, the abandonment of horticulture, and other aspects of material culture indicate an expansion of Numic-speaking peoples into the region from the Mojave Desert area to the west (Bettinger and Baumhoff 1982; Madsen 1975; Rhode and Madsen 1994). The model is premised on the fact that Numic-speaking groups were present in the area at the time of contact. Furthermore, glotto-chronological evidence suggests that the languages spoken by these groups (primarily Shoshone, Paiute, and Ute) shared a common origin and began to diverge approximately 1000 years ago (Rhode and Madsen 1994).

By 1300, Numic-speaking Shoshonean peoples entered the Project area from the west. These groups followed a lifeway more similar to the Archaic than the immediately preceding Formative groups. They were highly mobile, relied on seasonal hunting and gathering, and lived in temporary structures called wickiups. Numic sites can be identified by Desert Side-notched projectile points and Numic ceramics, and often include hearths and roasting pits. Subsistence options for these groups included plant collecting, small and large game hunting, fishing, and some limited agriculture. The descendants of these groups lived in southern Utah at the time of Western contact and included the Shivwit, Koosharem, Kanosh, Indian Peaks, and Cedar City bands of the Southern Paiute. Protohistoric and historic Southern Paiute sites are not commonly found but have been identified in the vicinity of the Project.

Ethnography

Paiute Indians are a group of native peoples who generally inhabit the Great Basin region of the southwestern United States. Generally, Paiutes are divided into three groups: Northern Paiute, Southern Paiute, and Mono people. The Northern Paiute have historically inhabited regions of California, Oregon, Nevada, and Idaho; the Mono People inhabit regions of California; and Southern Paiute territory includes regions in southern Nevada, northern Arizona, and southern Utah (Poll et al. 1989).

Southern Paiute people speak a Shoshonean language, a dialect in the Numic family of languages, which in turn is a branch of the Uto-Aztecan language family, a broad family of Native American languages found throughout the western United States and Northern Mexico (Simms 2008). The language of the Southern Paiute people is closely related to that of the Northern and Southern Utes, and scholars generally agree that speakers of Numic languages began to spread across the Great Basin from California sometime around AD 1000. (Bettinger and Baumhoff 1982). Fluency in Paiute languages has decreased in recent years and there are currently projects aimed at reviving and preserving the different Paiute dialects (Paiute Indian Tribe of Utah 2018).

Bands of Southern Paiute traditionally lived in locations in the territory of the Project area. Historically, Southern Paiute subsistence was based on hunting, fishing, and gathering wild foods; bands augmented hunting and gathering activities with small gardens. Paiute people used bows and arrows for hunting and were skilled in the art of basketmaking; the cultivation of willow and other raw materials; and the preparation of fiber, cordage, and fabric (Simms 2008). Southern Paiute Tribes depended on seasonally available foods such as agave, cacti, juniper berries, roots and tubers, various seeds, pine nuts, yucca, rabbits, antelope, and deer. Each Paiute group subsisted on various foods depending on the geographical location and cultural traditions of their individual bands. These people lived primarily in independent, small bands of three to ten households and placed primary importance on their camp groups (Holt et al. 2006).

The first recorded European contact with the Southern Paiute occurred during the Domingo-Escalante expedition to find an overland route from New Mexico to Monterey, California. In 1776, a party of Spanish explorers, led by Fray Silvestre Vélez de Escalante and Fray Francisco Dominguez, encountered a band of women gathering seeds near what is modernday Cedar City, Utah (Holt et al. 2006). The Paiute people have been described as peaceful seminomadic foragers who practiced limited horticultural activities and skillfully utilized the available resources of their homelands (Holt et al. 2006). The peaceful Paiute people

were sometimes subjected to raids, taken as captives, and sold as slaves by neighboring Tribes to the Spanish (Poll et al. 1989).

Trappers and slave traders followed the Spanish Trail through Utah, yet the Paiutes managed to stay in control of their territory until the 1850s when settlers from the Church of Jesus Christ of Latter-Day Saints (Mormons/LDS) began to move into the Southern Paiute territory (Holt et al. 2006). Although the Mormons had, in general, a friendly view of the Native Americans, domesticated livestock and crop lands soon took over the grazing lands of the animals that the Natives hunted and drove away game. The Mormons occupied many Paiute water sources, and the streams that had once provided water for gathered foods were now utilized for irrigation; this made it difficult for the Southern Paiute to continue their traditional way of life (Poll et al. 1989).

Despite disagreements as to band affiliation among scholars, it is clear that the Southern Paiute traditionally defined themselves by food names and geographical locations of groups (Steward 1938; Hafen and Hafen 1954). These groups were highly flexible and consisted for the most part of households bound together by kinship, marriage ties, and specialization. During the nineteenth century as populations dwindled, the groups consolidated in order to adapt to their changing environment, and chieftainships came about in many cases as a response to these consolidations (Euler 1966). The Southern Paiute resisted the government's efforts to relocate them to the Ute reservations. The Kaibab Band of Paiute Indians was formed after the Indian Reorganization Act of 1934, and in 1950 an organized Tribal government was formed (Arizona State University 2018). Paiute populations were heavily affected by European diseases and food shortages after an influx of European settlers in the 1860s, and by 1869 Paiutes were faced with the option of moving out of their traditional homelands and relocating into marginal desert areas or living on the fringes of Mormon settlements.

Present-day Paiute communities are located in Pahrump, Moapa, and Las Vegas, Nevada; in Willow Springs, Arizona; and in the towns of Cedar City, Koosharem, Kanosh, Indian Peaks, Shivits, and Kaibab, Utah. The Kaibab Paiute reservation is not far from the Project area; it is located by the Utah–Arizona border near Kanab, Utah and approximately 50 miles north of the Grand Canyon. This reservation consists of five tribal villages and approximately 200 tribal members, most of whom live on the reservation near Kanab Creek, which is considered a sacred site. Present-day Southern Paiute are known for skillful basket weaving in the tradition of their ancestors (Grand Canyon Trust 2018).

History

The first Europeans in Utah were Spanish explorers, missionaries, and traders. The route they followed looped up from the pueblos of the Four Corners region, ran north of the Project area, and then south-southwest to the west of the Project area. An alternative route ran south of the Project area across the Arizona Strip. This Old Spanish Trail likely followed routes previously used by Native Americans. It was later used by fur trappers, traders, and soldiers. Goods from Santa Fe, New Mexico, including Native American slaves, were transported along this route to Los Angeles, California. A variety of other goods, including horses and mules, were traded back. The Spanish also traded with the Utes along this route for Southern Paiutes captured as slaves. The route was used as early as 1829, but the first wagons on the trail were likely those of the Mormon Battalion traveling from San Diego, California to Salt Lake City, Utah in 1849 (Hafen and Hafen 1954).

In 1862, Mormon ranchers first came to Long Valley, the land east of Zion National Park, to graze cattle along the East Fork of the Virgin River. Robert and Isabella Berry named this location Berryville but were later killed by Native Americans in 1866 and the region was abandoned. In 1871, Mormons from the Muddy River settlement in Nevada resettled the area, naming the town Glendale. By the 1880s, the Mormon population in the area had grown and the nearby towns of Orderville and Mount Carmel Junction had been

established. Glendale became part of the United Order, a program of economic and moral reform that began in 1874; together, the towns of Mt. Carmel, Orderville, and Glendale have become known as Long Valley (Bradley 1999). Homestead entries within the Project area were patented in 1892, 1897, 1900, 1902, and 1937 (BLM 2018). In 1900, the Denver and Rio Grande Western Railroad opened a branch from its main line, south to Marysvale, well to the north in the Sevier River Valley; no rail line ever reached farther south, and so residents of Long Valley had to travel north to the railhead at Marysvale (Athearn 1962).

The southern part of the current US-89 route, running north from Kanab, mostly followed a succession of linear valleys. The original 19th-century road was poorly constructed, with steep grades and a rough surface. The Utah State Road Commission designated the highway from Nephi south to Kanab as a state road around 1910. However, this route initially went through Alton and Johnson Canyon to the east, bypassing the Project area. The more direct route via Long Valley and Glendale required difficult construction over a sandy mesa near Kanab. This sand-clay road was constructed in 1916; in the early-1920s, the State Road Commission designated it State Route 11. By 1926, it was designated part of US-89, although at the time US-89 only went as far north as Spanish Fork. The portion of US-89 that runs through the Project area has been realigned, paved, and widened numerous times since then (Knowlton 1965; Bradley 1999).

Settlers first arrived into the area surrounding Bryce Canyon in 1864. Exploration in 1852 by Mormon pathfinders had resulted in the determination that Panguitch Valley and the Sevier Valley to the south was a suitable area for 50 to 100 families to settle (Chidester and Bruhn 1949). The construction of the 10-mile-long Tropic Canal, which runs from the East Fork of the Sevier River across the Paunsaugnut Plateau to the Paria Valley, began in 1889. Within the next two years, anticipating the benefits of this irrigation system, several families moved into the area. In 1892, the canal was completed and the following year, the Tropic and East Fork Irrigation Company was established to administer this and another canal.

The publicizing of Bryce Canyon and its inclusion in the National Parks System contributed to the success of the region, bringing better roads and a steady stream of tourists and allowing locals to invest in the creation of hotels and restaurants. Bryce Canyon National Park was named after one of its first settlers, Ebenezer Bryce, a Scottish emigrant. Tourism increased when the Union Pacific Railroad built a rail line to Cedar City. Here, tourists could secure a bus tour starting in Cedar Breaks and continue on to Bryce Canyon, Zion National Park, and the north rim of the Grand Canyon (Caywood and Grant 1994; Chidester and Bruhn 1949; Newell and Talbot 1998).

The area that is now Zion National Park was originally inhabited by Southern Paiute Indians and subsequently explored and settled by Mormon pioneers expanding out of Cedar City to the settlement of Springdale. The name “Zion” is credited to an early settler named Isaac Behunin; it is a Biblical name that symbolizes a place of utopia (Zion Nation Park 2017). Increased access to Southern Utah created new tourism enterprises, and by the start of the 20th century Utahans were beginning to recognize the need to preserve the unique landscapes of their state while profiting from the scenic magnificence of Utah’s geological wonders. Twelve national parks and monuments were created in Utah by 1970, and all but three of these are in Southern Utah (Poll et al. 1989). Under the national Antiquities Act of 1906, a national monument was created at Zion Canyon by President Howard Taft in 1909; originally named “Mukuntuweap National Monument” (Paiute for “straight canyon), it was changed to “Zion National Monument” in 1918 and then “Zion National Park” in 1910 (Zion National Park 2017).

Cedar Breaks National Monument was created in 1933 by President Franklin D. Roosevelt; it is a natural amphitheater of eroded sedimentary rock from the Claron Formation sitting at over 10,000 feet in elevation (NPS 2018). Coral Pink Sand Dunes State Park was created in 1963. This popular recreational area encompasses nearly 3370 acres and was formed by the Venturi effect on the area’s Navajo sandstone, resulting in the unusually colored dunes found in the park (Zion National Park 2018). In addition to the

majestic geology of these parks, they are home to distinctive plants and wildlife, such as the bristlecone pine in Cedar Breaks National Monument and the Coral Pink Sand Dunes tiger beetle (NPS 2018).

Tourism to the national parks and monuments in the region continues to be an important economic factor in the Project area, as the unique and beautiful scenery of the region continues to attract tourists from all over the world and filmmakers for the western setting.

CLASS I AND ARCHIVAL RESEARCH

Prior to the commencement of fieldwork, records on file with the Utah Division of State History were checked to determine whether previously identified cultural resources were present or if any previously reported archaeological investigations had been conducted within 0.5 mile of the proposed Project area. It was determined that 38 previous cultural resource surveys, 7 previously identified historic structures, and 34 previously recorded cultural resource sites are located within 0.5 mile of the Project area (UDSH 2018b).

Cultural Resource Definitions

Identified cultural resources and potential sites were defined according to criteria established by the BLM Manual 8110 "Cultural Resources Manual" (BLM 2004; UDSH 2018a). An archaeological site (prehistoric or historic) contains the physical remains of past human activity that is at least 50 years old and consists of at least one of the following:

- At least 10 artifacts of a single class within a 10-meter-diameter area, except when all artifacts are from a single source (e.g., single pot or bottle)
- At least 15 artifacts of at least 2 classes within a 10-meter area
- One or more archaeological features in temporal association with any number of artifacts
- Two or more temporally associated archaeological features without artifacts

Artifact or feature occurrences that do not meet any of these criteria are considered isolated occurrences (IOs). IOs are recorded and described, but they do not qualify as sites and are often Not Eligible for inclusion on the NRHP. However, the NRHP does have an "object" property type where IOs can be categorized when recommended Eligible. Roadside memorials are commonly found while surveying within road rights-of-way (ROWs). Roadside memorials generally indicate the location of a roadside fatality and the markers or shrines tend to be maintained by relatives. Although roadside memorials are not NRHP-Eligible, they are significant to members of the local communities and cultures and are recorded to ensure their avoidance during Project implementation.

Previously Conducted Cultural Resource Surveys

Background research identified 38 previously conducted cultural resource surveys within 0.5 mile of the Project area (**Table 1**). Of these, seven previous cultural surveys cross into or overlap some portion of the Project area, two of which were conducted within the past ten years (blue highlighted blue text in **Table 1**). These surveys mapped within or adjacent to the Project area are shown in **Appendix B**. These recent surveys consist of watershed and waste water surveys. No portion of the Project area was left unsurveyed due to prior survey efforts.

TABLE 1
PREVIOUS CULTURAL SURVEYS WITHIN 0.5 MILE OF THE PROJECT AREA

Survey No.	Survey Name	Organization	Date	Within APE*
U75AF0049	Long Valley Improvement Project	Archaeological Environmental Research Corporation (AERC)	1975	In
U77AF0068	Cultural Resource Evaluation in South Central Utah	AERC	1977	Out
U78AF0322	Long Valley/Mount Carmel Junction Locality	AERC	1978	Out
U79BL0092	K. S. Anderson Agricultural Trespass	BLM	1979	In

TABLE 1 PREVIOUS CULTURAL SURVEYS WITHIN 0.5 MILE OF THE PROJECT AREA				
Survey No.	**Survey Name**	**Organization**	**Date**	**Within APE***
U79BL0093	L. D. Anderson Agricultural Trespass	BLM	1979	Out
U80BL0116	Mount Bell ROW	BLM	1980	Out
U80BL0181	Garkane Power Line Upgrade	BLM	1980	Out
U81BL0226	Orderville ROW Water Well	BLM	1981	Out
U82BL0166	Black Rock Chaining	BLM	1982	Out
U82BL0172	Glendale Town Sale	BLM	1982	Out
U83NH0165	Alton—Kolob Class II	Nickens and Associates	1983	Out
U84BL0697	Black Knoll Rip Rap Pit	BLM	1984	In
U85BL0906	Keith Walber Land Sale	BLM	1985	Out
U85BL0910	Glendale Baseball Park R&PP	BLM	1985	Out
U86NI0487	Alton Coal Project Survey	Museum of Northern Arizona	1986	Out
U88BL0539	Glendale Dump Sale	BLM	1988	Out
U89BL0240	Glendale Dump Access ROW	BLM	1988	Out
U91BL0018	East Fork Access Road ROW	BLM	1991	Out
U92IG0094	South Central Utah Telephone, Arizona to Mount Carmel Junction	Intersearch	1992	Out
U92UJ0622	SCS Muddy Creek-Orderville Chaining	Utah State University	1992	In
U94IG0133	South Central Utah Telephone, Mount Carmel Junction to Zion National Park	Intersearch	1994	Out
U98ST0307	Muddy Wash Bridge Replacement (Utah Department of Transportation)	SWCA	1998	Out
U01MQ0510	Garkane Power's Mt. Carmel to Zion	Montgomery Archaeological Consultants	2001	Out
U03BL0632	Xpressweb Services Orderville	BLM	2003	Out
U03BL0894	Glendale Landfill Expansion	BLM	2003	Out
U04BL0680	Glendale Bench Watershed Project	BLM	2004	Out
U06HO0544	Glendale Waterline Project	Bighorn Archaeological Consultants	2006	Out
U06HO1371	Orderville Water System Improvements	Bighorn Archaeological Consultants	2006	In
U07BL0560	Bald Knoll Community Pit	BLM	2007	In
U07HO1381	Cultural Resources Inventory of the Orderville Water System Improvements Alternative near Mount Carmel Junction	Bighorn Archaeological Consultants	2007	Out
U11SH0605	Cultural Resources Inventory of a Proposed Range	NRCS	2011	Out

TABLE 1 PREVIOUS CULTURAL SURVEYS WITHIN 0.5 MILE OF THE PROJECT AREA				
Survey No.	**Survey Name**	**Organization**	**Date**	**Within APE***
	Improvement Project West of Glendale Kane County Utah			
U11UM0953	The East Fork and Yellow Jacket Canyon Re-seeding Project, Kane County, Utah	SITLA	2011	Out
U12SH0189	Cultural Resources Inventory of Kane County Emergency Watershed Protection (EWP)	NRCS	2012	In
U13IG0529	Caruso-SITLA Emerald Green Mine Survey in Kane County	Intersearch	2013	Out
U13SH0294	A Supplemental Cultural Resources Inventory of EWP Locations Along the East Fork of the Virgin River, Kane County, Utah	NRCS	2013	Out
U14HO0043	A Cultural Resource Inventory for the Long Valley Sewer Improvement District Waste Water System Upgrade Project, Kane County, Utah	Bighorn Archaeological Consultants	2014	In
U16SH0722	Cultural Resources Inventory in Support of an EWP Project Along Johnson Canyon, Kane County, Utah	NRCS	2016	Out
U17SH0395	Cultural Resources Inventory for FY2016 NRCS Riparian Restoration Project No. 748D431608E, Kane County, Utah	NRCS	2017	Out
***Note:** "In" indicates the survey is overlapped or crossed by some portion of the current Project APE (also in blue text); "Out" indicates the survey is not overlapped by any portion of the current Project; blue highlighting represents "In" surveys conducted within the past 10 years.				

Previously Recorded Cultural Resource Sites

Background research identified 41 previously recorded cultural resources within 0.5 mile of the Project area (**Table 2**). Of these, four sites (indicated by blue text in **Table 2**) were mapped within or adjacent to the Project APE. These cultural resources consist of four prehistoric lithic scatters in the vicinity of the Bald Knolls Community Pit and Black Knoll Rip-Rap Pit.

TABLE 2 PREVIOUSLY IDENTIFIED CULTURAL RESOURCE SITES WITHIN 0.5 MILE OF THE PROJECT AREA			
Site No.	**Description**	**Eligibility**	**In/Out***
42KA0625	Prehistoric campsite	Unevaluated	Out
42KA1156	Prehistoric open habitation (possibly destroyed)	Determined unevaluated	Out
42KA1158	Prehistoric campsite	Unevaluated	Out

TABLE 2 PREVIOUSLY IDENTIFIED CULTURAL RESOURCE SITES WITHIN 0.5 MILE OF THE PROJECT AREA			
Site No.	**Description**	**Eligibility**	**In/Out***
42KA1159	Prehistoric campsite	Unevaluated	Out
42KA1160	Prehistoric campsite	Unevaluated	Out
42KA1161	Prehistoric campsite (possibly destroyed)	Unevaluated	Out
42KA1162	Prehistoric campsite	Unevaluated	Out
42KA1163	Prehistoric campsite	Unevaluated	Out
42KA1836	Historic coal mine (Mackelprang Coal Mine)	Determined Not Eligible	Out
42KA1956	Multi-component: prehistoric open camp; historic isolate	Recommended Eligible	Out
42KA1960	Prehistoric campsite	Unevaluated	Out
42KA1986	Prehistoric open habitation	Unevaluated	Out
42KA2121	Prehistoric campsite	Rcommended Not Eligible	Out
42KA2416	Prehistoric open habitation	Recommended Eligible	Out
42KA2676	Prehistoric artifact scatter	Determined Not Eligible	Out
42KA2677	Prehistoric lithic scatter	Recommended Not Eligible	In
42KA2678	Prehistoric lithic scatter	Recommended Not Eligible	In
42KA2417	Prehistoric campsite	Recommended Eligible	Out
42KA2712	Prehistoric lithic scatter	Recommended Eligible	Out
42KA2713	Prehistoric artifact scatter	Recommended Eligible	Out
42KA3279	Prehistoric room block	Recommended Eligible	Out
42KA3280	Prehistoric campsite	Unevaluated	Out
42KA3281	Prehistoric ground stone scatter	Recommended Not Eligible	Out
42KA3899	Prehistoric ground stone and fire-cracked rock (FCR) scatter	Recommended Eligible	Out
42KA3920	Prehistoric artifact scatter	Recommended Eligible	Out
42KA3921	Prehistoric village with artifact scatter	Recommended Eligible	Out
42KA3922	Prehistoric open habitation with artifact scatter	Recommended Eligible	Out
42KA3929	Prehistoric artifact scatter	Recommended Eligible	Out
42KA3930	Prehistoric open habitation with artifact scatter	Recommended Eligible	Out
42KA3931	Prehistoric ceramic scatter	Recommended Not Eligible	Out
42KA3932	Prehistoric lithic scatter	Recommended Not Eligible	Out
42KA5680	Prehistoric lithic scatter	Recommended Eligible	Out
42KA6178	Historic ditch	Determined Eligible	Out
42KA6243	Prehistoric campsite with artifact scatter	Determined Eligible	Out
42KA6244	Prehistoric campsite with artifact scatter	Determined Eligible	Out
42KA6245	Historic flood control ditch	Determined Eligible	Out

TABLE 2 PREVIOUSLY IDENTIFIED CULTURAL RESOURCE SITES WITHIN 0.5 MILE OF THE PROJECT AREA			
Site No.	**Description**	**Eligibility**	**In/Out***
42KA6331	Prehistoric lithic scatter	Recommended Eligible	In
42KA6332	Prehistoric lithic scatter	Recommended Eligible	In
42KA6460	Prehistoric artifact scatter	Determined Eligiible	Out
42KA7261	Prehistoric campsite	Recommended Eligible	Out
42KA7725	Historic check dams	Recommended Eligible	Out
***Note:** "In" indicates the site is located within the project APE (also in blue text); "Out" indicates the site is located outside the project APE			

Previously Recorded Historic Structures

Background research identified 7 historic structures within 0.5 mile of the Project area, none of which are located within or crossed by any portion of the Project APE. These historic structures are described below (**Table 3)**.

TABLE 3 PREVIOUSLY IDENTIFIED HISTORIC STRUCTURES WITHIN 0.5 MILE OF THE PROJECT AREA*						
Property ID	**Property Name**	**Date Constructed**	**Construction Type**	**Original Use**	**Eligibility**	**NRHP Status**
31067	Orderville LDS Chapel	Unknown	Church/ meetinghouse	Religious facility	Undetermined	Not Listed
32819	Orderville Rock School	1890		School	Eligible/ Contributing	Not Listed
33219	Virgin River Bridge (OD 689)	1932	Bridge	Road transportation related	Eligible/ Contributing	Not Listed
33220	Orderville Co-Op Buildings	1878	Mining—other (misc.)	Industrial (general)	Demolished	Not Listed
50442	Valley School	1935	Horizontal school	School	Eligible/ Significant	Listed
50442	Valley School	1936	Horizontal school	School	Eligible/ Significant	Listed
59437	N/A	1920	Central block with project bays	Single dwelling	Undetermined	Not Listed
***Note:** Data derived from the Utah Division of State History's Preservation Pro online database.						

General Land Office Maps

Historic General Land Office (GLO) maps and plats were also reviewed for the Project area and accessed through the BLM website on September 28, 2018. Original cadastral surveys for Township 40 South, Range 5 West (1877, 1914, and 1961); Township 40 South, Range 6 West (1877, 1936, and 1961); Township 40 South, Range 7 West (1877, 1896, 1937, 1944, 1961, and 1965); and Township 41 South, Range 7 West (1877, 1926, 1945, and 1965) were perused (BLM 2018). These surveys indicate few historic improvements near the Project area (**Table 4**), including historic roads, trails, ditches, telephone lines, homesteads, and coal mines.

The historic US-89 highway is located adjacent to the Project area, is greater than 50 years old, and has an alignment visible on the historic GLO maps. This historic road has been repaved, recontoured, and relocated since its original designation and, therefore, was not recorded as part of this Project.

TABLE 4
HISTORIC GENERAL LAND OFFICE MAPS

Date	Township	Range	Historic Features
1877	40 South	5 West	Road (*To Johnsonville and Kanab*)
1877	40 South	6 West	Road (*From Long Valley to Skum Pak*), trail
1896	40 South	7 West	Road (*Old Wood Road*)
1877	40 South	7 West	Townsite (*Glendale*), structures (*School House, Jannet Knight, Wm Johnson, Thds Smith*), roads (*Mill Race, County Road*), ditch
1937	40 South	7 West	Road (*State highway To Glendale*), ditch
1944	40 South	7 West	Road (*U. S. Highway No. 89 - To Orderville - To Glendale*), mines (*Foot Coal Mine, Coal Mine*), cultivated fields, fences, ditch, transmisiosn lines
1965	40 South	7 West	Highway ROW (*West R/W Line U.S. Highway 89*)
1877	41 South	7 West	Roads (*County Road*, unnamed), mines (*Coal, Coal, Coal*), townsite (*Mt. Carmel*), structures (*G.A. Hicks,* unnamed), ditch
1926	41 South	7 West	Townsite (*Mt. Carmel*), roads (*To Clear Cr. & Zion Canon, Mt. Carmel, Kanab, State Road Mt. Carmel to Kanab*), fence
1965	41 South	7 West	Roads (US-89), Structures (*Water Tank, Pump House,* unnamed), power line, canal, townsite (*Mt. Carmel*)

Paleontology

A paleontological review of the Project area was conducted by the Utah Geological Survey (UGS) on October 3, 2018. UGS determined that there are no paleontological localities recorded for the Project area and that Quaternary and recent alluvial deposits that are exposed in the borrow pit sites and over parts of the hydroplant and reservoir Project areas have a low potential for yielding significant fossil localities (PFYC 5).

In the Cove Reservoir, Orderville hydroplant, and Glendale hydroplant portions of the Project area there are also exposures of the Cretaceous Tropic Shale, Dakota and Straight Cliffs Formations that have a moderate to high potential for yielding significant fossil localities (PFYC 3 to 4). The UGS recommends awareness of potential impacts to paleontological resources if these Cretaceous deposits are disturbed. Otherwise, unless fossils are discovered as a result of construction activities, this Project should have no impact on paleontological resources. See **Appendix A** for the paleontological consultation letter and details.

SURVEY METHODS

The APE for the Project totals approximately 791.68 acres. Construction equipment will vary depending on what Project feature is being developed and will most likely consist of bulldozers, compactors, graders, loaders, track hoes, trailers, dump trucks, semi-trucks, concrete mixers, water trucks, pickup trucks, flatbed trailers, and other large construction equipment. Construction of the dam will require large earth-moving machinery, a portable gravel pit operation, and multiple personnel. Continued excavation and import of material to build the dam incrementally to its full height will require large machinery that will make continual trips between the reservoir and borrow sites as the dam is constructed.

The survey was conducted in 15-meter-wide transects throughout the Project area (**Figure 3**) for a total of approximately 791.68 acres surveyed. The survey was conducted in block surveys for the proposed reservoir, Glendale hydroplant, and five borrow pit locations (County Pit, Bald Knolls Community Pit, Bald Knolls Community Pit Expansion, Black Knoll Rip-Rap Pit, and Tait Pit); the survey was conducted in 15-meter-wide linear surveys for the proposed new pipeline and power line locations and the proposed road maintenance locations; and the survey was conducted in cursory "spot survey" for the remaining borrow pit (Lambs Pit). This resulted in approximately 791.68 acres surveyed.

No portion of the Project area was left unsurveyed due to prior survey efforts or difficult terrain; however, portions of the Project area in developed areas of Glendale along the proposed new pipeline were excluded from survey due to prior urban and/or agricultural disturbance (**Figure 4**). Additionally, sections of the proposed Cove Reservoir were excluded due to steep slopes (greater than 30 percent; **Figure 5**). However, these unsurveyed portions were spot checked for visible cultural resources.

IO locations were documented during the survey. New cultural resource sites identified during the survey were noted and then recorded after the survey was conducted for a more thorough review as necessary. These IOs and sites are discussed in the following *Survey Results* section. The Utah BLM's Digital Data Standards—May 2012 (BLM 2012) were adhered to at all times.



Figure 3. Project overview looking across proposed dam site from the southwest end of dam. View to the northeast.



Figure 4. Project overview showing area excluded from new survey. View to the south.



Figure 5. Overview of proposed Cove Reservoir with area excluded due to steep slopes. View to the southwest

SURVEY RESULTS

As a result of the survey, a total of 1 previously recorded site, 9 new sites, and 15 IOs were identified and recorded. Of the 41 previously recorded sites mapped within 0.5 mile of the Project area, 4 sites were determined to be either adjacent to or crossed by the Project APE and were searched for during field efforts. Additionally, modern bottles and cans, wire, plastic, fragments of milled lumber, and fences of undetermined age within the Project area were not recorded.

Survey conditions varied during the survey; several days had overcast skies, rain, and poor access road conditions due to muddy, clay soils that complicated the Class III survey. There were also a few days of sunny skies and comfortable fall temperatures. For most of the survey, ground visibility was excellent (averaging between 60–80 percent). No portion of the Project area was left unsurveyed due to severe terrain or other hazardous conditions.

Archaeological Sites

A total of 41 previously recorded sites have been mapped within 0.5 mile of the Project area. Of these sites, only four were determined to be either adjacent to or crossed by the Project APE: 42KA2677, 42KA2678, 42KA6331, and 42KA6332 (**Table 5**). Two of these sites (42KA2677 and 42KA2678) were last revisited in 2018 and were not relocated, and no attmpt was made to relocate these sites in 2019 and they are not further discussed in this report; the remaining two sites were searched for during field investigations (42KA6331, and 42KA6332) with one site being relocated in 2019 (42KA6331) and the other not relocated (42KA6332) and not further discussed in this report. The remaining 39 previously identified sites that were determined to be located outside the Project APE are not discussed further in this report.

As a result of the survey, a total of one previous site and nine new sites were identified and recorded within the Project APE (**Table 5**). Each of these new sites are discussed below, mapped in **Appendix C**, and further discussed in their respective Utah Archaeological Site Forms in **Appendix D**.

TABLE 5
CULTURAL RESOURCES IDENTIFIED WITHIN THE PROJECT APE

Site No.	Temp No.	Description	Eligibility Recommendation
42KA6331	FS-01	Prehistoric lithic scatter	Eligible – D
42KA8900	B-FS-01	Historic artifact scatter	Not Eligible
42KA8901	B-FS-02	Multicomponent: prehistoric lithic scatter; historic artifact scatters	Not Eligible
42KA8902	B-FS-03	Historic artifact scatter	Not Eligible
42KA8903	B-FS-04	Historic artifact scatter	Not Eligible
42KA8904	B-FS-05	Prehistoric artifact scatter	Eligible – D
42KA8972	FS-03	Prehistoric lithic scatter	Not Eligible
42KA8973	FS-02	Prehistoric artifact scatter	Not Eligible
42KA8974	FS-04	Prehistoric artifact scatter	Eligible – D

Previous Cultural Resource Sites

During the Class III survey, one previously reocrded cultural resource site was relocated and recorded within the project APE: 42KA6331. This site is described here and in **Appendix D**.

42KA6331

Site **42KA6331** is a previously recorded prehistoric lithic scatter on BLM-managed lands. The site was originally recorded in 2007 by the BLM GSENM and was determined Eligible for listing on the NRHP under Criterion D for information potential due to the unusual depositional context of the site's location; the site was evaluated under a Programmatic Agreement (Storm 2007). [REDACTED]

Based on the 2019 recording, Transcon concurs with the previous site evaluation and recommends that site 42KA6331 is Eligible for listing on the NRHP under Criterion D for information potential. Site 42KA6331 is located inside of the Project APE on BLM-managed lands; however, the project design team will ensure the proposed project disturbance will not impact the area around the site. Therefore, Transcon recommends the proposed Project will result in *No Adverse Effect to Historic Properties*. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.

New Cultural Resource Sites

During the Class III survey, nine new cultural resource sites were identified and recorded: 42KA8785 (NFS-01), 42KA8900 (B-FS-01), 42KA8901 (B-FS-02), 42KA8902 (B-FS-03), 42KA8903 (B-FS-04), 42KA8904 (B-FS-05), 42KA8972 (FS-02), 42KA8973 (FS-03), and 42KA8974 (FS-04). These new sites are described below and in **Appendix D**.

42KA8785

Site 42KA8785 (temporary site NFS-01) is a newly recorded expansive surface scatter of prehistoric artifacts. [REDACTED]

This site was recorded for the first time by Transcon archaeologists in 2019. [REDACTED]

Based on the 2019 recording, Transcon recommends site 42KA8785 is Eligible for listing on the NRHP under Criterion D for information potential. Site 42KA8785 is located inside the Project APE on privately-owned lands; however, the project design team will ensure the proposed project disturbance will avoid the site by at least 15 meters, utilizing the southern portion of the existing pit. Therefore, Transcon recommends the proposed Project will result in *No Adverse Effect to Historic Properties*. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.

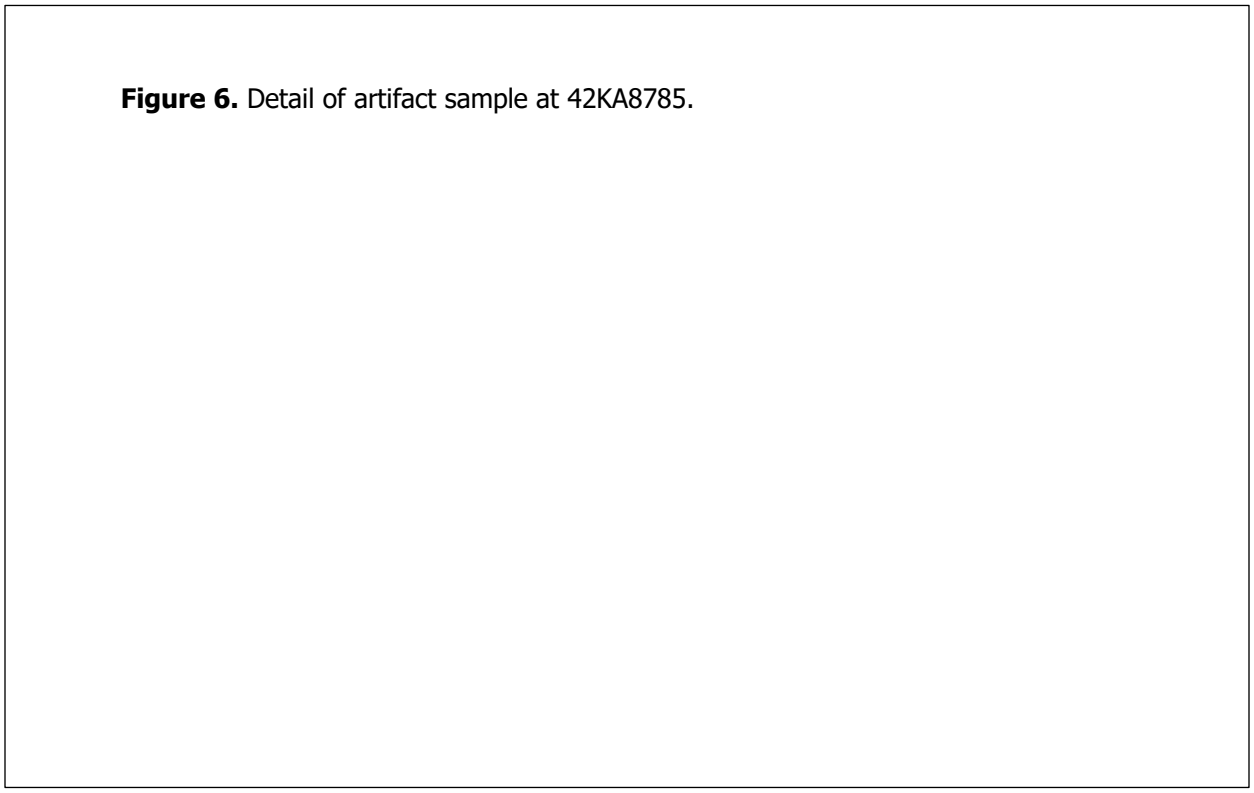

Figure 6. Detail of artifact sample at 42KA8785.

42KA8900

Site 42KA8900 (temporary number B-FS-01) is a relatively small, previously unrecorded historic artifact scatter. This site was identified and recorded for the first time by Transcon archaeologists in 2018. [REDACTED]

Based on the 2018 recording, Transcon recommends this site as Not Eligible for listing on the NRHP under any Criteria. As such, Transcon recommends that the proposed project would result in no historic properties affected.

42KA8901

Site 42KA8901 (temporary number B-FS-02) is a previously unrecorded multicomponent site located on privately-owned lands. This site was identified and recorded for the first time by Transcon archaeologists in 2018. [REDACTED]

Based on the 2018 recording, Transcon recommends this site as Not Eligible for listing on the NRHP under any Criteria. Transcon recommends the proposed project will result in no effect to historic properties.

Figure 7. Overview north of 42KA8901 showing artifacts actively being buried by the gravel pit.

42KA8902

Site 42KA8902 (temporary number B-FS-03) is a previously unrecorded historic artifact scatter. This site was identified and recorded for the first time by Transcon archaeologists in 2018. [REDACTED]

Based on the 2018 recording, Transcon recommends this site as Not Eligible for listing on the NRHP under any Criteria. Transcon recommends the proposed project will result in no effect to historic properties.

42KA8903

Site 42KA8903 (temporary number B-FS-04) is a previously unrecorded, large historic artifact scatter. This site was identified and recorded for the first time by Transcon archaeologists in 2018. [REDACTED]

Based on the 2018 recording, Transcon recommends this site as Not Eligible for listing on the NRHP under any Criteria. Transcon recommends the proposed project will result in no effect to historic properties.

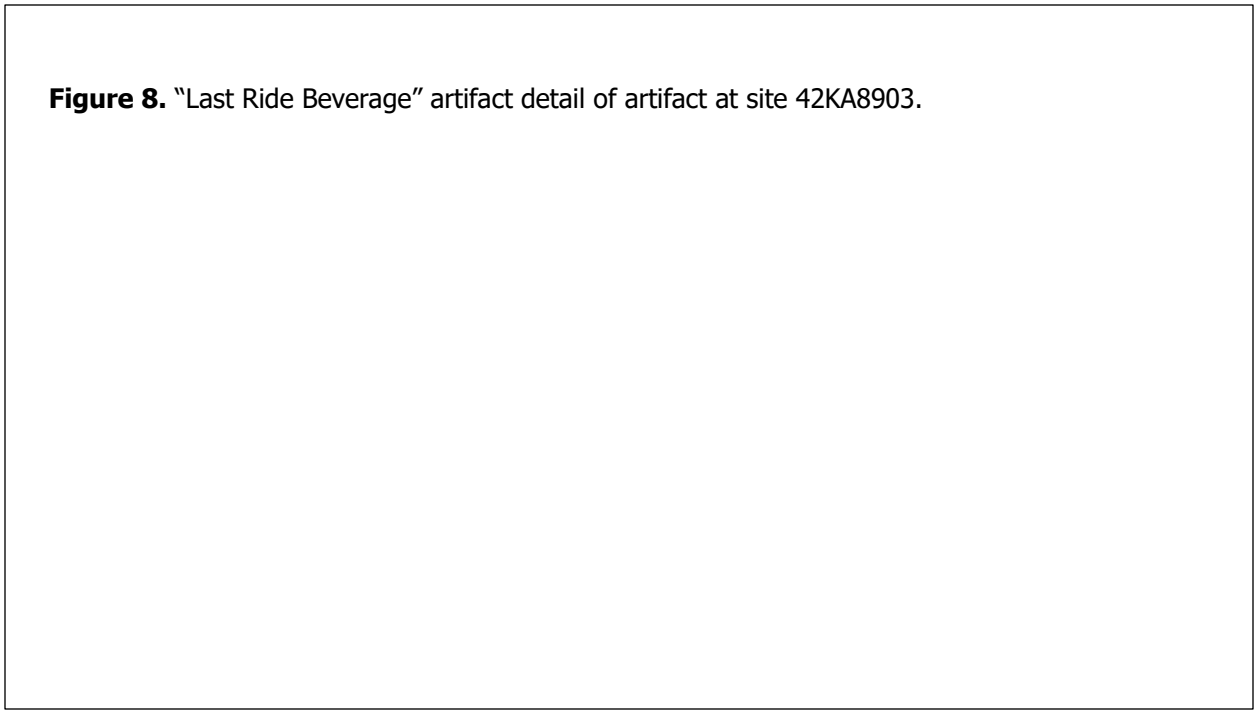

Figure 8. "Last Ride Beverage" artifact detail of artifact at site 42KA8903.

42KA8904

Site 42KA8904 (temporary number B-FS-05) is a previously unrecorded large prehistoric artifact scatter located on privately-owned lands (**Figure 9**). This site was identified and recorded for the first time by Transcon archaeologists in 2018. [REDACTED]

Based on the 2018 recording, Transcon recommends this site as Eligible for listing on the NRHP under Criterion D as there is a high potential for cultural depth at this site, due to the aeolian nature of the soil deposition; therefore, this site could possibly yield important information pertaining to the history or prehistory of the region. Site 42KA8904 is located outside of the Project APE on privately owned property that will not be purchased by KCWCD for the Project and thus will not be disturbed by construction of the reservoir or access roads. Therefore, Transcon recommends the proposed Project will result in *No Adverse Effect to Historic Properties*. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.

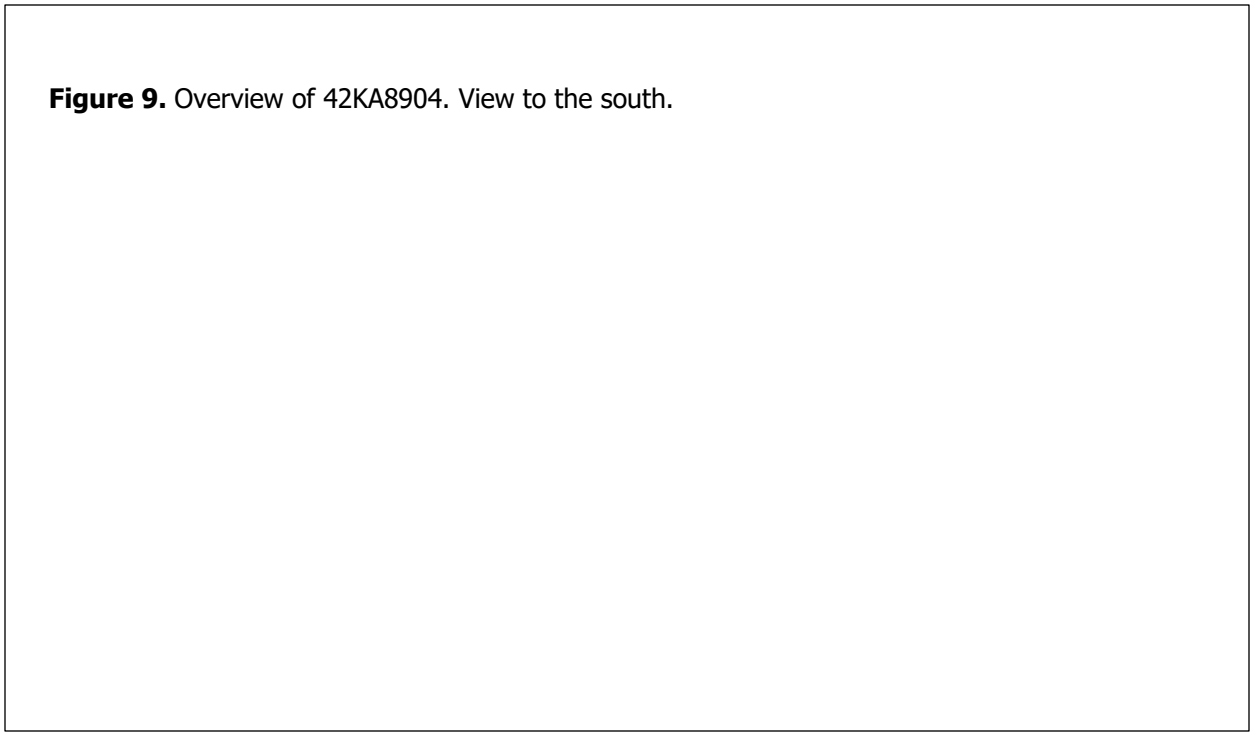

Figure 9. Overview of 42KA8904. View to the south.

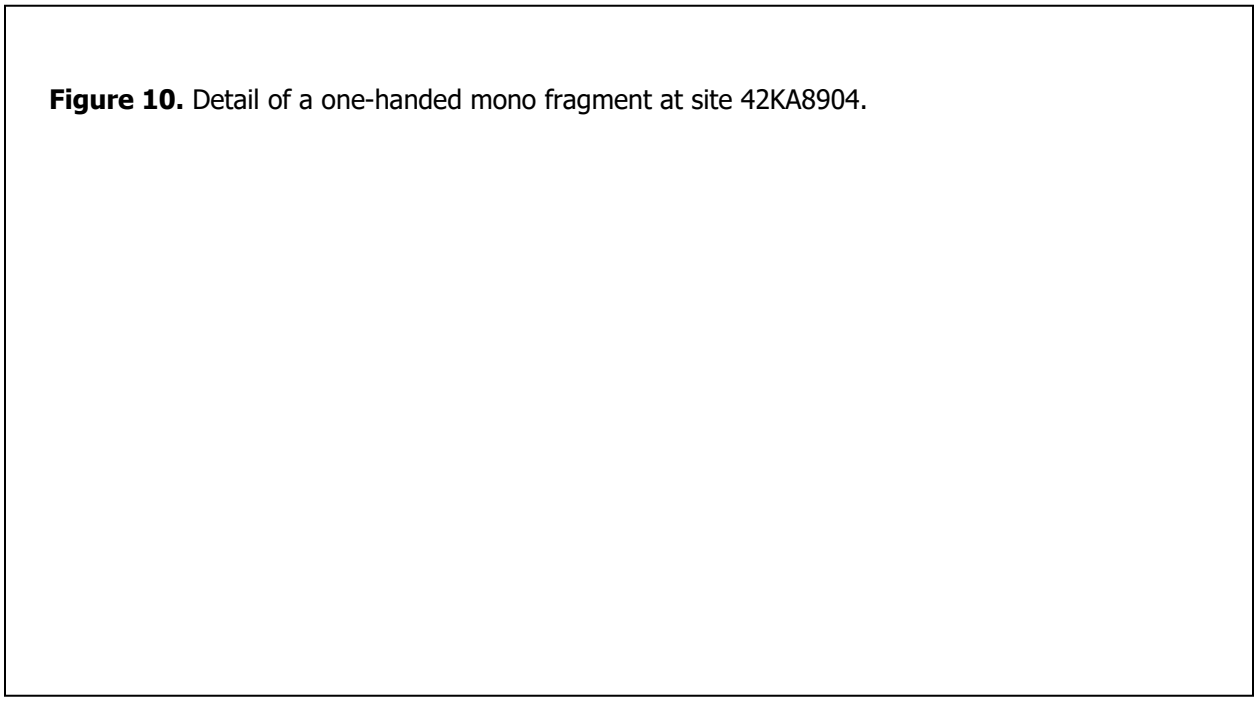

Figure 10. Detail of a one-handed mono fragment at site 42KA8904.

42KA8972

Site 42KA8972 (temporary number FS-03) is a newly recorded, small prehistoric artifact scatter located on BLM-managed lands. This site was identified and recorded for the first time by Transcon archaeologists in 2019. [REDACTED]

Based on the 2019 recording, Transcon recommends this site as Not Eligible for listing on the NRHP under any Criteria. Transcon recommends the proposed project will result in no effect to historic properties.

42KA8973

Site 42KA8973 (temporary number FS-02) is a newly recorded, small prehistoric artifact scatter located on BLM-managed lands. This site was identified and recorded for the first time by Transcon archaeologists in 2019. [REDACTED]

Based on the 2019 recording, Transcon recommends this site as Not Eligible for listing on the NRHP under any Criteria. Transcon recommends the proposed project will result in no effect to historic properties.

42KA8974

Site 42KA8974 (temporary site FS-04) is a newly recorded extensive prehistoric artifact scatter located on privately-owned lands. [REDACTED]

This site was recorded for the first time by Transcon archaeologists in 2019. [REDACTED]

Based on the 2019 recording, Transcon recommends this site as Eligible for listing on the NRHP under Criterion D for information potential. Site 42KA8974 is located inside of the Project APE on privately-owned lands; however, the project design team will ensure the proposed project disturbance will avoid the site by at least 15 meters, utilizing the southern portion of the existing pit. Therefore, Transcon recommends the proposed Project will result in *No Adverse Effect to Historic Properties*. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.

Figure 11. Overview of 42KA8974. View to the northeast overlooking Tait Pit.

Isolated Occurrences

During the Class III survey, a total of 15 IOs were identified and recorded (**Table 6**). Transcon recommends all 15 of these IOs are Not Eligible for listing on the NRHP under any Criteria. It should be noted that IO-05, five obsidian shatter pieces, was possibly previously illegally collected and dumped at its present locations, and may not be prehistoric occupation of the area. This IO was identified on the ground surface and very near site 42KA8903, which also contained evidence of modern dumping activities.

TABLE 6
NEWLY IDENTIFIED ISOLATED OCCURRENCES WITHIN THE PROJECT APE*

IO No.	Temporal Affiliation	Description	UTM - E	UTM - N
IO-01	Historic	Two historic coal/wood-burning stoves		
IO-02	Prehistoric	Two prehistoric whiteware ceramic sherds		
IO-03	Historic	One historic Chevy vehicle trunk lid (1966 Florida license plate)		
IO-04	Prehistoric	One prehistoric white ware sherd		
IO-05	Prehistoric	Five prehistoric obsidian shatter pieces (three snowflake obsidian, one mahogany, and one black)		
IO-06	Prehistoric	One white chert tertiary flake		
IO-07	Prehistoric	Three white chert tertiary flakes and one brown quartzite flake		
IO-08	Prehistoric	Prehistoric ceramic fragment; grayware with wite slip		
IO-09	Prehistoric	Prehistoric ceramic fragment; grayware with wite slip		

TABLE 6 NEWLY IDENTIFIED ISOLATED OCCURRENCES WITHIN THE PROJECT APE*				
IO No.	**Temporal Affiliation**	**Description**	**UTM - E**	**UTM - N**
IO-10	Prehistoric	Prehistoric ceramic fragment; grayware with wite slip		
IO-11	Historic	Historic farming equipment (plow)		
IO-12	Prehistoric	Prehistoric ceramic fragment; grayware		
IO-13	Prehistoric	Prehistoric ceramic fragment; grayware with wite slip		
IO-14	Prehistoric	One prehistoric chert core, one brown chert ertiary flake, one gray quartzite flake, one hammerstone (10cm long by 7.7cm wide by 4.8cm thick), one piece of FCR, and four grayware ceramic fragments (one with wite slip)		
IO-15	Prehistoric	Four chert tertiary flakes (gray and brown) and four ceramic fragments (two grayware and one brownware)		
***Note:** UTM coordinates provided in NAD'83 Zone 12; "E" represents Easting and "N" represents Northing.				

SURVEY SUMMARY AND RESULTS

Transcon archaeologists conducted a Class III cultural resources survey of approximately 791.68 acres of BLM, SITLA, and privately-owned lands near Glendale and Orderville, in Kane County, Utah. The Project area generally parallels US-89 to the west, with the exception of Bald Knolls Community Pit, Bald Knolls Community Pit Expansion, and Black Knoll Rip-Rap Pit, which is accessed from Glendale Bench Road in Glendale. This investigation was requested by the NRCS and the KCWCD to determine if any significant cultural resources, which could be affected by the proposed undertaking, were present within the Project area. Important cultural resources may include historic or prehistoric archaeological sites or objects; historically or architecturally significant structures, buildings, or landscapes; and Traditional Cultural Properties which are NRHP-Eligible.

The cultural resources survey was completed between October 1–8 and October 10–15, 2018, and between June 12 through14, July 10, and September 19, 2019, for a total of 32 person-days of survey. As a result of the survey, 1 previously recorded cultural resource site, 9 new cultural resource sites, and 15 IOs are located within the Project APE (**Table 7**). There were no previously identified historic structures or historic developments located within the Project APE.

TABLE 7
CONCLUSIONS AND RECOMMENDATIONS

Site Number	Site Description	Eligibility	Effects
42KA6331	Prehistoric lithic scatter	Eligible—D	*No Adverse Effect to Historic Properties* if the site is avoided. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.
42KA8785	Prehistoric artifact scatter	Eligible – D	*No Adverse Effect to Historic Properties* if the site is avoided. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.
42KA8900	Historic artifact scatter	Not Eligible	No Effects
42KA8901	Multicomponent: prehistoric lithic scatter, historic artifact scatters	Not Eligible	No Effects
42KA8902	Historic artifact scatter	Not Eligible	No Effects
42KA8093	Historic artifact scatter	Not Eligible	No Effects
42KA8904	Prehistoric ceramic, lithic, and FCR scatter	Eligible—D	*No Adverse Effect to Historic Properties* if the site is avoided. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.
42KA8972	Prehistoric lithic scatter	Not Eligible	No Effects
42KA8973	Prehistoric artifact scatter	Not Eligible	No Effects
42KA8974	Prehistoric artifact scatter	Eligible—D	*No Adverse Effect to Historic Properties* if the site is avoided. Should any future project-related activities occur within 15 meters of the site, a cultural resources monitor must be present.

Of the 10 sites identified within the Project APE, 4 are recommended Eligible for listing on the NRHP under Criterion D for their information potential: 42KA6331, 42KA8785, 42KA8904, and 42KA8974. The remaining 6 sites and all 15 IOs are recommended Not Eligible for listing under any Criteria (**Table 7**).

If the site avoidance recommendations are followed, implementation of the Project would result in *No Adverse Effect to Historic Properties*. If any previously undetected or unreported cultural features or deposits are encountered during future Project-related activities, these activities must be discontinued in the immediate area of the feature(s) and an NRCS archaeologist, BLM archaeologist, or SITLA archaeologist, where appropriate, must be consulted to evaluate their nature and significance.

This cultural resource survey and resulting report were completed as part of those studies and were conducted in compliance with Section 106 of the NHPA of 1966, as amended. The NRCS Utah State Office served as the lead federal agency.

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APPENDIX A

PROJECT CORRESPONDENCE

APPENDIX B

PROJECT BACKGROUND RESEARCH MAPS

APPENDIX C

PROJECT RESULTS MAPS

APPENDIX D

UTAH ARCHAEOLOGICAL SITE FORMS

(November 2015) **BUREAU OF LAND MANAGEMENT**

Summary Report of Cultural Resources Inspection

PROJECT NUMBER: U21TN0840

Report Title: ***Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah***

1. Report Date: April 2021
2. Date(s) of Survey: November 15 to 19, 2021 and March 20, 2022
3. Development Company: Alpha Engineering, for the Natural Resources Conservancy District and Kane County Water Conservancy District
4. Responsible Institution: Transcon Environmental, Inc.
5. Principal Investigator: Jennifer Bannick
6. BLM Field Office: Kanab Field Office
7. County(ies): Kane County, Utah
8. NEPA Number: *TBD*
9. Fieldwork Location:
   USGS Map: Mount Carmel and Orderville, Utah
   Township 41 South Range 7 West Sections 8, 9, 17, 18, and 19

10. Description of the Undertaking (including the Area of Potential Effects):
The Natural Resources Conservation Service (NRCS) and Kane County Water Conservancy District (KCWCD) are proposing the addition of a pipeline to their *Cove Reservoir Project* (U18TN0544), which originally consisted of a reservoir and associated facilities. The original U18TN0544 Class III inventory was conducted in October of 2018. The additional pipeline is being completed as *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement (EIS), Kane County, Utah—Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah* (Addendum Project; Utah Antiquities Project Number U21TN0840). This addendum and supplemental inventory area are the result of a change in project complexity, changing from an Environmental Assessment to an EIS.

The supplemental inventory area is generally located within an existing Utah Department of Transportation (UDOT) highway right-of-way (ROW) on the eastern side of US-89 (State Street), along portions of Center Street and Cottonwood Lane to the east of US-89, and within agricultural fields and unnamed dirt roads that cross sections of Tait Lane, West 2500 South (Lambs Lane), Stevens Lane, and Muddy Creek Road on the western side of US-89 (State Street) within the town of Mount Carmel in Long Valley, Kane County, Utah. The Addendum Project crosses 0.02 mile (0.11 acre) of Bureau of Land Management (BML) Kanab Field Office-managed lands, 0.01 mile (0.01 acre) of School and Institutional Trust Land Administration (SITLA)-managed lands, and 11.47 miles (68.71 acres) of privately owned lands (survey) for a total Project area that is 9.06 miles (68.83 acres) in length. The inventory was linear and conducted in 15-meter-wide transects throughout the Project area. No portion of the Project was left unsurveyed due to prior survey efforts.

The proposed Addendum Project alignment totals approximately 9.06 miles in length and is located within portions of Township 41 South, Range 7 West, Sections 8, 9, 17, 18, and 19 of the Salt Lake Baseline and Meridian. The Project crosses the Mount Carmel and Orderville, Utah 7.5-minute U.S. Geological Survey (USGS) topographic quadrangle maps (**Appendix A***, Project Results Maps*).

The Addendum Project *Area of Potential Effects* (APE) totals 9.06 miles (68.83 acres) in length in Kane County, Utah. Throughout the addendum Project area, for a total of 9.06 miles (47,836 feet), a new pipeline will be placed as part of

improvements associated with the proposed Cove Reservoir which would be located immediately southwest of the town of Orderville, Utah. A 25-foot temporary ROW will be required on established roads to accommodate equipment during construction. To account for flexibility in design, a survey corridor of 15 meters (approximately 50 feet) was evaluated. This results in a horizontal APE of 15 meters (50 feet) and a linear APE of 47,836 feet (9.06 miles), resulting in a total of 68.83 acres evaluated for cultural resources.

In support of the NRCS and KCWCD, Alpha Engineering retained Transcon Environmental, Inc. (Transcon) to conduct a cultural resources evaluation. The cultural resources inventory and this resulting report have been completed as part of that evaluation and were conducted in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended. The NRCS served as the lead agency on both the original and Addendum Project. The Class III inventory was conducted under a BLM Kanab Field Office fieldwork authorization (FWA) dated November 08, 2021, a SITLA FWA dated November 04, 2021, and a UDOT FWA dated November 04, 2021. A desktop literature review was conducted for the proposed Project area on October 18, 2021, and a Class III (intensive pedestrian) and Class II (reconnaissance) cultural resources inventory was conducted between November 15 to 19, 2021 and on March 20, 2022, for a total of 11 person-days of fieldwork. Jennifer Bannick and Lindsey M. Evenson served as Principal Investigators and Jennifer L. Bannick served as Field Director and report author.

11. Location(s) and Date(s) of Literature Review:

1. Field Office: N/A
2. Utah Division of State History/Sego: October 18, 2021
3. Historic Records and Maps: October 18, 2021
4. Satellite imagery: October 18, 2021

12. Results of Literature Review (½ mile buffer):

On October 18, 2021, records on file with the Utah Division of State History (UDSH) were checked prior to the commencement of fieldwork to determine whether previously identified cultural resources were present or if any previously reported archaeological investigations had been conducted within 0.5 mile of the proposed Project alignment (UDSH 2021a). The results of this background research are presented in **Appendix B**, *Results of Literature Review*. The results of this literature review indicate there are a total of 16 previously conducted cultural resource surveys (**Table B-1**, *Previous Cultural Surveys Within 0.5 Mile of the Project Area*) and 15 previously recorded cultural resource sites (**Table B-2**, *Previously Identified Cultural Resource Sites Within 0.5 Mile of the Project Area*) within 0.5 mile of the Project area. Of these, 6 previous surveys and 4 previously identified sites were mapped as overlapping, being immediately adjacent, or being crossed by some portion of the current Project APE.

Previously Conducted Cultural Resource Surveys

Background research identified 16 previously conducted cultural resource surveys within 0.5 mile of the Project area (**Appendix B**, *Results of Literature Review*). Of these, 6 previous cultural surveys cross into or overlap some portion of the Project APE, and 2 of these surveys were conducted within the past 10 years. These recent surveys (U14HO0043 and U17HO0675) were conducted for a wastewater system upgrade and a highway improvement project. The remaining surveys consist of surveys for sewer improvement, agricultural trespass, seeding, gravel, bridge replacement, watershed, and wildlife habitat improvement surveys. The surveys mapped within or adjacent to the Project APE are detailed in **Table B-1**, *Previous Cultural Surveys within 0.5 Mile of the Project Area*. No portion of the current Project was left unsurveyed due to prior survey efforts.

Previously Recorded Cultural Resource Sites

Background research identified 15 previously recorded cultural resources within 0.5 mile of the Project area; these previously recorded sites are detailed in **Table B-2**, *Previously Recorded Cultural Resource Sites within 0.5 Mile of the Project Area.* Of these, four sites were mapped within or adjacent to the Project APE during the literature review. These cultural resources consist of a two prehistoric artifact scatters (42KA1157 and 42KA1965), a historic bridge abutment (42KA4538), and a historic ditch (42KA4539). During the literature review, it was noted that previous sites 42KA1157, 42KA1958, and 42KA1965 were found to be the same site. Additionally, during the Class III inventory, previous sites 42KA4538 and 42KA4539 were relocated outside of the current Project APE.

Historic Document Review

In addition to the Sego literature review (described above), Transcon consulted a number of historic documents and records, including BLM land records (e.g., historic General Land Office [GLO] records, land patents, mining records, grazing records, Master Title Plat records, etc.), the Utah State Historic Preservation Office's historic contexts, individual BLM field office predictive models (if available) and Class I documents (if available), water rights, Sanborn maps, and Utah Division of Water Rights (UDWR) records (BLM 2021a, 2021b, 2021c, 2021d, 2021e; LOC 2021; UDSH 2021a, 2021b; UDWR

2021). The GLO records, land patents, grazing records, and water rights records yielded historic resources in or very near to the Project area (see General Land Office Maps, Land Patent Records, Grazing Allotment Records, and Water Rights Records sections below).

General Land Office Maps

Historic GLO maps and plats were reviewed for the Project area and accessed through the BLM website on October 18, 2021. Original cadastral surveys for Township 41 South, Range 7 West (1877, 1926, 1945, and 1965) were perused (BLM 2021a). These surveys indicate a few historic improvements near the Project area including historic roads, ditches, transmission lines, ditches, fences, structures, agricultural fields, and a coal mine (see **Table 1**, *Historic General Land Office Maps*, below).

TABLE 1
HISTORIC GENERAL LAND OFFICE MAPS

Date	Township	Range	Historic Features near the Project Area
1877	41 South	7 West	Roads (*County Road*, unnamed), structures (*Sawmill, JW Reed, Ruf Jolly, Wm Jolly,G.A. Hicks*, unnamed residences), unnamed ditches, fence lines, cultivated fields (*Fiddlers Green*, unnamed), town (*Mount. Carmel*)
1926	41 South	7 West	Roads (Old Road, Mount. *Carmel to Kanab*, unnamed), town (Mount *Carmel*), ditch (*Irrigation Ditch*) structures (*Diversion Dam,* unnamed residences), transmission lines (*Telephone Line Orderville to Mount Carmel,* unnamed)
1945	41 South	7 West	Road (*To Mount Carmel, Utah*), structure (*Coal Mine*), transmission line
1965	41 South	7 West	Roads (*US-89*, unnamed), transmission lines (*Power Line, Telephone Line*), structures (*Pump House, Water Tank, Flume, Coal, Barn,* unnamed residences), town (*Mount. Carmel*), canal

Additional historic maps were accessed from both the USGS TopoView topographic map viewer created by the National Geologic Map Database Project and the Utah Geological Survey Aerial Imagery Collection (DNR 2021; USGS 2021a, 2021b). Historic aerial imagery in the vicinity of the Project indicates a few visible historic developments, including established roads/highways, ditches, and cultivated fields. Portions of the historic County Road system may be the same as (or adjacent to) the present alignment of US-89 (DNR 2021).

Land Patent Records

Historic land patent records within the Project area were also reviewed and accessed through the BLM website on October 18, 2021. These historic resources indicate 22 land patents near the Project area, with dates ranging from 1880 to 1980. These include Thomas W. Blackburn (4/5/1928; 6/5/1928), Henry W. Esplin (5/10/1884), William J. Jolley (11/15/1881), Francis L. Porter (5/10/1884), Kirsten Sorensen (2/13/1899), Christena Heaton (3/9/1927), William A. Bringhurst (5/15/1880), Rasmus M. Engelstad (8/1/1883), Silas Hoyt (10/1/1880), Lorene C. and Sharon C. Lamb (7/30/1980), Utah State (6/16/1924; 4/13/1965), Henry B.M. Jolley (10/1/1880), Edward T. Lamb (6/16/1931) Robert Moncur (7/18/1898), Earl J. Sorensen (2/5/1931), David W.P. Stevens (11/10/1930; 2/12/1931), Ezra W. Stevens (8/12/1918), Alfred Misner (3/28/1905), and Hans C. Sorensen (9/21/1916) (BLM 2021b).

Grazing Allotment Records

Historic grazing allotment records within the Project area were also reviewed and accessed through the BLM website on October 18, 2021. This resource indicated seven active grazing allotments surrounding the Project area; however, none cross into or overlap any portion of the Project APE: the Gardner Hollow Allotment (UT24049) is located to the north of the APE; the Spring Hollow Allotment (UT04151) and Glendale Bench Allotment (UT24051) are to northeast of the APE; the Red Hollow Allotment (UT 14097) and the Sugar Knoll Allotment (UT 04117) are to the east and southeast of the APE; the Carmel Junction Allotment (UT 24021) is south of the APE, and the Zion Allotment (UT 04138) encompasses a large area west of the APE and the town of Mount Carmel. There are no dates associated with this data to indicate if these are historic allotments (BLM 2021e).

Water Rights Records

Historic water rights records within the Project area were reviewed and accessed through the UDWR records website on October 18, 2021. These historic resources indicate that there are 10 historic water rights within 0.5 mile of the Project APE consisting of underground water sources (underground water wells), and surface water rights with sources from springs (Fiddlers Green Spring No. 1, Fiddlers Green Spring No. 2, Fiddlers Green Spring No. 3, Mount Carmel Springs, Spring

Hollow Spring, and Hard Pan Spring), and the East Fork Virgin River. Historic water rights that may be within the Project APE include 81-4346 (Diversion/Return from East Fork Virgin River, Kane County Water Conservancy District, 2000), 81-1133 (Mount Carmel Springs, Town of Orderville, 1870) and 81-1141 (Surface, East Fork Virgin River [Long Valley], Mount. Carmel Irrigation Company, 1865) (UDWR 2021).

Summary and Expectations
Based on the results of the record search, it was anticipated that three previous sites may be located within or immediately adjacent to the project APE in the new survey area; however, it was understood that the sites' previous recordings were old/outdated and had poor location information and, as a result, might not be relocated in the project APE.

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13. Description of Field Methods:
The survey was conducted in 15-meter-wide transects throughout the entire Project APE. This resulted in a total of approximately 68.83 acres evaluated for cultural resources. No portion of the current Project was left unsurveyed due to prior survey efforts. A total of 48.66 acres were surveyed to Class III standards; some fenced off and inaccessible areas on private property with posted no trespassing signs within the APE (20.17 acres) were surveyed to Class II standards due to safety and trespassing concerns (**Table 2**, *Total Survey Area*).

Isolated occurrence (IO) locations were documented during the survey. Previously identified cultural resource sites identified during the survey had locations noted, revisited, and recorded/updated after the survey was conducted for a more thorough review and to update site documentation, as necessary. These sites and IOs are discussed below in **Table 3**, *Total Sites Recorded*, **Appendix C***, Cultural Resource Sites Within the Project APE*, and **Appendix D**, *Newly Identified Isolated Occurrences within the Project APE*. The Cultural Resource Fieldwork Guidelines and Standards BLM Supplement H-8110—Utah—February 2021 and the Utah SHPO & Antiquities Section Archaeological Compliance Guidance—June 2020 were adhered to at all times during fieldwork (BLM 2021f; UDSH 2021c).

14. Area Surveyed:
Table 2, *Total Survey Area,* below, indicates the total acreage per landowner surveyed to Class I and III standards within the entire Project area.

TABLE 2
TOTAL SURVEY AREA

	BLM	SITLA	Private	UDOT	TOTAL
Project Mileage	0.02	0.00	9.04	0.00	**9.06**
Class II Survey Mileage*	0.00	0.01	3.37	0.00	**3.38**
Class III Survey Mileage*	0.02	0.00	8.10	0.00	**8.12**
Class II Acreage	0.00	0.01	20.16	0.00	**20.17**
Class III Acreage	0.11	0.00	48.55	0.00	**48.66**
Total Survey Mileage	**0.02**	**0.01**	**11.47**	**0.00**	**11.50**
Total Project Acreage	**0.11**	**0.01**	**68.71**	**0.00**	**68.83**

* Survey mileage based on 15m wide transects (Acres * 0.167).

15. Sites Recorded:
Of the four previously recorded sites mapped within the Project APE, previous sites 42KA1157 and 42KA1965 were found to be the same site during the literature review (and also found to include site 42KA1958 which was not plotted in Sego but listed on previous site maps and reports). Additionally, during the Class III inventory sites 42KA4538 and 42KA4539 were relocated outside of the current Project APE (**Table 3**, *Total Sites Recorded*). The two remaining previously recorded sites (42KA4538 and 42KA4539) mapped within the APE were relocated outside of the current Project APE during the Class III inventory. Although these sites were not relocated in the current Project APE, updated Utah Archaeology Site Forms (UASF) were prepared, however GIS data was not updated. Additionally, four new sites (42KA9490, 42KA9491, 42KA9492, and 42KA9493) were identified and documented during survey. Updated and new UASFs have been prepared for sites 42KA1157 (also 42KA1965/42KA1958), 42KA4538, 42KA4539, 42KA9490, 42KA9491, 42KA9492, and 42KA9493.

TABLE 3 TOTAL SITES RECORDED*										
		BLM		State		Private		Tribal		Total
		#	Site No.	#	Site No.	#	Site No.	#	Site No.	
Revisits *Updated*	Eligible	0		0		1	42KA1157*	0		1
	Not Eligible	0		0		2	42KA4538* 42KA4539*	0		2
Revisits *Not Updated*	Eligible	0		0		0		0		0
	Not Eligible	0		0		0		0		0
Newly Recorded	Eligible	1	42KA9491*	0		1	42KA9490	0		2
	Not Eligible	0		0		2	42KA9492 42KA9493	0		2
TOTAL		**1**		**0**		**6**		**0**		**7**
*Note: Site 42KA9491 is located mostly on privately owned land with a small portion of the site alignment on BLM land; site 42KA1157 is also sites 42KA1965 and 42KA1958; sites 42KA4538 and 42KA4539 were relocated outside of the current Project APE.										

16. Individual Site Descriptions and Determinations of Eligibility and Effect:
There is one previously recorded site, 42KA1157 (also 42KA1965 and 42KA1958), and four newly recorded sites (42KA9490, 42KA9491, 42KA9492, 42KA9493) within the Project APE; additionally, two previously recorded sites (42KA4538 and 42KA4539) were mapped within but relocated outside of the current Project APE. These sites are described in detail in **Appendix C***, Cultural Resource Sites Within the Project APE*. Of these sites, one is recommended Eligible for listing on the National Register of Historic Places (NRHP) under Criterion D (42KA1157), one site is recommended Eligible for the NRHP under Criteria A and D (42KA9491), one site is recommended Eligible for the NRHP under Criteria A, C, and D (42KA9490), and four sites are recommended Not Eligible for the NRHP under any Criteria (42KA4538, 42KA4539, 42KA9492, and 42KA9493).

17. Isolated Occurrences:
Three IOs were identified and recorded within the Project APE during the Class III inventory. These IOs are individually described and photographed below, and mapped in **Appendix A**, *Project Results Maps*. All three IOs are recommended Not Eligible for listing on the NRHP under any Criteria.

IO-01
IO-01 is a historic monument erected in 1995 to commemorate the settlement of Long Valley and Orderville, and the early pioneers. The monument is an obelisk constructed from concrete with river cobbles pressed into the surface measuring 7.5-feet-high, by 52-inches-square, and located on top of a 20-foot square concrete pad (**Figure 1**).

IO-02
IO-02 is an unnamed historic road segment that appears on the 1879 GLO maps. The road segment dates from 1879 or earlier and consists of a barren path that is between 15 to 18 feet wide, covered in natural cobbles. It is not modified from its historic format, has no prepared foundation or ditches, but does have a natural drainage to the east that flows parallel to the road (**Figure 2**).

IO-03
IO-03 is a wagon yoke measuring about 42 inches long by 7 inches at the widest. The tongue is a narrow juniper post tapering from 3 inches in diameter down to 2 inches in diameter and 28 inches long. The wagon yoke ends in a loop of commercially formed sheet metal riveted through the post and is bound to a 4-inch steel ring, which is connected to two large eye bolts with oval split-rings. The eye bolts are set into two rusted steel plates, which likely reinforced a piece of wood. One eye bolt is a modern style made from formed steel rod and the other is an older forged or cast design. **Figure 3**).

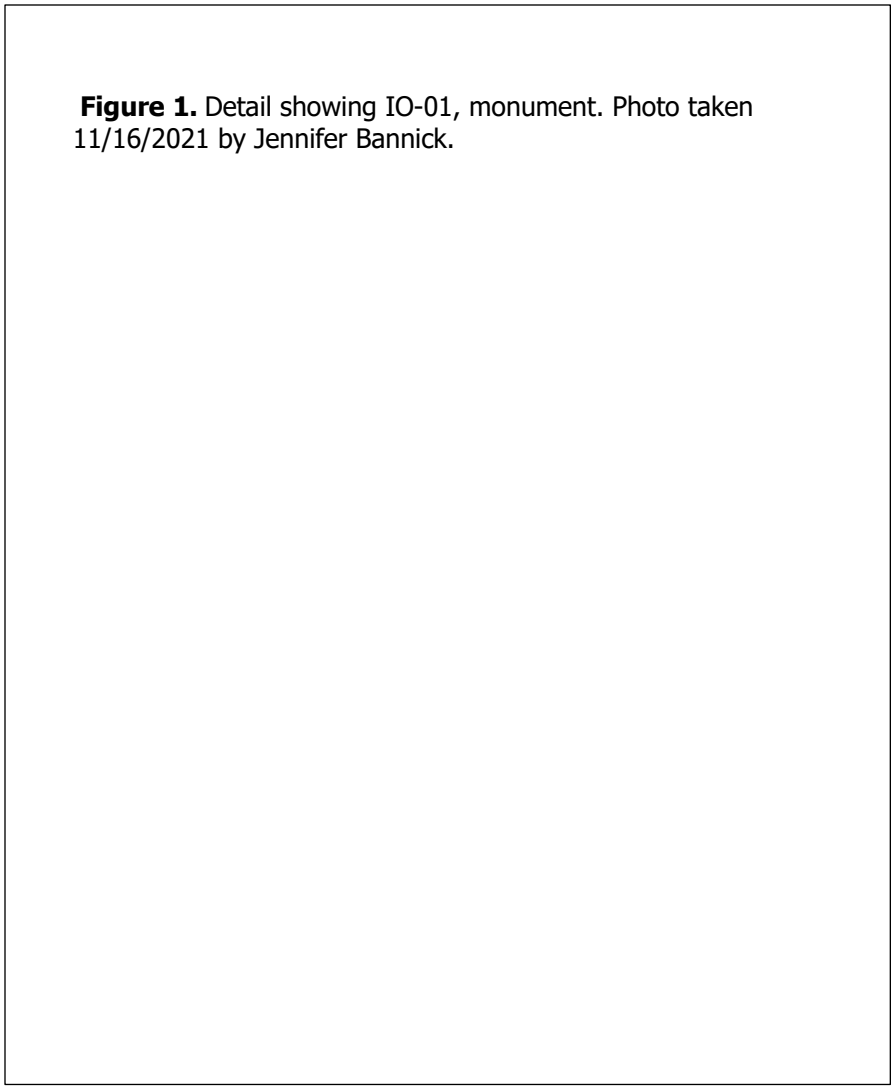

Figure 1. Detail showing IO-01, monument. Photo taken 11/16/2021 by Jennifer Bannick.

Figure 2. Overview showing IO-02, historic road. View to the north. Photo taken 11/18/2021 by Aaron Larsen.

Figure 3. Detail showing IO-03 wagon yoke. Photo taken 11/18/2021 by Aaron Larsen.

18. Summary of Findings:

As a result of the Class III inventory, it was determined that a total of five cultural resource sites (one previously identified and four newly recorded) are located within or crossed by the Project APE (42KA1157, 42KA9490, 42KA9491, 42KA9492 42KA9493). Updated UASFs have been prepared for the previously recorded site identified within the Project APE during

new survey (42KA1157 [also 42KA1965/42KA1958]) and for two previously recorded site that were mapped within the current Project APE but relocated outside of the APE (42KA4538 and 42KA4539); additionally, Transcon identified four new cultural resource sites as a result of this survey (42KA9490, 42KA9491, 42KA9492, and 42KA9493). Three IOs (IO-01to IO-03) were also identified and recorded within the Project APE as a result of new survey. Modern debris was also noted but not recorded at various places within the Project area, as it appears to have originated from modern transportation and recreational activities.

Survey conditions were good, consisting of sunny to clouded or partially clouded skies and cool temperatures. For most of the survey, ground visibility was fair to excellent, ranging between 40 to 80 percent or greater (**Figures 4**, **5**, **6** and **7**). Of the five cultural resource sites identified within the Project APE during new survey, one previously recorded site (42KA1157 [also 42KA1965/42KA1958]) is recommended Eligible for listing on the NRHP under Criterion D; one site is recommended Eligible for the NRHP under Criteria A and D (42KA9491), one site is recommended Eligible for the NRHP under Criteria A, C, and D (42KA9490), and two sites (42KA9492 and 42KA9493) are recommended Not Eligible for the NRHP under any Criteria. Additionally, two previously recorded mapped in but located outside of the current Project APE (42KA4538 and 42KA4539) and three IOs are recommended Not Eligible for the NRHP under any Criteria.

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19. Collection Yes___ No _X_

(If Yes) Curation Facility: N/A Accession Number(s): N/A

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20. Conclusion/Recommendation of Effect:
Transcon archaeologists conducted a Class II/III cultural resources inventory of 0.02 mile on BLM-managed lands, 0.01 mile on SITLA-managed land, and 11.47 miles on privately owned lands (survey) in a total Project area that is 9.06 miles in length within the town of Mount Carmel in Long Valley, Kane County, Utah. The Class II/III cultural resources survey was completed between November 15 and 19, 2021, and on March 20, 2022. This investigation was requested by Alpha Engineering, in support of the NRCS and KCWCD, to determine if any significant cultural resources which could be affected by the proposed undertaking were present within the Project area.

As a result of the survey, it was determined that a total of five cultural resource sites are located within the Project APE (see **Appendix C***, Cultural Resource Sites Within the Project APE*, for details). Of the five sites identified within the Project APE, one previously recorded site (42KA1157 [also 42KA1965/42KA1958]) is recommended Eligible for listing on the NRHP under Criterion D for information potential; two sites are recommended Eligible for the NRHP under Criteria A and D (42KA9490 and 42KA9491) for their association with significant regional events and for information potential; site 42KA9490 is also recommended to be Eligible for listing on the NRHP under Criterion C as it embodies the distinctive characteristics of a type, period, and method of construction in the region; the remaining sites (42KA9492 and 42KA9493) are recommended Not Eligible for the NRHP under any Criteria. Additionally, two sites that were previously determined Not Eligible for the NRHP were mapped within but relocated outside of the current Project APE (42KA4538 and 42KA4539).

Transcon recommends that the Project will result in *No Adverse Effects to Historic Properties*. At one Eligible site location within the Project APE, (42KA1157 [also 42KA1965/42KA1958]) the site area has been bisected and heavily disturbed by the construction and maintenance of US-89. It is partially located in an agricultural field with evidence of livestock trampling and past plowing within the field. There is an existing pipeline cutting through the site area, and the site area on the eastern side of US-89 has been previously tested (see 2021 UASF) and all elements of the site are non-contributing to the overall eligibility of the site within the current Project APE.

For the two additional Eligible sites within the Project area (42KA9490 and 42KA9491), an inadvertent discovery plan should be prepared, and a Historic Properties Treatment Plan (HPTP) should be developed to mitigate adverse effects to the sites (**Table 4**, *Project Summary and Conclusions*).

If any previously undetected or unreported cultural features or deposits are encountered during future project-related activities, these activities must be discontinued in the immediate area of the feature(s), and a BLM archaeologist (or UDOT archaeologist, where appropriate) must be consulted to evaluate their nature and significance.

TABLE 4 PROJECT SUMMARY AND CONCLUSIONS					
Site No.	**Temporal Affiliation**	**Site Description**	**Eligibility**	**Effects**	**Site Protective or Avoidance Measures**
42KA1157	Prehistoric	Prehistoric artifact scatter	Eligible—D	*No Adverse Effect*	None; the portion of the site within the Project APE is heavily disturbed by previous road construction/maintenance, plowing, livestock and a sewer line, it has also been previously tested and is non-contributing to the overall eligibility of the site.
42KA4538	Historic	Historic bridge abutment	Not Eligible	No effect	N/A; also, outside of the current Project APE.
42KA4539	Historic	Historic ditch/ flume	Not Eligible	No effect	N/A; also, outside of the current Project APE.
42KA9490 (FS-01)	Historic	Historic ditch (*Mount Carmel Irrigation Ditch–West Ditch*)	Eligible—A, C, D	*No Adverse Effect*	An inadvertent discovery plan should be prepared, and a HPTP should be developed to mitigate adverse effects to the site.
42KA9491 (FS-02)	Historic	Historic ditch (*Mount Carmel Irrigation Ditch–East Ditch*)	Eligible—A, D	*No Adverse Effect*	An inadvertent discovery plan should be prepared, and a HPTP should be developed to mitigate adverse effects to the site.
42KA9492 (FS-03)	Historic	Historic road (*Lamb's Lane*)	Not Eligible	No effect	N/A
42KA9493 (FS-04)	Historic	Historic road (*Tait Lane*)	Not Eligible	No effect	N/A

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*Include the appropriate amount of 1:24,000 scale topographic maps, which clearly identify the APE, area of Class II or III survey, sites, and isolated finds.
**Include at least one landscape photograph of the area surveyed.
8100-3 Form

Figure 4. Overview showing site 42KA9490 *Mount Carmel Irrigation Ditch—East Ditch* (Segment 3) in a private yard in Mount Carmel. View to the southwest. Photo taken 11/17/21 by Aaron Larsen.

Figure 5. Overview showing a portion of site 42KA9490 *Mount Carmel Irrigation Ditch—East Ditch* Segment 5 visible in the foreground in the outskirts of Mount Carmel. View to the northeast. Photo taken 11/17/2021 by Jennifer Bannick.

Figure 6. Overview showing site 42KA9491 *Mount Carmel Irrigation Ditch—West Ditch* (Segment 1) with F-02 retention pond and headgate in the foreground. View to the east. Photo taken 11/18/21 by Jennifer Bannick.

Figure 7. Overview showing a portion of site 42KA9491 *Mount Carmel Irrigation Ditch—West Ditch* with Segment 2 visible in the foreground below the berm. View to the east/southeast. Photo taken 11/18/2021 by Jennifer Bannick.

APPENDIX A

PROJECT RESULTS MAPS

APPENDIX B

RESULTS OF LITERATURE REVIEW

APPENDIX C

CULTURAL RESOURCE SITES WITHIN THE PROJECT APE

Utah Division of State History

Short Cultural Resources Inventory Report Form

State Project Number: U23TN0682

Report Title: *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation*

Report Date: February 2024

Report Author(s): Aaron D. Larsen and Jennifer Bannick

Principal Investigator: Jennifer Bannick/Lindsey M. Evenson

Person-Days for Survey: A total of two person-days of survey for Jennifer Bannick on October 10 and 11, 2023.

Acreage: APE: 13.72
Intensive: 8.47
Recon/Intuitive: 5.25

Project Background:

The Natural Resources Conservation Service (NRCS) and Kane County Water Conservancy District (KCWCD) are proposing the use of the Bald Knolls Community Pit to provide riprap for their *Cove Reservoir Project* (U18TN0544), which originally consisted of a reservoir and associated facilities. The original U18TN0544 Class III inventory was conducted in October, 2018. The additional borrow pit is being completed as *Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation* in Kane County, Utah (Project) (Utah Antiquities Project Number U23TN0682). This supplemental inventory area is the result of a change in project complexity, changing from an Environmental Assessment to an Environmental Impact Statement, and a later assessment of the original project requirements and determination of preferred material sources.

As part of the proposed Project, NRCS and KCWCD have requested a cultural resources evaluation of the Project area in Kane County, Utah. The NRCS and KCWCD retained Transcon Environmental, Inc. (Transcon) to conduct the cultural resources evaluation and resulting report in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended.

The proposed Project *Area of Potential Effects* (APE) measures 2.29 miles (13.72 acres) in length entirely on private property along County Road 2095 between County Roads 2895 and 2912 east of the town of Glendale, in Kane County, Utah. The Project is located within portions of Township 40 South, Range 6 West, Section 35 of the Salt Lake Baseline and Meridian and crosses the Bald Knoll, Utah 7.5-minute U.S. Geological Survey topographic quadrangle map (U.S. Geological Survey [USGS] 2023) (Appendix A, *Project Results Map*).

Area of Potential Effect Definition:

The Project APE totals 2.29 miles (13.72 acres) in length. The Project APE is the site of a former borrow pit (*Esplin Glendale Bench Pit* or *Esplin Pit*) where basalt bedrock has previously been quarried for use as riprap. The Project proposes to reopen the borrow pit to procure riprap for construction and armoring of the planned *Cove Dam*. Observed basalt exposures in the Project area measure 10 to 20 feet thick, and procurement activities to fulfill the dam construction needs (approximately 29,000 cubic yards of riprap) would require quarrying 1.8 acres of basalt to a thickness of 10 feet. The Class III (intensive pedestrian) cultural resources inventory was conducted following Utah State Historic Preservation Office (USHPO) guidelines in 15-meter transects in a modified block survey within the Project area, resulting in a total of 2.29 miles or 13.72 acres of survey. No portion of the Project was left unsurveyed due to prior survey efforts; however, some areas of difficult or hazardous terrain encountered within the Class III inventory area were subject to Class II (reconnaissance) inventory due

to safety concerns. This resulted in a total Project APE of 2.29 miles (13.72 acres), a total Class II (reconnaissance) inventory of 5.25 acres, and a total Class III Inventory of 8.47 acres (Table 1).

TABLE 1
TOTAL PROJECT AREA

	BLM	SITLA	UDOT	USFS	Private	Other	Total
Class II Inventory Acreage	0.00	0.00	0.00	0.00	5.25	0.00	5.25
Class III Inventory Acreage	0.00	0.00	0.00	0.00	8.47	0.00	8.47
Total Project Mileage	0.00	0.00	0.00	0.00	2.29	0.00	2.29
Total Project Acreage	0.00	0.00	0.00	0.00	13.72	0.00	13.72

* Survey mileage based on 15-meter-wide transects (Acres * 0.167).

Identification Strategies (*archaeological, historical, and ethnographic*):

The desktop background research review, Class III cultural resources inventory, and this resulting report have been completed by Transcon and conducted in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended. The survey was conducted in coordination with the NRCS, and as the Project is located entirely on private property, no formal field work authorization was required. The desktop review was conducted on September 13, 2023, and the cultural resources survey was conducted on October 10 and 11, 2023, for a total of two person-days of fieldwork. Jennifer Bannick and Lindsey M. Evenson served as co-principal investigators, Jennifer Bannick served as field director, and Jennifer Bannick and Aaron D. Larsen served as report co-authors. All Transcon staff meet the Secretary of the Interior's professional qualification standards for the state of Utah; additionally, Lindsey M. Evenson holds PLPCO Permit #177; Lindsey M. Evenson and Jennifer Bannick are permitted as Principal Investigators (Statewide, Historic) and Aaron D. Larsen is permitted as a Field Director (Great Basin, San Juan, Historic) under the United States Department of the Interior Permit for Archaeological Investigations/Utah BLM Cultural Resource Use Permit (CRUP) permit number 24UT81313, valid 1/12/2024 – 1/11/2027.

Location(s) and Date(s) of Pre-Field Records Search:

1. Utah Division of State History: September 13, 2023
2. Federal/State Office: N/A
3. Historic Records/Maps: September 13, 2023
4. Other: N/A

Results of Pre-Field Records Search (*sites and projects within agency-defined APE buffer and/or site leads from research*):

A background research review was conducted on the USHPO's Sego and Utah Digital Asset Manager online cultural resources databases on September 13, 2023 (USHPO 2023). The results of this literature review indicate there are a total of 11 previously conducted cultural resource surveys (Table B-1, *Previous Cultural Surveys Within 0.5 Mile of the Project Area*) and 16 previously recorded cultural resource sites (Table B-2, *Previously Identified Cultural Resource Sites Within 0.5 Mile of the Project Area*) within 0.5 mile of the Project area. Of these, five previously conducted surveys and one previously recorded site (42KA7537) are mapped as overlapping, being immediately adjacent to, or being crossed by some portion of the current Project APE.

Records on file with USHPO's Historic Utah Buildings database were perused on September 14, 2023. This resource identified no recorded historic structures within 0.5 mile of the current Project APE (HUB 2023).

Historic General Land Office (GLO) maps for Township 40 South, Range 6 West (1877, 1979) were perused on the BLM Land Records website (BLM 2023). These surveys indicate the potential presence of various resources, including historic roads/trails and a historic structure (*Cabin*) near the Project area (Table B-3, *Historic General Land Office Maps*).

Additional historic maps were accessed from both the USGS TopoView topographic map viewer created by the National Geologic Map Database project and the Utah Geological Survey Aerial Imagery Collection (Department of Natural Resources [DNR] 2023; USGS 2023). Historic topographic maps in the vicinity of the proposed Project indicate several historic developments, including:

- Unnamed roads (1966 Bald Knoll, Utah 1:24,000 scale topographic maps)
- Unnamed roads (1968 Bald Knoll, Utah 1:24,000 scale topographic maps)

Date(s) of Survey: October 10 and 11, 2023

Description of Findings:

The Class III inventory area was characterized by a moderately disturbed rural landscape at the base of and along a basalt ridge. Survey conditions consisted of partly cloudy to clear skies and warm temperatures. For most of the survey, ground surface visibility was poor to moderate and averaged 20 to 60 percent depending on vegetation (Figures 1 to 6). Some areas contained dense cheatgrass and other opportunistic ground-cover vegetation obstructing the view of the ground. Undisturbed areas were typified by juniper-pinyon woodland vegetation, including juniper, pinyon, big sagebrush, rabbitbrush, and various forbs and grasses. Some modern debris was also noted but not recorded at various places within the Project area, as it appears to have originated from modern transportation and recreational activities.

As a result of the new Class III inventory, two cultural resource sites (42KA7537 [*Kanab Creek Cave*] and 42KA9789 [FS-01]) were identified and documented. Both site 42KA7537 and 42KA9789 are recommended Eligible for the National Register of Historic Places (NRHP) under Criterion D for information potential. One isolated occurrence (IO), IO-01, was identified during the survey. These identified resources are further described below.

Archaeological Sites

42KA7537

Site 42KA7537 is a previously recorded prehistoric cave and artifact scatter (*Kanab Creek Cave*) located on an outcrop of a basalt terrace east of the town of Glendale in Kane County, Utah. The site was originally recorded by the NRCS in 2013 and determined Eligible for listing on the NRHP under Criterion D for information potential (Hoffmann and Williamson 2013).

The site was previously described as a prehistoric cave (F01) and associated artifact scatter that includes lithic debris, ceramic fragments, stone tools, and a diffuse scatter of fire-cracked rock (FCR) (Hoffmann and Williamson 2013). The roof and rear of the cave are stained with possible smoke residue and covered with a pack rat midden, and one obsidian tertiary flake and four ceramic fragments were observed on the cave floor which did not appear to have been looted. Four lithic tools and three ceramic sherds were identified and formally recorded: P01 translucent marbled chert possible Nawthis Side-Notched projectile point; P02 white chert Elko Corner-notched projectile point; P03 late-stage biface with concave base; P04 possible chert drill; P05 North Creek Gray rim sherd; P06 North Creek Gray rim sherd; and P07 indeterminate Black-on-White sherd (Hoffmann and Williamson 2013). Additionally, two discrete artifact concentration areas consisting of an estimated 100 to 500 flakes of lithic debitage and 416 ceramic fragments were observed on the

slope in front of and below the cave, and a diffuse scatter of FCR and a modern fire ring were observed in an area near the mouth of the cave. Approximately 25 percent of the site was estimated to have been negatively impacted by a roadcut for nearby mining/rock quarrying activities (Hoffmann and Williamson 2013).

In 2023, Transcon recorded the cave/rockshelter (F-01) and three collector's piles (AC-01, AC-02, and AC-03) and observed a moderately dense artifact scatter with a composition generally matching the original 2013 recording. Comparing the photos taken during the original recording with the present condition reveals movement of large cobbles and small boulders and a significant loss of sediment inside the shelter. In combination with the three collector's piles, the evidence strongly suggests the rockshelter has been looted. The previously noted distinct artifact concentrations were not observed, possibly due to revegetation or looting. The previously noted area of FCR near the mouth of F-01 was relocated, accompanied by faint, ashy soil stains. No diagnostic artifacts that appeared on the original recording were relocated, and no diagnostic artifacts were recorded in 2023. Despite looting, undisturbed subsurface cultural deposits may still be preserved inside the rockshelter and on the surrounding terrace.

Transcon recommends site 42KA7537 is Eligible for listing on the NRHP under Criterion D for information potential and recommends the proposed Project will have *No Adverse Effects* to Historic Properties present and no impact, assuming certain protective measures are carried out.

42KA9789 (FS-01)

Site 42KA9789 is a newly recorded prehistoric campsite that was identified and recorded for the first time by Transcon archaeologists in 2023. The site is located at the base of a basalt terrace east of the town of Glendale in Kane County, Utah.

Transcon recorded a chert scraper (A-01), a chert biface (A-02), and a moderately dense, well-defined artifact scatter, some scattered quartzite FCR, and areas of possible ashy soil staining. No concentrations or other organization was observed, and the sediments in the area generally consist of light and dark patches further confusing the difference between natural sediment and potential culturally modified sediments. The site occupies an exposed crescent defined by basalt boulders upslope and a cheatgrass field downslope, and subsurface cultural deposit is likely preserved beneath eolian sediments trapped by vegetation.

Transcon recommends site 42KA9789 is Eligible for listing on the NRHP under Criterion D for information potential and recommends the proposed Project will have *No Adverse Effects* to Historic Properties present and no impact, assuming certain protective measures are carried out.

Isolated Occurrences

Additionally, one IO was identified within the Project area (Figures 7 and 8). IO-01 consists of a single white prehistoric chert tertiary flake of indeterminate age. IO-01 is recommended Not Eligible for listing on the NRHP under any Criteria.

<u>Conclusion and Management Recommendations:</u>

A Transcon archaeologist conducted a Class III (intensive pedestrian) and Class II (reconnaissance) cultural resources survey on October 10 and 11, 2023, of approximately 13.72 acres (2.29 miles) located on private property along County Road 2095 between County Roads 2895 and 2912 east of the Town of Glendale, in Kane County, Utah. Of the 2.29 miles (13.72 acres), approximately 5.25 acres of difficult and hazardous terrain and was evaluated to Class II (reconnaissance) survey standards. The remaining 8.47 acres were evaluated to Class III (intensive pedestrian) cultural resources inventory (survey) standards and surveyed in 15-meter-wide transects throughout the proposed Project APE. This investigation was requested by the

NRCS and KCWCD to determine if any significant cultural resources which could be affected by the proposed undertaking were present within the Project area.

As a result of the Class III/II inventory, it was determined that two cultural resource sites and one IO are located within the Project APE. Both sites (42KA7537 [*Kanab Creek Cave*] and 42KA9789) are recommended Eligible for the NRHP under Criterion D for information potential. Additionally, one isolated occurrence was identified within the Project APE (IO-01) and is recommended as Not Eligible for the NRHP under any Criteria (Table 2, *Project Summary and Conclusions*).

Transcon recommends that the Project will result in *No Adverse Effects* to Historic Properties if all ground disturbance is avoided within 15 meters of each eligible site boundary (42KA7537 and 42KA9789). If this is unavoidable, a cultural monitor should be present for all ground-disturbing activities within 15 meters of the site boundary.

TABLE 2
PROJECT SUMMARY AND CONCLUSIONS

Site Number	Site Description	Eligibility	Protective Measures
42KA7537	Prehistoric cave and artifact scatter (*Kanab Creek Cave*)	Eligible—D	Avoid all ground disturbing activities within 15 meters of the site boundary; a cultural monitor must be present during all ground disturbance within 15 meters of the site boundary, and avoidance flagging must be placed 15 meters from the site boundary prior to any construction activities near the site area.
42KA9789	Prehistoric artifact scatter	Eligible—D	Avoid all ground disturbing activities within 15 meters of the site boundary; a cultural monitor must be present during all ground disturbance within 15 meters of the site boundary, and avoidance flagging must be placed 15 meters from the site boundary prior to any construction activities near the site area.

If any previously undetected or unreported cultural features or deposits are encountered during future Project-related activities, these activities must be discontinued in the immediate area of the feature(s) and an NRCS archaeologist must be consulted to evaluate their nature and significance.

References:

Bureau of Land Management (BLM). 2023. "Cadastral Surveys and Plats" Land Records, Bureau of Land Management, Utah. Accessed August 22, 2023, at https://www.ut.blm.gov/LandRecords/search_plats.cfm.

Hoffmann, Tara S., and Andrew M. Williamson. 2013. 42KA7537 Site Form. Prepared by NRCS. On file at the Utah Division of State History.

U.S. Geological Survey (USGS). 2023. Bald Knoll, UT 7.5-Minute topographic map. Accessed September 13, 2023, at https://ngmdb.usgs.gov/topoview/viewer/#12/37.3126/-112.4379.

Utah Division of Natural Resources (DNR). 2023. UGS Aerial Imagery Collection. Accessed on September 13, 2023, at https://geodata.geology.utah.gov/imagery/.

Utah State Historic Preservation Office (USHPO). 2023. Sego. Utah Department of Heritage and Arts, Utah Division of State History. Accessed September 13, 2023, at https://shpo.utah.gov/portal/apps/webappviewer/index.html?id=8d1c8337d050431080f7dce538f7677c.

Utah State Historic Preservation Office, Historic Utah Buildings (HUB). 2023. Utah Division of State History. Accessed September 14, 2023, at: https://shpo.utah.gov/portal/apps/webappviewer/index.html?id=8e218e18c2b74477b5f520e5617bebaf.

Required Materials:

☒7.5' Quadrangle Base map(s) for Project Area (*Project Results Map*)

☐7.5' Quadrangle Base map (s) for Surveyed Area (if different than #1)



Figure 1. Project overview showing the top of a basalt ridge in the survey area above site 42KA7537. View to the east-northeast. Photo taken 10/11/2023.



Figure 2. Project overview showing the survey APE on top of the basalt ridge and slope excluded areas of the ridge. View to the southwest. Photo taken 10/11/2023.



Figure 3. Project overview showing the survey APE in the foreground. View to the southeast. Photo taken 10/11/2023.

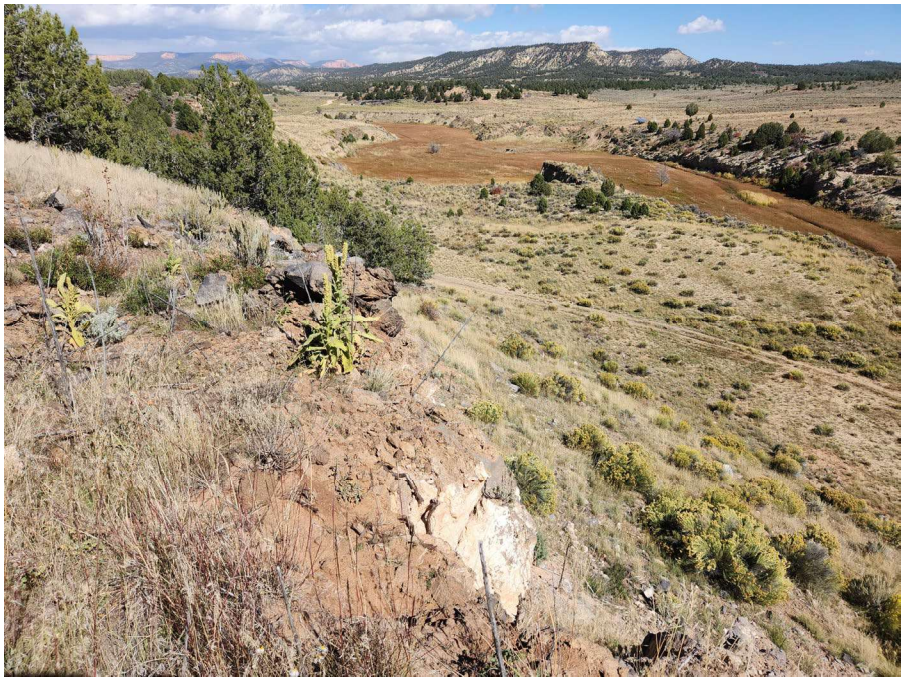

Figure 4. Project overview in the survey APE showing slope excluded Class II area in the survey area from the basalt ridge top. View to the northeast. Photo taken 10/11/2023.



Figure 5. Project overview showing a slope excluded area in the central survey area from the ridge top. View to the south. Photo taken 10/11/2023.



Figure 6. Project overview showing a large slope excluded area from the ridge top in the central survey area. View to the north. Photo taken 10/11/2023.

Figure 7. Overview showing IO-01, prehistoric chert flake. View to the northwest. Photo taken 10/10/2023.

Figure 8. Detail showing IO-01, prehistoric chert flake. Photo taken 10/10/2023.

APPENDIX A

PROJECT RESULTS MAP

APPENDIX B

RESULTS OF LITERATURE REVIEW

September 3, 2026

Tara S. Hoffmann
Water and Cultural Resources Specialist
Natural Resources Conservation Service
Wallace F. Bennett Federal Building
125 State Street #6416
Salt Lake City, Utah 84138

RE: Kane County Water Conservancy District's Cove Reservoir Project—Cultural Resources Review Memo, Indirect Breach Inundation/Visual Areas of Potential Effect (APEs)

Dear Ms. Hoffmann:

Pursuant to your request, Eocene Environmental Group, Inc. (Eocene, formerly Transcon Environmental, Inc.) is pleased to present this Cultural Resources Review Memo as part of the desktop *Breach Inundation/Visual Areas of Potential Effect analysis for the Kane County Water Conservancy District's Cove Reservoir Project* (Project) in Kane County, Utah. The purpose of this desktop review is to, prior to construction design finalization, identify cultural resources within the Indirect Breach Inundation/Visual Project Areas of Potential Effect (APE) that may be impacted by the proposed Project.

The Natural Resources Conservation Service (NRCS) and Kane County Water Conservancy District (KCWCD) are proposing to construct the new Cove Reservoir within the existing Glendale, Mt. Carmel, and Orderville irrigation systems. This proposed reservoir would be located immediately southwest of Orderville, Utah, off Cove Road. Additional improvements would include the construction of approximately 1.5 miles of new pipeline, the Glendale hydroelectric power plant, and 0.2 miles of new power line and 0.7 acres of utility corridor along United States Highway 89 (US-89) and Cove Road; these improvements would be located west of US-89 and the East Fork of the Virgin River in Glendale, Utah. The Project also proposes the potential use of three previously disturbed borrow pits—Lambs Pit, Tait Pit, and Esplin Pit—for Project-related construction needs. Use of the three existing borrow pits for construction of the earthen-fill dam is expected to result in the disturbance of an estimated 5.7 acres. Lambs Pit and Tait Pit would require permanent disturbance of approximately 0.5 acres or 0.7 acres, respectively. Only one of these pits would be selected for the project, and along with approximately 5.0 acres of permanent disturbance from the Esplin Pit, no disturbance outside the previously disturbed areas is proposed at these borrow pit locations.

The NRCS has identified four distinct APEs for the entire proposed Project, including the Direct APE, the Visual APE, and two Indirect Breach Inundation APEs (Sunny Day APE/ Rainy Day APE), all of which partially overlap each other (see **Appendix A**). Cultural resources within the Direct APE have previously been inventoried and evaluated and are not considered as part of this review. The two Indirect Breach Inundation APEs (Sunny Day APE/ Rainy Day APE) consist of unbuffered breach inundation zones which include the proposed Cove Reservoir area and the

individual downstream inundation zones, and the Visual APE consists of a 1-mile buffer around the proposed Cove Reservoir, which does not include the borrow pits or pipeline areas as only the proposed Cove Reservoir and the inundation zone will require a visual analysis (**Appendix A**).

Alpha Engineering retained Eocene to conduct a Class I cultural resources evaluation of the proposed Project Indirect Breach Inundation APEs/Visual APE (see below). A background research literature review was conducted on July 15, 2026, through the Utah State Historic Preservation Office's (SHPO) Sego and Utah Digital Asset Manager online cultural resources databases. The results of this literature review indicate there are a total of 158 previously conducted cultural resource surveys that cover 100 percent of the Direct APE, approximately 40 percent of the Visual APE, approximately 32.3 percent of the Sunny Day APE, and approximately 31.4 percent of the Rainy Day APE. Additionally, the APEs encompass 97 previously recorded cultural resource sites and 20 historic structures.

A review of these previously recorded sites and structures within the various Project APEs indicates that none of them would require a formal Visual Effects Analysis as they would not be subject to adverse visual or indirect impacts from the implementation of the Project. Therefore, the recommended determination of effect for both the Visual and Indirect Breach Inundation APEs is *No Adverse Effect*.

If you have any questions regarding this this desktop review, please contact me directly at (801) 649-5141, extension 310, or levenson@eocene.com.

Sincerely,



Lindsey M. Evenson
Regional Manager, Region 20
Cultural Resources Program Manager | Senior Archaeologist
Eocene Environmental Group, Inc.

PROJECT DESCRIPTION

The NRCS and KCWCD are proposing to construct the new Cove Reservoir within the existing Glendale, Mt. Carmel, and Orderville irrigation systems. This proposed reservoir would be located immediately southwest of Orderville, Utah, off Cove Road. Additional improvements would include the construction of approximately 1.5 miles of new pipeline, the Glendale hydroelectric power plant, and 0.2 miles of new power line and 0.7 acres of utility corridor along US-89 and Cove Road; these improvements would be located west of US-89 and the East Fork of the Virgin River in Glendale, Utah. The Project also proposes the potential use of three previously disturbed borrow pits—Lambs Pit, Tait Pit, and Esplin Pit—for Project-related construction needs; no disturbance outside the previously disturbed areas is proposed at these borrow pit locations.

The NRCS has identified four distinct APEs for the entire proposed Project, including the **Direct APE**, the **Visual APE,** and two Indirect Breach Inundation APEs (**Sunny Day APE/ Rainy Day APE**), which partially overlap each other. The NRCS also determined that no other visual or atmospheric impacts would occur from Project implementation. There may be temporary auditory effects caused by rock quarrying activities at the Esplin Pit, as raised by the Moapa Band of Paiute Indians, which have been consulted on and accounted for by the NRCS (see **Appendix A**). The Direct APE consists of the proposed Cove Reservoir (buffered), pipelines, and three borrow pits (Esplin, Lambs, and Tait). The two Indirect Breach Inundation APEs (Sunny Day APE/ Rainy Day APE) consist of unbuffered breach inundation zones which include the proposed Cove Reservoir area and the individual downstream inundation zones, and the Visual APE consists of a 1-mile buffer around the proposed Cove Reservoir, which does not include the borrow pits or pipeline areas as only the proposed Cove Reservoir and the inundation zone will require a visual analysis.

Alpha Engineering retained Eocene to conduct a cultural resources evaluation (desktop literature review) of the proposed Project Indirect APE/Visual APE. The evaluation was requested by Alpha Engineering to determine if any significant cultural resources that could be affected by the proposed Project are present within the Indirect APE/Visual APE. Important cultural resources may include historic or prehistoric archaeological sites or objects; historically or architecturally significant structures, buildings, or landscapes; and traditional cultural places (TCPs) that are or could be considered eligible for inclusion in the National Register of Historic Places (NRHP).

PROJECT AREA OF POTENTIAL EFFECT LOCATIONS AND DIMENSIONS

The entire Project APE is generally located southwest of Orderville, south and east of Glendale, and within and south of Mount Carmel in Kane County, Utah (**Appendix A**). The proposed Project consists of the Direct, Indirect Breach Inundation (Sunny Day APE/ Rainy Day APE), and Visual APEs, which overlap in some areas.

The Direct APE totals approximately 712.46 acres, including 0.23 acres of Bureau of Land Management (BLM) Kanab Field Office (KFO)–managed lands, 70.33 acres of Utah Trust Lands Administration (TLA)–managed lands, and 641.90 acres of privately owned lands. The Direct APE is located within portions of Township 40 South, Range 6 West, Section 35; Township 40 South, Range 7 West, Sections 23, 26, and 27; and Township 41 South, Range 7 West, Sections 5, 6, 8, 9, 17, 18, and 19 of the Salt Lake Baseline and Meridian and crosses the Bald Knoll, Glendale, Orderville, and Mount Carmel, Utah, United States Geological Survey (USGS) 7.5-minute topographic quadrangle maps (USGS 2026).

The Sunny Day Indirect Breach Inundation APE totals approximately 3,122.63 acres, including 1,147.18 acres of BLM-managed lands, 181.85 acres of TLA-managed lands, 77.27 acres of National Park Service (NPS)–managed lands, 0.92 acres of Utah State Parks–managed land, and 1,715.41 acres of privately owned lands. The Sunny Day APE is located within portions of Township 41 South, Range 7 West, Sections 4, 5, 6, 8, 9, 17, 18, 19, and 30; Township 41 South, Range 8 West, Sections 24, 25, 34, 35, and 36; Township 41 South, Range 9.5 West, Sections 31 and 32; Township 41 South, Range 10 West, Section 36; Township 41 South, Range 11 West, Sections 30, 31, 32, 33, and 34; Township 41 South, Range 12 West, Sections 19, 20, 21, 22, 23, 25, 26, 27, 28, 29, and 30; Township 41 South, Range 13 West, Sections 20, 21, 22, 23, 25, 26, 27, 28, 29, and 30; Township 41 South, Range 14 West, Sections 25, 35, and 36; Township 42 South, Range 8 West, Sections 2, 3, 4, 5, 6, 7, 8, 9, and 10; Township 42 South, Range 9 West, Sections 3, 4, 5, 6, 8, 9, 10, 11, 12, and 14; Township 42 South, Range 10 West, Sections 1, 2, 3, 3, 4, 5, 6, 9, and 10; Township 42 South, Range 11 West, Sections 1, 2, 3, 4, and 5; and Township 42 South, Range 14 West, Sections 1, 2, 10, and 11 of the Salt Lake Baseline and Meridian and crosses the Springdale East, Springdale West, Virgin, Hurricane, Harrisburg Junction, Mount Carmel, Orderville, and The Barracks, Utah, USGS 7.5-minute topographic quadrangle maps (USGS 2026).

The Rainy Day Indirect Breach Inundation APE totals approximately 3,892.76 acres, including 1,403.92 acres of BLM-managed lands, 192.38 acres of TLA-managed lands, 77.34 acres of NPS-managed lands, 0.92 acres of Utah State Parks–managed land, and 2,218.20 acres of privately owned lands. The Rainy Day APE is located within portions of Township 41 South, Range 7 West, Sections 4, 5, 6, 8, 9, 17, 18, 19, and 30; Township 41 South, Range 8 West, Sections 24, 25, 34, 35, and 36; Township 41 South, Range 9.5 West, Sections 31 and 32; Township 41 South, Range 10 West, Section 36; Township 41 South, Range 11 West, Sections 30, 31, 32, 33, and 34; Township 41 South, Range 12 West, Sections 19, 20, 21, 22, 23, 25, 26, 27, 28, 29, and 30; Township 41 South, Range 13 West, Sections 20, 21, 22, 23, 25, 26, 27, 28, 29, and 30; Township 41 South, Range 14 West, Sections 25, 35, and 36; Township 42 South, Range 8 West, Sections 2, 3, 4, 5, 6, 7, 8, 9, and 10; Township 42 South, Range 9 West, Sections 3, 4, 5, 6, 8, 9, 10, 11, 12, and 14; Township 42 South, Range 10 West, Sections 1, 2, 3, 3, 4, 5, 6, 9, and 10; Township 42 South, Range 11 West, Sections 1, 2, 3, 4, and 5; Township 42 South, Range 14 West, Sections 1, 2, 10, 11, 15, 16, 19, 20, and 21; Township 42 South, Range 15 West, Sections 22, 23, 24, 26, 27, 28, 31, 32, and 33; Township 43 South, Range 15 West, Section 6; Township 43 South, Range 16 West, Sections 1, 12, 13, 14, 15, 20, 21, 22, 28, 29, and 30; and Township 43 South, Range 17 West, Sections 25 and 36 of the Salt Lake Baseline and Meridian and crosses the Springdale East, Springdale West, Virgin, Hurricane, Harrisburg Junction, Mount Carmel, Orderville, The Barracks, Washington Dome, St George, White Hills, and Washington, Utah, USGS 7.5-minute topographic quadrangle maps (USGS 2026).

The Visual APE totals approximately 4,952.29 acres, including 245.00 acres of BLM–managed lands, 1,698.01 acres of TLA-managed lands, and 3,009.28 acres of privately owned lands. The Visual APE is located within portions of Township 40 South, Range 7 West, Sections 31, 32, and 33; Township 40 South, Range 8 West, Section 36; Township 41 South, Range 7 West, Sections 4, 5, 6, 7, 8, and 9; and Township 41 South, Range 8 West, Sections 1 and 2 of the Salt Lake Baseline and Meridian and crosses the Orderville, Utah, USGS 7.5-minute topographic quadrangle map (USGS 2026).

TABLE 1. TOTAL PROJECT AREAS						
Area of Potential Effect	**BLM**	**NPS**	**State**	**USP**	**Private**	**Total**
Sunny Day APE Acreage (Indirect Breach Inundation Areas)	1,147.18	77.27	181.85	0.92	1,715.41	**3,122.63**
Rainy Day APE Acreage (Indirect Breach Inundation Areas)	1,403.92	77.34	192.38	0.92	2,218.20	**3,892.76**
Visual APE Acreage (1 Mile Buffer of Cove Reservoir and Facilities)	245.00	0.00	1,698.01	0.00	3,009.28	**4,952.29**
Direct APE Acreage (Cove Reservoir, Pipes, Canals, Esplin Pit, Tait Pit, Lamb's Pit)	0.23	0.00	70.33	0.00	641.9	**712.46**

INDIRECT AREAS OF POTENTIAL EFFECT AND VISUAL AREA OF POTENTIAL EFFECT ASSESSMENT

The NRCS has identified four distinct APEs for the entire proposed Project, including the **Direct APE**, the **Visual APE**, and two **Indirect Breach Inundation APEs** (**Sunny Day APE/ Rainy Day APE**), which partially overlap each other (**Appendix A**). The Direct APE consists of the proposed Cove Reservoir (buffered), pipelines, and three borrow pits (Esplin, Lambs, and Tait); these areas were inventoried and documented in **U18TN0544** Cultural Resources Inventory Report (CRIR), KCWCD's Cove Reservoir Project; **U21TN0840** CRIR, KCWCD's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah—Addendum to CRIR; KCWCD's Cove Reservoir Project (U18TN0544), Kane County, Utah; and **U23TN0682** CRIR, KCWCD's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation. Effects to resources within the Direct APE are considered in these reports and impacts from indirect (Breach Inundation Zones: Sunny Day and Rainy Day APEs) and visual effects are considered for this review (**Appendix A**).

Section 106 of the National Historic Preservation Act requires federal agencies to consider the impacts, including visual impacts, of their undertakings on the ability of certain historic properties to convey their historic significance. Under the National Environmental Policy Act of 1969, federal agencies must consider visual impacts of proposed projects, including potential effects on historic properties, scenic resources, and the scenic experiences of people who view the landscape.

Auditory impact-causing elements for the Direct Project APE may include the use of heavy machinery and construction of Project components. Auditory effects may also result from vibrations that could cause damage to prehistoric or historic structures, such as cracks in prehistoric or historic foundations, wall fall within prehistoric or historic structures, or damage to prehistoric rock art or historic inscriptions. Atmospheric impact-causing elements may include coarse particles, such as dust, from road use, digging, grading, drilling, construction activities, or construction lighting, which interfere with the view of the sky. Environmental degradation due to certain construction activities, excavating, and vegetation clearing may also change the land surface, which can contribute to increased atmospheric pollution. Visual effects can result from

the development of relatively permanent, aboveground infrastructure, which can require a Visual Effect Assessment (VEA).

Atmospheric and auditory effects resulting from the implementation of this Project would be temporary during construction and will not be considered for this review. There may be some additional auditory effects from recreation at the reservoir, which were considered by the NRCS during tribal consultations and no concerns were raised. There may be temporary auditory effects caused by rock quarrying activities at the Esplin Pit, as raised by the Moapa Band of Paiute Indians, which have been consulted on and accounted for by the NRCS (see **Appendix A**). Potential hydrologic effects from Project implementation would likely be minimal as water output flows would remain the same; however, these effects may also be considered in a separate review.

Due to the varied geography surrounding the reservoir, a Visual APE of 1 mile around the periphery of the proposed Cove Reservoir was evaluated for potential visual resources that could be impacted by the current undertaking; however, it was only applicable to certain site types and sites that are unevaluated, considered Eligible for listing on the NRHP, and/or tribally sensitive sites that would be both visible to the undertaking and possess setting as a contributing aspect of their NRHP eligibility (**Table 2**). Additionally, site types that typically do not include viewshed as a component contributing to NRHP eligibility include prehistoric quarries, earthen dams or reservoirs, irrigation canals, historic mines or mine openings without associated structures, historic roads, railroads without associated structures, and telegraph lines because visual setting is not considered a critical attribute of their general historical setting and because some of these structures are often integrated into developed landscapes. As such, these site types do not generally include visual setting as an aspect of integrity for NRHP consideration since they are not experienced in association with any particular past landscape (Sullivan et al. 2018).

The inundation zones for the Sunny Day and Rainy Day scenarios were calculated using Hydrologic Engineering Center's River Analysis System (HEC-RAS), developed by the United States Army Corps of Engineers. HEC-RAS is designed to perform one- and two-dimensional hydraulic calculations for a full network of natural and constructed channels. A reservoir breach could impact various cultural resources, including prehistoric and historic sites, structures, landscapes, and artifacts within the Indirect Breach Inundation APEs (Sunny Day APE/ Rainy Day APE). These resources could be directly impacted by the breach due to inundation or damage from debris or indirectly by changes to the surrounding environment.

TABLE 2.
SITE TYPE CRITERIA FOR INCLUSION IN VISUAL IMPACT ASSESSMENT*

Prehistoric	Historic
Petroglyphs	Historic Inscriptions
Pictographs	Historic Scenic Overlooks
Prehistoric Dendroglyphs	Historic Dendroglyphs
Prehistoric Cairns	Historic Cairns
Prehistoric Architectural Sites	Historic Architectural Sites
Prehistoric Scenic Roads/Trails	Historic Scenic Roads/Trails
Prehistoric rockshelters	Architectural Districts on a case-by-case basis

TABLE 2. SITE TYPE CRITERIA FOR INCLUSION IN VISUAL IMPACT ASSESSMENT*	
Prehistoric	**Historic**
Prehistoric, Historic, Ethnohistoric, or Multi-Component	
National Historic Trails – Contributing Segments and High Potential Sites	
National Historic Landmarks	
Historic properties of traditional religious or cultural importance to Indian Tribes	
Traditional Cultural Properties	
Cultural resources identified by consulting parties as requiring a visual impact assessment	
Previously recorded cultural resources that have insufficient information and have a high likelihood of having character-defining features susceptible to visual effects	
Unrecorded cultural resources that have a high likelihood of having character-defining features susceptible to visual effects (e.g., sites that are identified through historic research)	
Unrecorded Utah Rock Art Research Association (URARA) cultural resource locations as displayed in the Utah SHPO Sego Application	
*Note: Site types which may be included in a visual impact assessment include sites that are Unevaluated, Eligible, or Listed sites on the NRHP.	

LITERATURE REVIEW

Eocene archaeologists conducted a desktop background research literature review for the Project APEs on July 15, 2026. Records on file with the Utah SHPO's Sego and Utah Digital Asset Manager (UDAM) online cultural resources databases were checked to determine if previously identified cultural resources are present within the various APEs (USHPO 2026a, 2026b). The results of this review indicate there are a total of 158 previously conducted cultural resource surveys crossing portions of these APEs (**Table 3**), there are 96 previously recorded cultural resource sites within all four overlapping Project APEs (**Table 4**), and there are 20 previously identified historic structures within the Indirect Breach Inundation APEs (Sunny Day APE/ Rainy Day APE) and Visual APEs (**Table 5**).

CULTURAL RESOURCE SURVEYS

Background research identified 158 previously conducted cultural resource surveys that overlap the various APEs within the proposed Project APE (**Table 3**). These previous surveys completely cover the Direct APE, cover approximately 40 percent of the Visual APE, approximately 32.3 percent of the Sunny Day APE, and approximately 31.4 percent of the Rainy Day APE (USHPO 2026a, 2026b).

TABLE 3. PREVIOUS CULTURAL SURVEYS WITHIN EACH AREA OF POTENTIAL EFFECT				
Survey No.	**Survey Name**	**Organization**	**Date**	**Location**
U70UA0003	An Archaeological Survey of The Dixie Reclamation Project	University of Utah, Archaeological Center (U of U)	1970	Sunny/ Rainy Day APEs
U73UA0008	LaVerkin Springs Disposal Facilities	U of U	1973	Sunny/ Rainy Day APEs

TABLE 3. PREVIOUS CULTURAL SURVEYS WITHIN EACH AREA OF POTENTIAL EFFECT				
Survey No.	**Survey Name**	**Organization**	**Date**	**Location**
U75AF0049	Long Valley Improvement Project	Archaeological-Environmental Research Corporation (AERC)	1975	Direct/ Visual/ Sunny/ Rainy Day APEs
U77AF0068	Cultural Resource Evaluation in South Central Utah	AERC	1977	Sunny/ Rainy Day APEs
U77IG0076	LaVerkin Springs Project	Intersearch, Inc.	1977	Sunny/ Rainy Day APEs
U78AF0322	Long Valley/Mt. Carmel Junction Locality	AERC	1978	Sunny/ Rainy Day APEs
U78AF0429	Mt Carmel Habitation 42 Ka 1958	AERC	1978	Sunny/ Rainy Day APEs
U79BL0092	K. S. Anderson Ag. Trespass	BLM	1979	Direct APE
U79SE0334	St. George Industrial Park	International Learning and Research , Inc .	1979	Rainy Day APE
U79BL0101	Sharon Lamb Ag. Trespass	BLM	1979	Sunny/ Rainy Day APEs
U80BL0116	Mtn. Bell R/W	BLM	1980	Sunny/ Rainy Day APEs
U80BL0126	Dixie Project Revocation EAR	BLM	1980	Sunny/ Rainy Day APEs
U80BL0524	Marsing Fence	BLM	1980	Sunny/ Rainy Day APEs
U81BL0166	Hurricane American Legion R&PP	BLM	1981	Sunny/ Rainy Day APEs
U82IG0163	Quail Creek Project	Intersearch, Inc.	1982	Sunny/ Rainy Day APEs
U83BL0553	Little Man Archaeological Sites: Excavations	BLM	1983	Sunny/ Rainy Day APEs
U83NH0165	Alton - Kolob Class II	Nickens and Associates	1983	Visual APE
U84BC0931	39.5 kv Diversion Dam Control Power Line	Brigham Young University (BYU), Office of Public Archaeology	1984	Sunny Day APE
U84BC0924	Three Powerline Routes in Iron & Washington Co.	BYU	1984	Sunny/ Rainy Day APEs
U84BL0669	Mt. Carmel Junction Land Sale	BLM	1984	Sunny/ Rainy Day APEs
U85IG0288	Survey Along SR-9 Virgin to Coalpits Wash	Intersearch, Inc.	1985	Sunny/ Rainy Day APEs
U86BC0015	An Archaeological Survey Of A Proposed 245kV Powerline Corridor In Southwest Washington County, Utah	BYU	1986	Rainy Day APE
U86IG0377	Nichols Peak Road	Intersearch, Inc.	1986	Rainy Day APE

TABLE 3. PREVIOUS CULTURAL SURVEYS WITHIN EACH AREA OF POTENTIAL EFFECT				
Survey No.	**Survey Name**	**Organization**	**Date**	**Location**
U86IG0794	St. George Culinary Line/Site Testing (2 repts.)	Intersearch, Inc.	1986	Rainy Day APE
U86IG0884	Excavations at Quail Creek	Intersearch, Inc.	1986	Sunny/ Rainy Day APEs
U86NA0882	Archaeological Investigations at Zion Nat. Park	NPS	1986	Sunny/ Rainy Day APEs
U86SE0347	Tree's Ranch Survey	Southern Utah University	1986	Sunny/ Rainy Day APEs
U86UC0142	State Lands Chaining - Muddy Creek	Antiquities Section, Utah Division of State History	1986	Visual APE
U87BC0136	St. George Water Treatment Facility	BYU	1987	Rainy Day APE
U88NP0024	Mtn. Fuel Cedar City to Ivins Pipeline	Nielson Consulting, Inc.	1988	Sunny/ Rainy Day APEs
U88PD0524	I-15 to Virgin River	P-III Associates	1988	Sunny/ Rainy Day APEs
U89BL0514	Falls Right-of-Way Realignment	BLM	1989	Direct APE
U89SJ0551	BioWest Bridge Across Virgin River	Sagebrush Archaeological Consultants	1989	Rainy Day APE
U89BL0015	Foote Ranch Wilderness Trespass	BLM	1989	Sunny/ Rainy Day APEs
U89BL0796	Hurricane Golf Course Exchange	BLM	1989	Sunny/ Rainy Day APEs
U90NP0344	UAMPS Middleton to Riverbottom 138KV	Nielson Consulting, Inc.	1990	Rainy Day APE
U90A10345	Data Recovery at Sites 42Ws54 & 42Ws1226--SR9	Alpine Archaeological Consultants (Alpine)	1990	Sunny/ Rainy Day APEs
U91IG0669	Dixie-Escalante Powerline	Intersearch, Inc.	1991	Rainy Day APE
U91NP0224	UAMPS Alt Lines vic. St. George & Middleton	Nielson Consulting, Inc.	1991	Rainy Day APE
U91A10794	Zion National Park Assessment	Alpine	1991	Sunny/ Rainy Day APEs
U91BL0018	East Fork Access Road Right-of-Way	BLM	1991	Sunny/ Rainy Day APEs
U91BL0507	North Steep Trails Fence	BLM	1991	Sunny/ Rainy Day APEs
U91NP0788	Quail Crk/Virgin R Bridge Borrow & Stag Areas	Nielson Consulting, Inc.	1991	Sunny/ Rainy Day APEs
U92UJ0622	SCS Muddy Creek-Orderville Chaining	Utah State University	1992	Direct/ Visual/ Sunny/ Rainy Day APEs
U92IG0094	S Central Utah Tel/AZ-Mt Carmel Jct	Intersearch, Inc.	1992	Sunny/ Rainy Day APEs

TABLE 3. PREVIOUS CULTURAL SURVEYS WITHIN EACH AREA OF POTENTIAL EFFECT				
Survey No.	**Survey Name**	**Organization**	**Date**	**Location**
U92IG0604	Wal-Mart Utilities, Harrisburg Junction	Intersearch, Inc.	1992	Sunny/ Rainy Day APEs
U93IG0624	Springdale Sewer Pipeline and Lagoons	Intersearch, Inc.	1993	Sunny/ Rainy Day APEs
U94AS0012	UDOT SR 9 & SR 17 vic. Hurricane and LaVerkin	Abajo Archaeology	1994	Sunny/ Rainy Day APEs
U94IG0133	S Centr Utah Telephone, Mt. Carmel Jct to Zion NP	Intersearch, Inc.	1994	Sunny/ Rainy Day APEs
U94NA0123	Parunaweap 1994 Historical Survey	NPS (Rocky Mountain Region)	1994	Sunny/ Rainy Day APEs
U94NP0152	UAMPS Quail Creek 69KV Line	Nielson Consulting, Inc.	1994	Sunny/ Rainy Day APEs
U95BL0792	Desert Tortoise Exchange Tract DTX-33	BLM	1995	Sunny/ Rainy Day APEs
U95US0020	Springdale Wastewater	Division of Water Quality	1995	Sunny/ Rainy Day APEs
U96BL0132	Parunweap Canyon Community Trail Rides	BLM	1996	Rainy Day APE
U98ST0307	Muddy Wash Bridge Replacement (UDOT)	SWCA Environmental Consultants	1998	Direct/ Sunny/ Rainy Day APEs
U98BL0735	Webb Hill Fish Barrier	BLM	1998	Rainy Day APE
U98BL0311	Virgin Falls Park	BLM	1998	Sunny/ Rainy Day APEs
U98BL0813	Virgin River/Ash-La Verkin Creeks Confluence-Evaluation	BLM	1998	Sunny/ Rainy Day APEs
U99CH0014	Southgate Ridge 120 Acres	Complete Archaeological Service Associates	1999	Rainy Day APE
U99JB0398	Two Trails across the Virgin River	JBR Environmental Consultants Inc.	1999	Rainy Day APE
U99MQ0200	UDOT St. George Southern Corridor	Montgomery Archaeological Consultants (MOAC)	1999	Rainy Day APE
U99MQ0322	St. George River Road	MOAC	1999	Rainy Day APE
U99IG0156	Alpha Sheep Bridge Road	Intersearch, Inc.	1999	Sunny/ Rainy Day APEs
U00BL0749	East Fork Of The Virgin River Inventory	BLM	2000	Sunny/ Rainy Day APEs
U00IG0317	Sunroc-Gravel Storage and Production Area Survey	Intersearch, Inc.	2000	Sunny/ Rainy Day APEs
U02BC0775	Quail Creek to Snow Canyon Waterline	BYU	2002	Rainy Day APE
U02IG0267	Landmark-Virgin River Trail Phase III	Intersearch, Inc.	2002	Rainy Day APE
U03ES1130	Materials Pit Expansion East of ST George for ADOT	EnviroSystems Management, Inc.	2003	Rainy Day APE

TABLE 3. PREVIOUS CULTURAL SURVEYS WITHIN EACH AREA OF POTENTIAL EFFECT				
Survey No.	**Survey Name**	**Organization**	**Date**	**Location**
U04BS1097	Hurricane City/Sand Hollow R&PP Lease Project	Baseline Data Inc.	2004	Rainy Day APE
U04HQ0847	Data Recovery on 42Ws2556	HRA, Inc. Conservation Archaeology	2004	Rainy Day APE
U04BL0873	Virgin Falls Fuel Reduction	BLM	2004	Sunny/ Rainy Day APEs
U05BS0397	Virgin River Trail	Baseline Data Inc.	2005	Rainy Day APE
U05MQ0662	UDOT's Arizona Stateline to Middleton	MOAC	2005	Rainy Day APE
U06HO1371	Orderville Water System Improvements	Bighorn Archaeological Consultants (Bighorn)	2006	Direct/ Visual/ Sunny/ Rainy Day APEs
U06HO0789	Virgin River Trail PII	Bighorn	2006	Rainy Day APE
U07HO0245	DEREA Black Roct To Beaver Dam Powerline Corridor	Bighorn	2007	Rainy Day APE
U07MX0929	South Bloomington/Sun River Trail	McFadden Archaeological Consulting	2007	Rainy Day APE
U07BL0025	Foot Ranche Powerline ROW	BLM	2007	Sunny/ Rainy Day APEs
U07HO1381	CRI Of The Orderville Water System Improvements Alternative Near Mt. Caramel Junction	Bighorn	2007	Sunny/ Rainy Day APEs
U08BL0450	Shinob Kibe Riparian Treatment	BLM	2008	Rainy Day APE
U08HO0032	CRI of the Warner Valley Reservoir	Bighorn	2008	Rainy Day APE
U08HO0783	Mall Drive Bridge Projects	Bighorn	2008	Rainy Day APE
U08UI1219	Washington Fields Roads	URS Corporation	2008	Rainy Day APE
U08BL1278	Parunuweap Canyon Inventory	BLM	2008	Sunny/ Rainy Day APEs
U08MX0948	Parunuweap Survey	Cultural Site Management and Research	2008	Sunny/ Rainy Day APEs
U08SH1091	Three Emergency Watershed Protection (EWP) Locations	NRCS	2008	Sunny/ Rainy Day APEs
U09SJ0115	Lake Powell Pipeline Project	Commonwealth Heritage Group, Inc. (formerly known as Sagebrush Consultants)	2009	Sunny/ Rainy Day APEs
U10LI0939	St. George Travel Management Plan	Logan Simpson Design Inc.	2010	Rainy Day APE
U10UQ0013	Virgin River Riparian Restoration Project #1656	Utah Division of Wildlife Resources	2010	Rainy Day APE

TABLE 3. PREVIOUS CULTURAL SURVEYS WITHIN EACH AREA OF POTENTIAL EFFECT				
Survey No.	**Survey Name**	**Organization**	**Date**	**Location**
U10BL0068	An Archaeological Inventory Of The P.U.B. (Morby) Virgin River Exchange, Washington County, Utah	BLM	2010	Sunny/ Rainy Day APEs
U10HO0027	UDOT Bridges Project	Bighorn	2010	Sunny/ Rainy Day APEs
U11HO0853	A Cultural Resource Inventory Of The City Of St. George 2011 Trails Restoration Project, Washington County, Utah	Bighorn	2011	Rainy Day APE
U11HO1029	A Cultural Resource Inventory Of The I-15 Milepost 0-16 Highway Improvements, Washington County, Utah	Bighorn	2011	Rainy Day APE
U11HO1116	A Cultural Resource Inventory Of The Questar Gas Company Virgin River Pipeline Replacement, Washington County, Utah	Bighorn	2011	Rainy Day APE
U11LI0017	St. George Virgin River Trail Segment C	Logan Simpson Design Inc.	2011	Rainy Day APE
U11SH0004	CRI For The Upper Virgin River Emergency Watershed Protection Project	NRCS	2011	Sunny/ Rainy Day APEs
U11UM0953	The East Fork And Yellow Jacket Canyon Re-seeding Project, Kane County, Utah	State of Utah School and Institutional Trust Lands Administration (SITLA)	2011	Sunny/ Rainy Day APEs
U12SH0189	CRI Of Kane County Emergency Watershed Protection	NRCS	2012	Direct/ Sunny/ Rainy Day APEs
U12HO1100	A Cultural Resource Inventory Of The Virgin River Trail, Phase III Corridor, Washington County, Utah	Bighorn	2012	Rainy Day APE
U12SH0272	Cultural Resources Inventory For Washington County 2012 Emergency Watershed Protection Project	NRCS	2012	Sunny/ Rainy Day APEs
U13SH0294	A Supplemental Cultural Resources Inventory Of Emergency Watershed Protection (EWP) Locations Along The East Fork Of The Virgin River, Kane County, Utah	NRCS	2013	Visual/ Sunny/ Rainy Day APEs
U13SH0167	Cultural Resources Inventory Of The Kane County Emergency Watershed Protection (EWP) Project Rock Quarry Location On Kanab Creek, Kane County, Utah	NRCS	2013	Direct APE
U13UT0901	Mall Drive Bridge Cultural Resources Inventory II	Utah Department of Transportation (UDOT; Region 4)	2013	Rainy Day APE

TABLE 3. PREVIOUS CULTURAL SURVEYS WITHIN EACH AREA OF POTENTIAL EFFECT				
Survey No.	**Survey Name**	**Organization**	**Date**	**Location**
U13BL0579	2013 Grand To Grand Stage Race Inventory	BLM	2013	Sunny/ Rainy Day APEs
U13SH0047	Cultural Resources Inventory Of The Grafton Heritage Partnership Wildlife Habitat Improvement Program (WHIP) Project, Washington County, Utah	NRCS	2013	Sunny/ Rainy Day APEs
U13SH1057	Cultural Resources Inventory Of The Esplin Wildlife Habitat Improvement Project, Kane County, Utah	NRCS	2013	Sunny/ Rainy Day APEs
U13SH1071	Cultural Resources Inventory Of The Fasselin Wildlife Habitat Improvement Project, Washington County, Utah	NRCS	2013	Sunny/ Rainy Day APEs
U13IG0529	Caruso-SITLA Emerald Green Mine Survey In Kane County	Intersearch, Inc.	2013	Visual APE
U14SH0315	Cultural Resources Inventory Of The Tait Land And Livestock, LLC Wildlife Habitat Improvement Project, Kane County, Utah	NRCS	2014	Visual/ Sunny/ Rainy Day APEs
U14SH0327	Supplemental Site Documentation And Archaeological Monitoring Summary For The Kane County Emergency Watershed Protection (EWP) Project Rock Quarry, Kane County, Utah	NRCS	2014	Direct APE
U14HO0043	A Cultural Resource Inventory For The Long Valley Sewer Improvement District Waste Water System Upgrade Project, Kane County, Utah	Bighorn	2014	Direct/ Visual/ Sunny/ Rainy Day APEs
U14HO0647	A Cultural Resource Inventory Of The Virgin River Stream Restoration Project, Washington County, Utah	Bighorn	2014	Rainy Day APE
U14HO1019	A Cultural Resource Inventory Of The Dixie Center Erosion Protection Project, Washington County, Utah	Bighorn	2014	Rainy Day APE
U14SH0668	Cultural Resources Inventory Of The Great Western Investments Environmental Quality Improvement Project, Washington County, Utah	NRCS	2014	Sunny/ Rainy Day APEs
U15LI0488	A Class III Cultural Resources Inventory Of 3,686 Acres For The Cottonwood Springs Vegetation Project, Kane County, Utah	Logan Simpson Design Inc.	2015	Direct APE
U15HO0924	A Cultural Resource Inventory Of The Virgin River South Trail - Phase I, Washington County, Utah	Bighorn	2015	Rainy Day APE

TABLE 3. PREVIOUS CULTURAL SURVEYS WITHIN EACH AREA OF POTENTIAL EFFECT				
Survey No.	**Survey Name**	**Organization**	**Date**	**Location**
U15LI0528	A Class III Cultural Resources Inventory of 275 Miles of the Western Transmission System, from the Navajo Generating Station in Page, Coconino County, Arizona, to the McCullough Substation near Henderson, Clark County, Nevada	UDOT (Region 4)	2015	Rainy Day APE
U15TD0791	A CRI Of 4 Acres For Questar's FL121 Pipeline Construction Project, Washington, Utah	Tetra Tech	2015	Rainy Day APE
U15EZ0146	An Archaeological Inventory Of The Proposed First Digital Telecom Fiber Optic Project, Along Highway SR-9 In Springdale, Washington County, Utah	EnviroWest LLC	2015	Sunny/ Rainy Day APEs
U16HO0559	A Cultural Resource Inventory Of The Lizzy Lane Sewer Replacement, Virgin River And Fort Pearce Wash Crossings, Washington County, Utah	Bighorn	2016	Rainy Day APE
U16HX0170	An Archaeological Investigation For The Purgatory Road Environmental Assessment, Washington, Utah	Horrocks Engineers	2016	Rainy Day APE
U16HY0406	A CRA For The Virgin River Coridor In St. George, Washington County, Utah	Certus Environmental Solutions, LLC (Certus)	2016	Rainy Day APE
U17HO0675	A Cultural Resource Inventory Of The US-89 Milepost 82-83 Highway Improvements Project, Kane County, Utah	Bighorn	2017	Direct/ Sunny/ Rainy Day APEs
U17BE1154	2017 Annual Report for the Programmatic Agreement between the Bureau of Reclamation and the Utah SHPO Regarding NHPA Responsibilities for Minor Agency Projects	United States Department of the Interior, Bureau of Reclamation	2017	Sunny/ Rainy Day APEs
U17HQ0992	Class III Cultural Resource Survey Of Off-highway Vehicle Routes In The Kanab Field Office: Trail Canyon Travel Management Area	HRA, Inc. Conservation Archaeology	2017	Sunny/ Rainy Day APEs
U17HY0265	An Archaeological Assessment For The Rockville Bridge Structure Rehabilitation, Washington County, Utah	Certus	2017	Sunny/ Rainy Day APEs
U17TN0772	Cultural Resources Inventory Report, UDOT's SR-9 Midway To Rockville Passing Lanes Project, Washington County, Utah	Transcon Environmental (Transcon)	2017	Sunny/ Rainy Day APEs

TABLE 3. PREVIOUS CULTURAL SURVEYS WITHIN EACH AREA OF POTENTIAL EFFECT				
Survey No.	**Survey Name**	**Organization**	**Date**	**Location**
U17TN0987	Cultural Resources Inventory Report, Sunroc SR-9 Rockville To Springdale Project, Washington County, Utah	Transcon	2017	Sunny/ Rainy Day APEs
U18TN0544	Cove Reservoir Project	Transcon	2018	Direct/ Visual/ Sunny/ Rainy Day APEs
U17HQ0452	An Archaeological Survey of 40 Acres West of Rockville, in Washington County, Utah	HRA, Inc. Conservation Archaeology	2018	Sunny/ Rainy Day APEs
U18BL0617	Barracks Ranch Buried Irrigation Pipeline ROW -UTU-93149	BLM	2018	Sunny/ Rainy Day APEs
U19TN0063	UDOT's SR-9; I-15 to Southern Parkway Improvements	Transcon	2019	Sunny/ Rainy Day APEs
U20TN0874	UDOT's US-89; Mt. Carmel to Orderville Passing Lane Project	Transcon	2020	Direct/ Visual/ Sunny/ Rainy Day APEs
U20HO0949	A Cultural Resource Inventory of the Sullivan Park Erosion Protection Project, Washington County, Utah	Bighorn	2020	Rainy Day APE
U20HO0308	A Cultural Resource Inventory of the Confluence Park Pedestrian Bridge Project, Washington County, Utah	Bighorn	2020	Sunny/ Rainy Day APEs
U21TN0298	Cultural Resources Inventory Report, South Central Communications' Orderville/Glendale Fiber-to-the-Home (FTTH) Project, Kane County, Utah	Transcon	2021	Direct APE
U21TN0840	Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah-Addendum to Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove Reservoir Project (U18TN0544), Kane County, Utah	Transcon	2021	Direct/ Visual/ Sunny/ Rainy Day APEs
U21HY0380	A Cultural Resource Assessment for the St. George Emergency Watershed Protection Projects – Virgin River Parcel, Washington County, Utah	Certus	2021	Rainy Day APE
U21A10307	A Class III Cultural Resource Inventory of Six Natural Resources Conservation Service Project Parcels in Garfield and Kane Counties, Utah	Alpine	2021	Sunny/ Rainy Day APEs
U21IG0716	Rockville FFSL Vegetation Treatment Inventory in Washington County	Intersearch, Inc.	2021	Sunny/ Rainy Day APEs

TABLE 3. PREVIOUS CULTURAL SURVEYS WITHIN EACH AREA OF POTENTIAL EFFECT				
Survey No.	**Survey Name**	**Organization**	**Date**	**Location**
U22UX0033	A Cultural Resources Survey for the Arcadian Fiber Optic Orderville to Bear Valley Project, Kane and Garfield Counties, Utah	Westland Engineering and Environmental Services (Westland)	2022	Direct/ Visual APEs
U22UX0032	Cultural Resources Survey for the Arcadian Fiber Optic Paria to Orderville Project, Kane County, Utah	Westland	2022	Direct/ Visual/ Sunny/ Rainy Day APEs
U22IG0055	The St. George City Archaeological Site Recording Project	Intersearch, Inc.	2022	Rainy Day APE
U22TN0348	Cultural Resources Inventory Report, South Central Communications' Mt. Carmel US-89 Fiber to the Home (FTTH) Project, Kane County, Utah	Transcon	2022	Sunny/ Rainy Day APEs
U22UT0316	US-89; Mt. Carmel Junction Station Shoulder Widening and Belly of the Dragon Trailhead Turn Lane MP 80.36-80.8, Kane County	UDOT (Region 4)	2022	Sunny/ Rainy Day APEs
U23SH0941	A Pedestrian Survey for a Proposed Irrigation Pipeline and Pump on Private Land in Kane County, Utah	NRCS	2023	Visual/ Sunny/ Rainy Day APEs
U23TN0682	Cultural Resources Inventory Report, Kane County Water Conservancy District's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah: Esplin Pit Evaluation	Transcon	2023	Direct APE
U23HO0459	A Cultural Resource Inventory of the George Washington Boulevard Bridge, Washington County, Utah	Bighorn	2023	Rainy Day APE
U24HO0158	A Cultural Resource Inventory of the SunRiver Trespass Remediation Project, Washington County, Utah	Bighorn	2024	Rainy Day APE
U24HX0317	An Archaeological Survey of the George Washington Boulevard Project	Horrocks Engineers	2024	Rainy Day APE
U24HO0577	A Cultural Resource Inventory of the La Verkin to Virgin Sewer Line, Washington County, Utah	Bighorn	2024	Sunny/ Rainy Day APEs
U24HO0855	A Cultural Resource Inventory of the Sheep Bridge Road Improvements Project, Washington County, Utah	Bighorn	2024	Sunny/ Rainy Day APEs
U24HO1104	A Cultural Resource Inventory of the Orderville Culinary Water Loop, Kane County, Utah	Bighorn	2024	Sunny/ Rainy Day APEs
U24UT0706	US-89; Mt. Carmel JCT to Muddy Canyon Passing Lane	UDOT (Region 4)	2024	Sunny/ Rainy Day APEs

TABLE 3. PREVIOUS CULTURAL SURVEYS WITHIN EACH AREA OF POTENTIAL EFFECT				
Survey No.	**Survey Name**	**Organization**	**Date**	**Location**
U25SH0035	Cultural Resources Inventory in Support of Sorensen Livestock Company's Irrigation Pipeline Project Near Orderville, Kane County, Utah	NRCS	2025	Direct/ Visual APEs
U25IG0179	The Washington County Confluence Park Archaeological Site Recording Project	Intersearch, Inc.	2025	Sunny/ Rainy Day APEs
U25UT0456	UDOT Region 4 Surplus 2025	UDOT (Region 4)	2025	Sunny/ Rainy Day APEs
U25HX0285	UDOT Zion NP Fiber Optic, Rockville to Mount Carmel Junction.	Horrocks Engineers		Sunny/ Rainy Day APEs
*Note: Location indicates which APE (Direct, Visual, Sunny Day, or Rainy Day) overlaps each project.				

CULTURAL RESOURCE SITES

Background research identified 96 previously identified cultural resource sites within the various proposed Project APEs consisting of prehistoric campsites, prehistoric petroglyphs and pictographs, prehistoric habitations, prehistoric artifact scatters, prehistoric lithic scatters, prehistoric rockshelters/caves, historic canals/ditches, historic check dams, historic roads, historic bridges, historic inscriptions, a historic borrow pit, historic flumes, historic foundations, a historic irrigation pond, a historic townsite, and a historic rock retention wall complex (**Table 4**). Some of these sites are overlapped by more than one APE; three sites are overlapped by only the Direct APE; 10 sites are overlapped by only the Visual APE; 14 sites are overlapped by only the Rainy Day APE; four sites are overlapped by both the Direct APE and Visual APEs; two sites are overlapped by the Visual, Sunny Day, and Rainy Day APEs; three sites are overlapped by the Direct, Visual, Sunny Day, and Rainy Day APEs; and 60 sites are overlapped by the Rainy Day and Sunny Day APEs (USHPO 2026a, 2026b).

None of the sites except for 42KA7537 (prehistoric cave and artifact scatter) meet the site type criteria for inclusion in the visual impact assessment and therefore do not require a formal visual effects assessment. Site 42KA7537 is only in the Direct APE and will be avoided (see **U23TN0682** CRIR, KCWCD's Cove East Fork Virgin River Plan-Environmental Impact Statement, Kane County, Utah).

TABLE 4. PREVIOUSLY IDENTIFIED CULTURAL RESOURCE SITES WITHIN EACH AREA OF POTENTIAL EFFECT			
Site No.	**Description**	**Eligibility**	**Location**
42KA1156	Prehistoric artifact scatter	*Unevaluated*	Sunny/ Rainy Day APEs
42KA1157	Prehistoric artifact scatter (same site as 42KA1958 and 42KA1965)	Determined Eligible	Sunny/ Rainy Day APEs
42KA1158	Prehistoric campsite	*Unevaluated*	Direct/ Visual APEs

TABLE 4. PREVIOUSLY IDENTIFIED CULTURAL RESOURCE SITES WITHIN EACH AREA OF POTENTIAL EFFECT			
Site No.	**Description**	**Eligibility**	**Location**
42KA1505	Prehistoric rock writing	Determined Eligible	Sunny/ Rainy Day APEs
42KA1958	Prehistoric artifact scatter (same site as 42KA1157 and 42KA1965)	Determined Eligible	Sunny/ Rainy Day APEs
42KA1960	Prehistoric artifact scatter	Determined Not Eligible	Sunny/ Rainy Day APEs
42KA1965	Prehistoric artifact scatter (same site as 42KA1157 and 42KA1958)	Determined Eligible	Rainy Day APE
42KA2192	Historic inscription	Recommended Not Eligible	Sunny/ Rainy Day APEs
42KA2416	Prehistoric artifact scatter	Recommended Not Eligible	Visual APE
42KA2417	Prehistoric lithic scatter	Determined Eligible	Visual APE
42KA3899	Prehistoric campsite	Determined Eligible	Visual APE
42KA3922	Prehistoric habitation	Determined Eligible	Visual APE
42KA3928	Prehistoric lithic scatter	Determined Not Eligible	Visual APE
42KA3929	Prehistoric artifact scatter	Determined Eligible	Visual APE
42KA3930	Prehistoric habitation	Determined Eligible	Visual APE
42KA3931	Prehistoric ceramic scatter	Determined Not Eligible	Visual APE
42KA3932	Prehistoric lithic scatter	Determined Not Eligible	Visual APE
42KA3933	Prehistoric artifact scatter	Determined Not Eligible	Visual APE
42KA4226	Historic road (*Old U.S. Highway 89/ State Route 89*)	Determined Eligible	Sunny/ Rainy Day APEs
42KA4293	Prehistoric rockshelter	Determined Eligible	Sunny/ Rainy Day APEs
42KA4527	Prehistoric rock art	Recommended Eligible	Sunny/ Rainy Day APEs
42KA4538	Historic bridge abutment	Determined Not Eligible	Sunny/ Rainy Day APEs
42KA4539	Historic ditch/flume	Determined Not Eligible	Sunny/ Rainy Day APEs
42KA5574	Prehistoric artifact scatter and depressions	Determined Eligible	Sunny/ Rainy Day APEs
42KA5577	Prehistoric petroglyph panel	Determined Eligible	Sunny/ Rainy Day APEs
42KA5583	Prehistoric campsite	Determined Eligible	Sunny/ Rainy Day APEs
42KA5584	Historic signature panel	Determined Eligible	Sunny/ Rainy Day APEs
42KA5585	Multi-component: prehistoric petroglyphs; historic inscriptions	Determined Eligible	Sunny/ Rainy Day APEs
42KA5586	Prehistoric petroglyphs	Determined Eligible	Sunny/ Rainy Day APEs

TABLE 4. PREVIOUSLY IDENTIFIED CULTURAL RESOURCE SITES WITHIN EACH AREA OF POTENTIAL EFFECT			
Site No.	**Description**	**Eligibility**	**Location**
42KA5904	Multi-component: prehistoric rockshelter; historic inscriptions	Recommended Eligible	Sunny/ Rainy Day APEs
42KA6243	Prehistoric campsite	Determined Eligible	Sunny/ Rainy Day APEs
42KA6245	Historic flood control ditch	Determined Eligible	Sunny/ Rainy Day APEs
42KA6765	Prehistoric rock art	Recommended Eligible	Sunny/ Rainy Day APEs
42KA6890	Muti-component: prehistoric habitation; historic borrow pit and debris scatter	Recommended Eligible	Sunny/ Rainy Day APEs
42KA7186	Historic irrigation pond	Determined Not Eligible	Sunny/ Rainy Day APEs
42KA7537	Prehistoric cave and artifact scatter	Determined Eligible	Direct APE
42KA7712	Historic flume	Determined Eligible	Sunny/ Rainy Day APEs
42KA7716	Historic foundation	Determined Not Eligible	Sunny/ Rainy Day APEs
42KA7717	Prehistoric campsite	Determined Eligible	Sunny/ Rainy Day APEs
42KA7725	Historic check dams	Determined Eligible	Sunny/ Rainy Day APEs
42KA8601	Prehistoric artifact scatter	Determined Eligible	Sunny/ Rainy Day APEs
42KA8602	Prehistoric artifact scatter	Determined Eligible	Sunny/ Rainy Day APEs
42KA8840	Prehistoric rock writing (*Parunuweap Rock Art Panel*)	In Progress—TBD	Sunny/ Rainy Day APEs
42KA8900	Historic artifact scatter	Determined Not Eligible	Direct/ Visual/ Sunny/ Rainy Day APEs
42KA8902	Historic artifact scatter	Determined Not Eligible	Direct/ Visual/ Sunny/ Rainy Day APEs
42KA8903	Historic artifact scatter	Determined Not Eligible	Direct / Visual APEs
42KA8904	Prehistoric artifact scatter	Determined Eligible	Direct / Visual APEs
42KA8974	Prehistoric artifact scatter	Determined Eligible	Direct APE
42KA9490	Historic ditch (*Mount Carmel Irrigation Ditch [West Ditch]*)	Determined Eligible	Direct/ Visual/ Sunny/ Rainy Day APEs
42KA9491	Historic ditch (*Mount.Carmel Irrigation Ditch [East Ditch]*)	Determined Eligible	Visual/ Sunny/ Rainy Day APEs
42KA9492	Historic road *(Lamb's Lane)*	Determined Not Eligible	Sunny/ Rainy Day APEs

TABLE 4. PREVIOUSLY IDENTIFIED CULTURAL RESOURCE SITES WITHIN EACH AREA OF POTENTIAL EFFECT			
Site No.	**Description**	**Eligibility**	**Location**
42KA9493	Historic road (Tait Lane)	Determined Not Eligible	Sunny/ Rainy Day APEs
42KA9589	Historic rock retention rock wall complex	Determined Not Eligible	Sunny/ Rainy Day APEs
42KA9789	Prehistoric campsite	Determined Eligible	Direct APE
42KA9790	Historic lateral ditch	Determined Not Eligible	Visual/ Sunny/ Rainy Day APEs
42WS0064	Prehistoric rockshelter with pictographs	*Unevaluated*	Sunny/ Rainy Day APEs
42WS0144	Prehistoric habitation	*Unevaluated*	Sunny/ Rainy Day APEs
42WS0305	Prehistoric rockshelter and artifact scatter	Recommended Eligible	Sunny/ Rainy Day APEs
42WS0337	Historic townsite (*Duncan's Retreat*)	Determined Not Eligible	Sunny/ Rainy Day APEs
42WS0395	Prehistoric rockshelter, petroglyphs, and artifact scatter	Recommended Eligible	Sunny/ Rainy Day APEs
42WS0396	Prehistoric rockshelter and artifact scatter	*Unevaluated*	Sunny/ Rainy Day APEs
42WS0404	Prehistoric artifact scatter	Recommended Eligible	Sunny/ Rainy Day APEs
42WS0486	Prehistoric habitation	*Unevaluated*	Rainy Day APE
42WS0795	Prehistoric lithic scatter	Determined Eligible	Rainy Day APE
42WS0796	Prehistoric artifact scatter	*Unevaluated*	Rainy Day APE
42WS0807	Prehistoric artifact scatter	Determined Not Eligible	Sunny/ Rainy Day APEs
42WS1158	Prehistoric village: petroglyph, pit structure; 3 room blocks; 5 habitation rooms, 12 storage rooms	Listed; Contributing	Sunny/ Rainy Day APEs
42WS1160	Prehistoric petroglyph panel and artifact scatter	Listed; Contributing	Sunny/ Rainy Day APEs
42WS1170	Prehistoric habitation	*Unevaluated*	Sunny/ Rainy Day APEs
42WS1175	Prehistoric rockshelter with slab lines cists	*Unevaluated*	Sunny/ Rainy Day APEs
42WS1176	Prehistoric habitation	*Unevaluated*	Sunny/ Rainy Day APEs
42WS1352	Prehistoric artifact scatter	*Unevaluated*	Sunny/ Rainy Day APEs
42WS1650	Prehistoric artifact scatter	Recommended Not Eligible	Rainy Day APE
42WS1659	Prehistoric habitation	Recommended Eligible	Rainy Day APE
42WS1665	Prehistoric artifact scatter and possible structure	Recommended Eligible	Rainy Day APE
42WS1681	Prehistoric habitation	Recommended Eligible	Rainy Day APE

TABLE 4. PREVIOUSLY IDENTIFIED CULTURAL RESOURCE SITES WITHIN EACH AREA OF POTENTIAL EFFECT			
Site No.	**Description**	**Eligibility**	**Location**
42WS1682	Prehistoric habitation	Recommended Eligible	Rainy Day APE
42WS1728	Prehistoric petroglyphs	Recommended Eligible	Sunny/ Rainy Day APEs
42WS1781	Prehistoric rockshelter and lithic scatter	Recommended Not Eligible	Sunny/ Rainy Day APEs
42WS1793	Prehistoric habitation and artifact scatter (two structures)	Listed; Contributing	Sunny/ Rainy Day APEs
42WS2114	Prehistoric rockshelter and dry laid masonry wall	Determined Not Eligible	Rainy Day APE
42WS2226	Prehistoric artifact scatter	Recommended Eligible	Rainy Day APE
42WS2273	Historic canal/syphon system	*Unevaluated*	Sunny/ Rainy Day APEs
42WS2356	Historic bridge (*Harrisburg Bridge, Berry Springs Bridge or Virgin River Bridge*)	Determined Not Eligible	Sunny/ Rainy Day APEs
42WS2556	Prehistoric artifact scatter	Determined Not Eligible	Rainy Day APE
42WS2795	Historic canal	Recommended Eligible	Sunny/ Rainy Day APEs
42WS2796	Historic canal	Recommended Eligible	Sunny/ Rainy Day APEs
42WS2799	Historic sawmill and artifact scatter	Recommended Eligible	Sunny/ Rainy Day APEs
42WS2809	Historic canal	Recommended Eligible	Sunny/ Rainy Day APEs
42WS3344	Historic ditch (*Springdale Irrigation Ditch*)	Determined Eligible	Sunny/ Rainy Day APEs
42WS3673	Prehistoric bedrock mortars	Determined Eligible	Sunny/ Rainy Day APEs
42WS4397	Historic road (*Road to Virgin City*)	Determined Eligible	Sunny/ Rainy Day APEs
42WS5515	Historic road	Determined Not Eligible	Rainy Day APE
42WS6113	Historic townsite (*Grafton Townsite*)	Listed	Sunny/ Rainy Day APEs
42WS6242	Historic site (indeterminate)	In Progress—TBD	Sunny/ Rainy Day APEs
42WS6789	Prehistoric petroglyph panel	Determined Eligible	Rainy Day APE
*Note: Location indicates which APE (Direct, Sunny Day, Rainy Day, or Visual) overlaps each site.			

UTAH ROCK ART RESEARCH ASSOCIATION ROCK IMAGERY

Background research conducted July 15, 2026, indicates that there is one URARA rock imagery location within an overlapping portion of the Sunny Day and Rainy Day APEs (also in-progress site 42KA8840) (USHPO 2026a).

UTAH REVISED STATUTE 2477 ROADS

The Utah Revised Statute (RS) 2477 Right-of-Way roads layer was reviewed on Utah SHPO's Sego website on July 15, 2025 (USHPO 2026a). This review identified one RS2477 road that crosses only the Visual APE; one RS2477 road that crosses both the Visual APE and Sunny Day/Rainy Day APEs; and five RS2477 roads that cross both the Sunny Day and Rainy Day APEs (**Table 5**). These roads do not meet the site criteria for a formal VEA, and Muddy Canyon Road, is a type "B" road, which is typically a county road located outside of incorporated municipalities, not designated as a state highway, which serves as rural route for farming, ranching, and recreation, connecting communities and providing access to public lands. Although a reservoir breach could cause damage or changes to the roads, the significance of the roads has already been compromised from continuous use and maintenance; therefore, they would not experience any additional significant impacts from the Indirect Breach Inundation (Sunny and Rainy Day) APEs that would further damage their historic significance.

TABLE 5.
RS2477 ROADS WITHIN THE PROJECT APE

Road ID	County No.	Class	Steet Name	Length (Miles)	Location*
RD130173	K2110	D	*Twin Hollow Road*	5.97	Visual APE
RD130181	K2150	B	*Muddy Canyon Road*	3.05	Visual APE, Sunny Day/ Rainy Day APEs
RD130274	K2735	D	*State Barn Ridge Road*	2.97	Sunny Day/ Rainy Day APEs
RD130073	K1300	B	*Elephant Cove Road (two segments)*	2.67, 17.15	Sunny Day/ Rainy Day APEs
RD130071	K1297	D	*Steep Trail Road*	2.41	Sunny Day/ Rainy Day APEs
RD130131	K1615	D	*K1615 Kane County*	1.88	Sunny Day/ Rainy Day APEs
RD270397	0397	B	*Sheep Bridge Road*	6.02	Sunny Day/ Rainy Day APEs

*Note: Location indicates which APE (Direct, Sunny Day, Rainy Day, or Visual) overlaps each site.

UTAH NRHP DISTRICTS

Two NRHP districts (Grafton Historic District and Parunuweap Canyon Archaeological District) overlap both the Sunny Day and Rainy Day APEs (USHPO 2026c). The Grafton Historic District encompasses the historic townsite of Grafton, Utah, which was a Mormon agricultural settlement that was established in 1861 and subsequently abandoned in 1945 (Lufkin 2010). The district is located along the Virgin River approximately 2 miles west of Rockville and adjacent to Zion National Park; it can be accessed via Bridge Road across the historic Rockville Bridge and remains one of Utah's best-preserved ghost towns which displays the settlement patterns, architecture, and agricultural practices of early Mormon colonization in southern Utah (Lufkin 2010). The district is listed on the NRHP under Criterion A for its association with events that have made a significant contribution to the broad patterns of our history, and it preserves a rare and largely intact example of a 19-century rural community with contributing resources including four historic residences, a church/schoolhouse, five agricultural outbuildings, five building foundations, the footings of a historic bridge, and associated roads, irrigation ditches, orchards, fields, fences, and other landscape features (Lufkin 2010). The Grafton Historic District retains its historic grid

layout, rural setting, and agricultural character, reflecting the community's reliance on irrigation and farming within the arid Virgin River Valley (Lufkin 2010). Although a reservoir breach could cause damage or changes to the outer perimeter of the district boundary, the contributing historic structures within the district would not experience significant impacts from the Indirect Breach Inundation (Sunny and Rainy Day) APEs that would damage their historic significance (**Figure 1**).



Figure 1. Overview showing the Sunny Day and Rainy Day APEs (overlapping) in purple and the Grafton Historic District in yellow (USHPO 2026c).

The Parunuweap Canyon Archaeological District is located inside of Zion National Park within an extremely steep-sided canyon that was formed by the East Fork of the Virgin River cutting through sedimentary rock of Jurassic and Triassic age consisting of Navajo sandstone, Kayenta formation, Moenave formation (including the Springdale sandstone member), as well as the upper layer of the Petrified Forest member of the Chinle formation (Stokes 1986; Horn 1996). Parunuweap Canyon's favorable climate and abundant natural resources supported human populations during the Ancestral Puebloan period and possibly the Southern Paiute occupation. Its near-pristine vegetation shows that the canyon remains largely unaltered, unlike heavily developed and accessible Zion Canyon (Horn 1996). Parunuweap Canyon is unique because most agricultural and historic activities did not significantly disturb its terraces or archaeological sites, unlike nearby canyons; however, natural erosion has likely damaged or removed some sites. Archaeological research began in 1933 under Ben Wetherill, who documented 14 sites and excavated at least five, representing several Anasazi cultural periods. Much of his later report and field notes were lost in a fire, though some information and artifacts survived for later study (Horn 1996). Russell K. Grater, Park Naturalist for Zion National Park, documented 57 sites between 1941 and 1946 in the park, including revisits to several of the sites recorded and excavated by Wetherill in

Parunuweap Canyon, and assigned Zion Archaeological Survey (ZAS) numbers to them (Horn 1996). In 1982, National Park Service researchers Cindy Beaudett and Deborah Armstrong attempted to relocate the sites previously recorded by Wetherill and Grater in Parunuweap Canyon. Although field notes from their work exist, no formal report or site records appear to have been produced (Horn 1996). In 1984, crews from the Midwest Archeological Center in Lincoln, Nebraska, returned to Zion National Park under the direction of Susan Vetter to survey areas of the park, including Parunuweap Canyon, that could be affected by visitor use (Horn 1996). During the survey, numerous previously undocumented sites were briefly recorded, and several previously known sites were relocated (Horn 1996). The National Park Service contracted with Alpine Archaeological Consultants, Inc., in 1991 to conduct an archaeological assessment of prehistoric structural remains in Zion National Park which resulted in the documentation of 16 previously recorded sites in Parunuweap Canyon (Horn 1996).

The archaeological sites within Parunuweap Canyon are significant under Criteria C and D because they represent the distinctive Virgin Anasazi culture and have contributed greatly to understanding the region's prehistoric peoples. Ben Wetherill's 1934 excavations recovered important artifacts and architectural evidence that helped establish the Virgin Anasazi as a distinct cultural variant. The sites also have the potential to provide further information about both the Virgin Anasazi and later Southern Paiute cultures. While some of Wetherill's excavated sites still contain intact cultural deposits, many other sites in the canyon remain unexcavated and may preserve valuable archaeological information (Horn 1996). Parunuweap Canyon's archaeological sites represent a small community that used the canyon's resources in diverse ways over a long period, from permanent settlements and field houses to short-term resource-gathering locations. These sites may reveal how population, settlement patterns, and resource use changed over time, offering broader insights into Virgin Anasazi culture and possibly later Southern Paiute use of the canyon. The canyon's unique transition between Sonoran life zones also provides opportunities to study human adaptation to an arid environment (Horn 1996).

The archaeological sites within Parunuweap Canyon would likely experience minimal to no direct impacts from indirect breach inundation because many are situated on elevated terraces, benches, or other areas above the canyon floor and outside the primary flood pathway. The canyon's topography and steep, confined terrain would further limit the lateral spread of floodwaters. Although localized erosion or sediment deposition could potentially affect sites near drainage channels, the anticipated inundation would not be expected to substantially damage or disturb intact archaeological deposits. Therefore, based on the elevated site locations and the anticipated extent of inundation, impacts from the Indirect Breach Inundation (Sunny and Rainy Day) APEs is unlikely to result in significant adverse effects to the district's archaeological resources, which include only contributing sites 42WS1158 (also recorded as 42WS219 and ZNP-5), 42WS1160 (also recorded as 42WS217 and ZNP-14), and 42WS1793 within the Indirect Breach Inundation (Sunny and Rainy Day) APEs. Site 42WS1158 is located on the north side of the East Fork Virgin River approximately 731 meters east of the Zion Park boundary on the second terrace above the river; site 42WS1160 is located near the edge of the highest East Fork Virgin River terrace; and site 42WS1793 is located at the base of a talus slope and trail on an old river terrace remnant (Naylor II 1992; Naylor II and Frank 1994; Frank 1994).

HISTORIC BUILDINGS/STRUCTURES

Background research conducted on July 15, 2026, for records on file with the Historic Utah Buildings (HUB) online database indicates that there are no previously recorded historic buildings/structures within the Direct APE, 14 historic buildings/structures overlapped by both the Sunny Day and Rainy Day APEs, and six historic buildings/structures within the Visual APE (**Table 6**; USHPO 2026c). Historic buildings/structures within the Visual APE consist of a religious facility (Orderville Latter-day Saints [LDS] Chapel), two schools (Orderville Rock School and Valley School), a bridge (Virgin River Bridge), a residential dwelling (100 South, Orderville), and industrial buildings (Orderville Co-op Buildings). The overlapping Sunny Day and Rainy Day APEs contain a religious facility (Mt. Carmel School and Church), a barn (Steven's Barn), a single swelling (the Dixon, Maynard, House and Studio); three residential buildings associated with the Esplin Ranch, a World War II-Era cottage (the Margaret Tait Home), and seven bridges including the Virgin River Bridge (OD 689), the Muddy Wash Bridge (OD 728), the 105951 Bridge, the Virgin River/ Harrisburg Bridge (OD 350), the East Fork Virgin River Bridge (OC 337), the Rockville Bridge (053019C), and the Hurricane/ LaVerkin Bridge).

Of the six historic buildings/structures within the Visual APE, one has been demolished (Property ID No. [PI No.] 33220 - Orderville Co-op Buildings), and one single dwelling is considered Ineligible/Non-contributing (PI No. 135092 - 100 South, Orderville). The four remaining buildings/structures located within the Visual APE (PI Nos. 31067, 32819, 50442, and 33219) are in Orderville, and the proposed Cove Reservoir would be obstructed from view by means of several ridges southwest of Gardner Hollow; additionally, these structures are located in a small-town environment surrounded by modern developments.

Of the 14 historic buildings/structures within the overlapping Sunny Day/Rainy Day APEs, one has been demolished (PI# 50974 - Muddy Wash Bridge [OD 728]), and a Google Earth review indicates that Steven's Barn (Property ID NO. 31786) has also likely been demolished as it does not appear to be in the location plotted in the HUB. Additionally, one building (PI No. 300560, an Esplin Ranch Building) is considered out-of-period as it dates to 2008, and five historic buildings/structures are considered Ineligible/Non-contributing (PI Nos. 105951, 130748, 300558, 300559, 3005610. The six remaining historic buildings/structures include two historic bridges with undetermined NRHP eligibility statuses: PI No. 7339 - Virgin River Bridge (OC 183), and PI No. 108043 - Virgin River/ Harrisburg Bridge (OD 350); two Eligible/National Register Individually Listed historic bridges: PI No. 115917 - Hurricane/ LaVerkin Bridge and PI No. 17795 - Rockville Bridge (053019C); the Mt. Carmel School and Church (Property ID No. 37252), and the Dixon, Maynard, House and Studio (Property ID No. 40479).

The Dixon, Maynard, House and Studio (Property ID No. 40479) is slightly elevated from the surrounding Long Valley floor and just over 1 mile away from the proposed Cove Reservoir, and the Mt. Carmel School and Church (Property ID No. 37252) is located along US-89 and is approximately 1.60 miles from the edge of the proposed Cove Reservoir; both of these buildings and each of the four bridges (all located within Washington County) are within the overlapping Indirect Breach Inundation Sunny Day/ Rainy Day APEs but are unlikely to be adversely impacted by the failure of the proposed Cove Reservoir due to distance, elevation, and the proposed reservoir safety features.

TABLE 6. PREVIOUSLY IDENTIFIED HISTORIC STRUCTURES WITHIN THE PROJECT AREA OF POTENTIAL EFFECTS									
Property ID No.	**Property Name**	**Street Address**	**Construction Year**	**Plan Type**	**Style**	**Original Use**	**Eligibility**	**NRHP Status**	**Location**
7339	Virgin River Bridge (OC 183)	Zion National Park, Washington County	1929	Bridge	Steel	Road Trans. Related	Undetermined	Not Listed	Sunny/ Rainy Day APEs
17795	Rockville Bridge (053019C)	150 South Bridge Road, Washington County	1924	Bridge	Steel	Road Trans. Related	Eligible/Contributing	NRHP Individually Listed Property	Sunny/ Rainy Day APEs
31067	Orderville LDS Chapel	Orderville, Kane County	Undetermined	Church/ Meetinghouse	Undetermined	Religious Facility	Undetermined	Not Listed	Visual APE
31786	Stevens Barn	Stevens Lane, Mt. Carmel, Kane County	1867	Barn-Other	Undefined	Agricultural (Gen.)	Undetermined	Not Listed	Sunny/ Rainy Day APEs
32819	Orderville Rock School	Orderville, Kane County	1890	Undetermined	Undetermined	School	Eligible/Contributing	Not Listed	Visual APE
33219	Virgin River Bridge (OD 689)	Off Highway 89, Orderville, Kane County	1932	Bridge	Concrete/Other	Road Trans. Related	Eligible/Contributing	Not Listed	Visual APE
33220	Orderville Co-op Buildings	Orderville, Kane County	1878	Mining—Other/Misc.	Plank Siding	Industrial (Gen.)	Demolished	Not Listed	Visual APE
37252	Mt. Carmel School and Church	Off Highway 89, Mt. Carmel, Kane County	1890	Crosswing	Stone: Other/Undefined	Religious Facility	Eligible/Contributing	NRHP Individually Listed Property	Sunny/ Rainy Day APEs
40479	Dixon, Maynard, House and Studio	Off Highway 89, Mt. Carmel, Kane County	1939	Other Residential Type	Round Logs	Single Dwelling	Eligible/Contributing	NRHP Individually Listed Property	Sunny/ Rainy Day APEs
50442	Valley School	Off Highway 89, Orderville, Kane County	1935	Horizontal School	Brick:Other/ Undefined	School	Eligible/Contributing	NRHP Individually Listed Property	Visual APE
50974	Muddy Wash Bridge (OD 728)	US-89, Orderville, Kane County	1932	Bridge	Concrete/Other	Road Trans. Related	Demolished	Not Listed	Sunny/ Rainy Day APEs
105951	Bridge	Virgin, Washington County	1940	Bridge	Steel	Road Trans. Related	Ineligible/ Non-contributing	Not Listed	Sunny/ Rainy Day APEs
108043	Virgin River/ Harrisburg Bridge (OD 350)	SR-9, Hurricane, Washington County	1934	Bridge	Concrete/Other	Road Trans. Related	Undetermined	Not Listed	Sunny/ Rainy Day APEs
115917	Hurricane/ LaVerkin Bridge	SR-9, Hurricane, Washington County	1908	Bridge	Other	Road Trans. Related	Eligible/Contributing	NRHP Individually Listed Property	Sunny/ Rainy Day APEs
130748	East Fork Virgin River Bridge OC 337	US-89, Orderville, Kane County	1961	Bridge	Steel	Road Trans. Related	Ineligible/ Non-contributing	Not Listed	Sunny/ Rainy Day APEs
135092	N/A	100 South, Orderville, Kane County	1932	Other Residential Type	Vinyl Siding	Single Dwelling	Ineligible/ Non-contributing	Not Listed	Visual APE
300558	Margaret Tait Home	2660 S State St, Orderville, Kane County	1950	WWII-Era Cottage	Wood/Other/Undefined	Single Dwelling	Ineligible/ Non-contributing	Not Listed	Sunny/ Rainy Day APEs
300559	Esplin Ranch	2710 S State St, Orderville, Kane County	1977	Manufactured Home	Aluminum Siding	Resedential (Gen.)	Ineligible/ Non-contributing	Not Listed	Sunny/ Rainy Day APEs
300560	Esplin Ranch	2720 S State St, Orderville, Kane County	2008	Ranch with Garage	Concrete/Other	Resedential (Gen.)	Out-of-Period	Not Listed	Sunny/ Rainy Day APEs
300561	Esplin Ranch	2910 S State St, Orderville, Kane County	1941	Period Cottage	Concrete/Other	Resedential (Gen.)	Ineligible/ Non-contributing	Not Listed	Sunny/ Rainy Day APEs

*Note: No historic structures are located within the Direct APE. Historic buildings/structures within the Visual APE are highlighted blue.

SUMMARY AND RESULTS

On July 15, 2026, Eocene archaeologists conducted a desktop literature review of the Direct APE, Indirect Breach Inundation (Sunny Day and Rainy Day) APEs, and Visual APE for the proposed Cove Reservoir Project located southwest of Orderville and north of Mount Carmel in Kane County, Utah. This review was requested by Alpha Engineering, per the NRCS, prior to construction concept design finalization to identify cultural resources within the Indirect Breach Inundation (Sunny Day and Rainy Day) APEs and Visual Project APEs that may be impacted by the proposed Project. Important cultural resources may include historic or prehistoric archaeological sites or objects; historically or architecturally significant structures, buildings, or landscapes; and TCPs that are NRHP eligible.

The results of this literature review indicate that there are a total of 158 previously conducted cultural resource surveys that cover 100 percent of the Direct APE, approximately 40 percent of the Visual APE, approximately 32.3 percent of the Sunny Day APE, and approximately 31.4 percent of the Rainy Day APE.

Research identified 96 cultural resources and 20 historic structures within the partially overlapping Direct, the Indirect Breach Inundation (Sunny Day and Rainy Day) APEs, and Visual APEs. None of the previously documented cultural resource sites or historic structures within these APEs meet the site type criteria for inclusion in the visual/indirect literature review and therefore do not require a formal visual effects assessment (**Table 7**). Additionally, the implementation of the Project will not impact the character-defining characteristics of the sites that allow them to convey their significance since visual component is not the character-defining feature that makes the sites eligible, and adverse effects to sites within both the Sunny Day and Rainy Day Indirect Breach Inundation zones are unlikely/minimal due to distance and the proposed reservoir safety features. Therefore, the recommended determination of effect for the Visual APE and the Indirect Breach Inundation (Sunny Day and Rainy Day) APEs is *No Adverse Effect*.

TABLE 7. VISUAL/INDIRECT BREACH INUNDATION (SUNNY DAY AND RAINY DAY) EFFECTS ASSESSMENT LITERATURE REVIEW*								
Site No.	**Description**	**Eligibility**	**Date of Last Recording**	**Land Ownership**	**Site Type Criteria of Concern**	**VEA Required?**	**APE**	**Justification for a VEA or no VEA (ex. Did not meet site type criteria)**
7339	Virgin River Bridge (OC 183)	Undetermined	Unknown	NPS	Historic Structure	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance, elevation, and the proposed reservoir safety features.
17795	Rockville Bridge (053019C)	Eligible/Contributing	Unknown	Town of Rockville (public-local)	Historic Structure	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance, elevation, and the proposed reservoir safety features.
31067	Orderville LDS Chapel	Undetermined	Unknown	Private	Historic Structure	N/A	Visual APE	The proposed Cove Reservoir would be obstructed from view by means of several ridges southwest of Gardner Hollow. The visual component of the structure is not a character-defining feature for eligibility, which is based on its design and historic association, and the structure is already surrounded by modern developments within the town of Orderville.
31786	Stevens Barn	Undetermined	Unknown	Private	Historic Structure	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria; the structure appears to have been demolished.
32819	Orderville Rock School	Eligible/Contributing	1983	Private	Historic Structure	N/A	Visual APE	The proposed Cove Reservoir would be obstructed from view by means of several ridges southwest of Gardner Hollow. The visual component of the structure is not a character-defining feature for eligibility, which is based on its design and historic association, and the structure is already surrounded by modern developments within the town of Orderville.

TABLE 7. VISUAL/INDIRECT BREACH INUNDATION (SUNNY DAY AND RAINY DAY) EFFECTS ASSESSMENT LITERATURE REVIEW*								
Site No.	**Description**	**Eligibility**	**Date of Last Recording**	**Land Ownership**	**Site Type Criteria of Concern**	**VEA Required?**	**APE**	**Justification for a VEA or no VEA (ex. Did not meet site type criteria)**
33219	Virgin River Bridge (OD 689)	Eligible/Contributing	1991	Private	Historic Structure	N/A	Visual APE	The proposed Cove Reservoir would be obstructed from view by means of several ridges southwest of Gardner Hollow. The visual component of the structure is not a character-defining feature for eligibility, which is based on its design and historic association, and the structure is already surrounded by modern developments within the town of Orderville.
33220	Orderville Co-op Buildings	Demolished	1986	Private	Historic Structure	N/A	Visual APE	Does not meet site type criteria; the structure appears to have been demolished.
37252	Mt. Carmel School and Church	Eligible/Contributing	1987	Private	Historic Structure	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance, elevation, and the proposed reservoir safety features.
40479	Dixon, Maynard, House and Studio	Eligible/Contributing	2002	Private	Historic Structure	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance, elevation, and the proposed reservoir safety features.
50442	Valley School	Eligible/Contributing	1985	Private	Historic Structure	N/A	Visual APE	The proposed Cove Reservoir would be obstructed from view by means of several ridges southwest of Gardner Hollow. The visual component of the structure is not a character-defining feature for eligibility, which is based on its design and historic association, and the structure is already surrounded by modern developments within the town of Orderville.
50974	Muddy Wash Bridge (OD 728)	Demolished	Unknown	UDOT	Historic Structure	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria; the structure appears to have been demolished.

TABLE 7. VISUAL/INDIRECT BREACH INUNDATION (SUNNY DAY AND RAINY DAY) EFFECTS ASSESSMENT LITERATURE REVIEW*								
Site No.	**Description**	**Eligibility**	**Date of Last Recording**	**Land Ownership**	**Site Type Criteria of Concern**	**VEA Required?**	**APE**	**Justification for a VEA or no VEA (ex. Did not meet site type criteria)**
105951	Bridge	Ineligible/Non-contributing	Unknown	UDOT	Historic Structure	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria. Also, adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
108043	Virgin River/ Harrisburg Bridge (OD 350)	Demolished	1991	UDOT	Historic Structure	N/A	Sunny/Rainy Day APEs	Demolished in 1991 after sustaining severe damage during the 1990 Virgin River flood. It was replaced by a new bridge on the same route.
115917	Hurricane/ LaVerkin Bridge	Eligible/Contributing	1995	Public-local	Historic Structure	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance, elevation, and the proposed reservoir safety features.
130748	East Fork Virgin River Bridge OC 337	Ineligible/Non-contributing	Unknown	UDOT	Historic Structure	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria. Also, adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
135092	100 South Orderville	Ineligible/Non-contributing	Unknown	Private	Historic Structure	N/A	Visual APE	Does not meet site type criteria
300558	Margaret Tait Home	Ineligible/Non-contributing	2025	Private	Historic Structure	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria. Also, adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
300559	Esplin Ranch	Ineligible/Non-contributing	2025	Private	Historic Structure	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria. Also, adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
300560	Esplin Ranch	Out-of-Period	2025	Private	Historic Structure	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria. Also, adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.

TABLE 7. VISUAL/INDIRECT BREACH INUNDATION (SUNNY DAY AND RAINY DAY) EFFECTS ASSESSMENT LITERATURE REVIEW*								
Site No.	**Description**	**Eligibility**	**Date of Last Recording**	**Land Ownership**	**Site Type Criteria of Concern**	**VEA Required?**	**APE**	**Justification for a VEA or no VEA (ex. Did not meet site type criteria)**
300561	Esplin Ranch	Ineligible/Non-contributing	2025	Private	Historic Structure	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria. Also, adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42KA1156	Prehistoric artifact scatter	Unevaluated	2014	Private	N/A	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria; also not relocated in 2014.
42KA1157	Prehistoric artifact scatter (previously combined with 42KA1958 and 42KA1965)	Determined Eligible—D	2021	Private	N/A	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria; also, adverse effects are unlikely/minimal due to distance, elevation, and the proposed reservoir safety features.
42KA1158	Prehistoric campsite	Unevaluated	2022	Private	N/A	N/A	Direct/Visual APEs	Does not meet site type criteria; also misplotted.
42KA1505	Prehistoric rock writing	Determined Eligible—D	1969	BLM	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance, elevation, and the proposed reservoir safety features. The site is situated on a ledge above the floodplain.
42KA1958	Prehistoric artifact scatter (previously combined with 42KA1157 and 42KA1965)	Determined Eligible—D	2021	Private	N/A	N/A	Sunny/ Rainy Day APEs	Does not meet site type criteria; also, adverse effects are unlikely/minimal due to distance, elevation, and the proposed reservoir safety features.
42KA1960	Prehistoric artifact scatter	Determined Not Eligible	2014	Private	N/A	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria.
42KA1965	Prehistoric artifact scatter (previously combined with 42KA1157 and 42KA1965)	Determined Eligible—D	2021	Private	N/A	N/A	Rainy Day APE	Does not meet the site type criteria; also, adverse effects are unlikely/minimal due to distance, elevation, and the proposed reservoir safety features.

TABLE 7. VISUAL/INDIRECT BREACH INUNDATION (SUNNY DAY AND RAINY DAY) EFFECTS ASSESSMENT LITERATURE REVIEW*								
Site No.	**Description**	**Eligibility**	**Date of Last Recording**	**Land Ownership**	**Site Type Criteria of Concern**	**VEA Required?**	**APE**	**Justification for a VEA or no VEA (ex. Did not meet site type criteria)**
42KA2192	Historic inscription	Recommended Not Eligible	1976	BLM	N/A	N/A	Sunny/Rainy Day APEs	Does not meet the site type criteria; also, adverse effects are unlikely/minimal due to distance, elevation, and the proposed reservoir safety features.
42KA2416	Prehistoric artifact scatter	Recommended Not Eligible	1993	Private	N/A	N/A	Visual APE	Does not meet site type criteria.
42KA2417	Prehistoric lithic scatter	Determined Eligible—D	2006	BLM	N/A	N/A	Visual APE	Does not meet site type criteria; the visual component of the site is not a character-defining feature of site eligibility, which is based on data potential. The site is also located in an area of pinyon-juniper with a blocked or partially blocked view.
42KA3899	Prehistoric campsite	Determined Eligible—D	1993	TLA	N/A	N/A	Visual APE	Does not meet site type criteria; the visual component of the site is not a character-defining feature of site eligibility, which is based on data potential. The site is also located in an area of pinyon-juniper with a blocked or partially blocked view.
42KA3922	Prehistoric habitation	Determined Eligible—D	1993	Private	N/A	N/A	Visual APE	Does not meet site type criteria; the visual component of the site is not a character-defining feature of site eligibility, which is based on data potential. The site is also located in an area of pinyon-juniper with a blocked or partially blocked view.
42KA3928	Prehistoric lithic scatter	Determined Not Eligible	1993	TLA	N/A	N/A	Visual APE	Does not meet site type criteria.

TABLE 7. VISUAL/INDIRECT BREACH INUNDATION (SUNNY DAY AND RAINY DAY) EFFECTS ASSESSMENT LITERATURE REVIEW*								
Site No.	**Description**	**Eligibility**	**Date of Last Recording**	**Land Ownership**	**Site Type Criteria of Concern**	**VEA Required?**	**APE**	**Justification for a VEA or no VEA (ex. Did not meet site type criteria)**
42KA3929	Prehistoric artifact scatter	Determined Eligible—D	1993	Private	N/A	N/A	Visual APE	Does not meet site type criteria; the visual component of the site is not a character-defining feature of site eligibility, which is based on data potential. The site is also located in an area of pinyon-juniper with a blocked or partially blocked view.
42KA3930	Prehistoric habitation	Determined Eligible—D	1993	Private	N/A	N/A	Visual APE	Does not meet site type criteria; the visual component of the site is not a character-defining feature of site eligibility, which is based on data potential. The site is also located in an area of pinyon-juniper with a blocked or partially blocked view.
42KA3931	Prehistoric ceramic scatter	Determined Not Eligible	1993	Private	N/A	N/A	Visual APE	Does not meet site type criteria.
42KA3932	Prehistoric lithic scatter	Determined Not Eligible	1993	Private	N/A	N/A	Visual APE	Does not meet site type criteria.
42KA3933	Prehistoric artifact scatter	Determined Not Eligible	1993	Private	N/A	N/A	Visual APE	Does not meet site type criteria.
42KA4226	Historic road (*Old U.S. Highway 89/ State Route 89*)	Determined Eligible—A	2022	BLM, Private, SITLA, UDOT, USFS	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance, elevation, and the proposed reservoir safety features.
42KA4293	Prehistoric rockshelter	Determined Eligible—D	1995	BLM	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance, elevation, and the proposed reservoir safety features.
42KA4527	Prehistoric rock art	Recommended Eligible—D	2008	BLM	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance, elevation, and the proposed reservoir safety features.
42KA4538	Historic bridge abutment	Determined Not Eligible	2021	Private	N/A	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria.

TABLE 7. VISUAL/INDIRECT BREACH INUNDATION (SUNNY DAY AND RAINY DAY) EFFECTS ASSESSMENT LITERATURE REVIEW*								
Site No.	**Description**	**Eligibility**	**Date of Last Recording**	**Land Ownership**	**Site Type Criteria of Concern**	**VEA Required?**	**APE**	**Justification for a VEA or no VEA (ex. Did not meet site type criteria)**
42KA4539	Historid ditch/flume	Determined Not Eligible	2021	Private	N/A	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria.
42KA5574	Prehistoric artifact scatter and depressions	Determined Eligible—D	2000	BLM	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance, elevation, and the proposed reservoir safety features.
42KA5577	Prehistoric petroglyph panel	Determined Eligible—D	2000	BLM	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance, elevation, and the proposed reservoir safety features.
42KA5583	Prehistoric campsite	Determined Eligible—D	2000	BLM	N/A	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria.
42KA5584	Historic signature panel	Determined Eligible—A	2000	BLM	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features. Additionally, the panel is just above a detached boulder that allowed the signatures to be 15 to 20 feet above the floor of the canyon.
42KA5585	Multi-component: prehistoric petroglyphs; historic inscriptions	Determined Eligible—D	2000	BLM	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features. Additionally, the panel is located at the base of a trail that is elevated over the surrounding terrain.
42KA5586	Prehistoric petroglyphs	Determined Eligible—D	2000	BLM	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features. Additionally, the panel is located in short narrow cleft in a cliff wall that is elevated over the surrounding terrain.

TABLE 7. VISUAL/INDIRECT BREACH INUNDATION (SUNNY DAY AND RAINY DAY) EFFECTS ASSESSMENT LITERATURE REVIEW*								
Site No.	**Description**	**Eligibility**	**Date of Last Recording**	**Land Ownership**	**Site Type Criteria of Concern**	**VEA Required?**	**APE**	**Justification for a VEA or no VEA (ex. Did not meet site type criteria)**
42KA5904	Multi-component: prehistoric rockshelter; historic inscriptions	Recommended Eligible—D	2002	BLM	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance, elevation, and the proposed reservoir safety features.
42KA6243	Prehistoric campsite	Determined Eligible—D	2006	BLM, Private	N/A	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria; also, adverse effects are unlikely/minimal due to distance, elevation, and the proposed reservoir safety features.
42KA6245	Historic flood control ditch	Determined Eligible—A/C	2006	Private	N/A	N/A	Sunny/Rainy Day APEs	The visual component of the site is not a character-defining feature to site eligibility, which is based on its design and association with Civilian Conservation Corps activities; the potential for additional waterflow would not impact the site.
42KA6765	Prehistoric rock art	Recommended Eligible—D	2008	BLM	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features. Additionally, the panel is located on the east wall of a slot canyon that is elevated over the surrounding terrain.
42KA6890	Muti-component: prehistoric habitation; historic borrow pit and debris scatter	Recommended Eligible—D	2010	Private	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42KA7186	Historic irrigation pond	Determined Not Eligible	2011	TLA	N/A	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria; also, adverse effects are unlikely/minimal due to distance, elevation, and the proposed reservoir safety features.

TABLE 7. VISUAL/INDIRECT BREACH INUNDATION (SUNNY DAY AND RAINY DAY) EFFECTS ASSESSMENT LITERATURE REVIEW*								
Site No.	**Description**	**Eligibility**	**Date of Last Recording**	**Land Ownership**	**Site Type Criteria of Concern**	**VEA Required?**	**APE**	**Justification for a VEA or no VEA (ex. Did not meet site type criteria)**
42KA7537	**Prehistoric cave and artifact scatter**	**Determined Eligible—D**	**2023**	**Private**	**Prehistoric cave/ rockshelter**	**N/A**	**Direct APE**	**The site is located in the Direct APE near Esplin Pit outside of the Indirect Breach Inundation APEs, and the Visual APE will not be impacted.**
42KA7712	Historic flume	Determined Eligible—A	2013	Private	N/A	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria; the potential for additional waterflow would not impact the site.
42KA7716	Historic foundation	Determined Not Eligible	2013	Private	N/A	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria.
42KA7717	Prehistoric campsite	Determined Eligible—D	2014	Private	N/A	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria; also, adverse effects are unlikely/minimal due to distance, elevation, and the proposed reservoir safety features.
42KA7725	Historic check dams	Determined Eligible—A	2013	Private	N/A	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria; the potential for additional waterflow would not impact the site.
42KA8601	Prehistoric artifact scatter	Determined Eligible—D	2017	BLM	N/A	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria.
42KA8602	Prehistoric artifact scatter	Determined Eligible—D	2017	BLM	N/A	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria.
42KA8840	Prehistoric rock writing (Parunuweap Rock Art Panel	*In Progress*	*In Progress*	BLM	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42KA8900	Historic artifact scatter	Determined Not Eligible	2018	Private	N/A	N/A	Direct/Visual/ Sunny/Rainy Day APEs	Does not meet site type criteria.
42KA8902	Historic artifact scatter	Determined Not Eligible	2018	Private	N/A	N/A	Direct/Visual/ Sunny/Rainy Day APEs	Does not meet site type criteria.

TABLE 7. VISUAL/INDIRECT BREACH INUNDATION (SUNNY DAY AND RAINY DAY) EFFECTS ASSESSMENT LITERATURE REVIEW*								
Site No.	**Description**	**Eligibility**	**Date of Last Recording**	**Land Ownership**	**Site Type Criteria of Concern**	**VEA Required?**	**APE**	**Justification for a VEA or no VEA (ex. Did not meet site type criteria)**
42KA8903	Historic artifact scatter	Determined Not Eligible	2018	Private	N/A	N/A	Direct/Visual APEs	Does not meet site type criteria.
42KA8904	Prehistoric artifact scatter	Determined Eligible—D	2018	Private	N/A	N/A	Direct/Visual APEs	Does not meet site type criteria. The site is adjacent to the future reservoir high-water line; however, the NRCS previously conducted a tribal visit, and this site was not a concern.
42KA8974	Prehistoric artifact scatter	Determined Eligible—D	2018	Private	N/A	N/A	Direct APE	Does not meet site type criteria; the site is actively eroding and being lost to an expanding gravel pit and will be avoided during dam construction.
42KA9490	Historic ditch (*Mount Carmel Irrigation Ditch [West Ditch]*)	Determined Eligible—A	2022	Private	N/A	N/A	Direct/Visual/ Sunny/Rainy Day APEs	Does not meet site type criteria; the visual component of the site is not a character-defining feature of site eligibility. The site will be impacted by pipe construction and mitigated per Memorandum of Agreement (MOA).
42KA9491	Historic ditch (*Mount.Carmel Irrigation Ditch [East Ditch]*)	Determined Eligible—A	2018	Private, BLM	N/A	N/A	Visual/Sunny/ Rainy Day APEs	Does not meet site type criteria; the visual component of the site is not a character-defining feature of site eligibility. The site will be impacted by pipe construction and mitigated per MOA.
42KA9492	Historic road *(Lamb's Lane)*	Determined Not Eligible	2022	Private	N/A	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria
42KA9493	Historic road (Tait Lane)	Determined Not Eligible	2022	Private	N/A	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria
42KA9589	Historic rock retention rock wall complex	Determined Not Eligible	2022	Private	N/A	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria
42KA9789	Prehistoric campsite	Determined Eligible—D	2023	Private	N/A	N/A	Direct APE	Does not meet site type criteria; the site will be avoided by dam construction.

TABLE 7. VISUAL/INDIRECT BREACH INUNDATION (SUNNY DAY AND RAINY DAY) EFFECTS ASSESSMENT LITERATURE REVIEW*								
Site No.	**Description**	**Eligibility**	**Date of Last Recording**	**Land Ownership**	**Site Type Criteria of Concern**	**VEA Required?**	**APE**	**Justification for a VEA or no VEA (ex. Did not meet site type criteria)**
42KA9790	Historic lateral ditch	Determined Not Eligible	2023	Private	N/A	N/A	Visual/Sunny/ Rainy Day APEs	Does not meet site type criteria.
42WS0064	Prehistoric rockshelter with pictographs	Unevaluated	1949	Private	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS0144	Prehistoric habitation	Unevaluated	1949/2022	Private	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features. The site was revisited as part of the Site Stewardship Program in 2022 but was not evaluated for the NRHP.
42WS0305	Prehistoric rockshelter and artifact scatter	Recommended Eligible—D	1983	Private	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS0337	Historic townsite (*Duncan's Retreat*)	Determined Not Eligible	2017	BLM, Private	N/A	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria.
42WS0395	Prehistoric rockshelter, petroglyphs, and artifact scatter	Recommended Eligible—D	1982	BLM, Private	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS0396	Prehistoric rockshelter and artifact scatter	*Unevaluated*	1970	BLM, Private	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS0404	Prehistoric artifact scatter	Recommended Eligible—D	2018	BLM	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS0486	Prehistoric habitation	*Unevaluated*	1974	BLM	N/A	N/A	Rainy Day APE	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.

TABLE 7. VISUAL/INDIRECT BREACH INUNDATION (SUNNY DAY AND RAINY DAY) EFFECTS ASSESSMENT LITERATURE REVIEW*								
Site No.	**Description**	**Eligibility**	**Date of Last Recording**	**Land Ownership**	**Site Type Criteria of Concern**	**VEA Required?**	**APE**	**Justification for a VEA or no VEA (ex. Did not meet site type criteria)**
42WS0795	Prehistoric lithic scatter	Determined Eligible—D	2023	Private	N/A	N/A	Rainy Day APE	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS0796	Prehistoric artifact scatter	*Unevaluated*	1976	Private	N/A	N/A	Rainy Day APE	Does not meet site type criteria.
42WS0807	Prehistoric artifact scatter	Determined Not Eligible	2025	Private	N/A	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria. Also, adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS1158	Prehistoric village: petroglyph, pit structure; 3 room blocks; 5 habitation rooms, 12 storage rooms	Listed; Contributing	1994	NPS	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features. Additionally, the site has been excavated.
42WS1160	Prehistoric petroglyph panel and artifact scatter	Listed; Contributing	1994	NPS	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS1170	Prehistoric habitation	Unevaluated	1978	Private	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS1175	Prehistoric rockshelter with slab lines cists	Unevaluated	1978	Private	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS1176	Prehistoric habitation	Unevaluated	1978	Private	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS1352	Prehistoric artifact scatter	Unevaluated	1980	BLM	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.

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Site No.	**Description**	**Eligibility**	**Date of Last Recording**	**Land Ownership**	**Site Type Criteria of Concern**	**VEA Required?**	**APE**	**Justification for a VEA or no VEA (ex. Did not meet site type criteria)**
42WS1650	Prehistoric artifact scatter	Recommended Not Eligible	1983	BLM, Private	N/A	N/A	Rainy Day APE	Does not meet site type criteria. Also, adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS1659	Prehistoric habitation	Recommended Eligible—D	1983	BLM	N/A	N/A	Rainy Day APE	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS1665	Prehistoric artifact scatter and possible structure	Recommended Eligible—D	1983	BLM	N/A	N/A	Rainy Day APE	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS1681	Prehistoric habitation	Recommended Eligible—D	1983	BLM	N/A	N/A	Rainy Day APE	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS1682	Prehistoric habitation	Recommended Eligible—D	1983	BLM	N/A	N/A	Rainy Day APE	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS1728	Prehistoric petroglyphs	Recommended Eligible—D	1969	Private	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS1781	Prehistoric rockshelter and lithic scatter	Recommended Not Eligible	1994	NPS	N/A	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria. Also, there appears to be a limited amount of fill within the shelter, and the associated artifacts suggest that this was a limited use site where core reduction and/or tool production or maintenance activities were occurring.
42WS1793	Prehistoric habitation and artifact scatter (two structures)	Listed; Contributing	1994	NPS	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.

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Site No.	**Description**	**Eligibility**	**Date of Last Recording**	**Land Ownership**	**Site Type Criteria of Concern**	**VEA Required?**	**APE**	**Justification for a VEA or no VEA (ex. Did not meet site type criteria)**
42WS2114	Prehistoric rockshelter and dry laid masonry wall	Determined Not Eligible	1988	BLM, SITLA	N/A	N/A	Rainy Day APE	Does not meet site type criteria. Test excavations determined there is no cultural depth.
42WS2226	Prehistoric artifact scatter	Recommended Eligible—D	1986	Private	N/A	N/A	Rainy Day APE	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS2273	Historic canal/syphon system	*Unevaluated*	2025	BLM, Private	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features. Also, the site was not relocated in 2025.
42WS2356	Historic bridge (*Harrisburg Bridge, Berry Springs Bridge or Virgin River Bridge*)	Determined Not Eligible	2025	Private	N/A	N/A	Sunny/Rainy Day APEs	Does not meet site type criteria. Also, the bridge has been removed and replaced with modern components and is no longer considered an archaeological site.
42WS2556	Prehistoric artifact scatter	Determined Not Eligible	1994	Private	N/A	N/A	Rainy Day APE	Does not meet site type criteria. Also, the completion of full-scale excavations at the site have exhausted its information potential.
42WS2795	Historic canal	Recommended Eligible—A	1994	NPS	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS2796	Historic canal	Recommended Eligible—A	1994	NPS	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS2799	Historic sawmill and artifact scatter	Recommended Eligible—A/D	2021	NPS	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.

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Site No.	**Description**	**Eligibility**	**Date of Last Recording**	**Land Ownership**	**Site Type Criteria of Concern**	**VEA Required?**	**APE**	**Justification for a VEA or no VEA (ex. Did not meet site type criteria)**
42WS2809	Historic canal	Recommended Eligible—A	1994	NPS, Private	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS3344	Historic ditch (*Springdale Irrigation Ditch*)	Recommended Eligible—A	2021	BLM, NPS, Private, SITLA, UDOT	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features. This site was also recorded as site 42WS3020 and was not relocated in 2021.
42WS3673	Prehistoric bedrock mortars	Determined Eligible—D	1998	BLM	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS4397	Historic road (*Road to Virgin City*)	Determined Eligible—A	2019	BLM, Private	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS5515	Historic road	Determined Not Eligible	2010	BLM	N/A	N/A	Rainy Day APE	Does not meet site type criteria. Also, adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS6113	Historic townsite (*Grafton Townsite*)	Listed	2025	BLM, Private	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS6242	Historic site (indeterminate)	*In Progress*	*In Progress*	NPS	N/A	N/A	Sunny/Rainy Day APEs	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.
42WS6789	Prehistoric petroglyph panel	Determined Eligible—C/D	2022	Private	N/A	N/A	Rainy Day APE	Adverse effects are unlikely/minimal due to distance and the proposed reservoir safety features.

*Note: Sites or structures that are either Eligible, Listed, or unevaluated for the NRHP are in bold blue text within the “NRHP Eligibility” column; bold blue highlighted text in the “Site Type Criteria of Concern” column indicates a site type that may require assessment for visual impacts.

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APPENDIX A

PROJECT AREA OF POTENTIAL EFFECT OVERVIEW MAP

KANE COUNTY

Supplemental Survey

Black Knoll Pit
(Removed from Final Alternatives)

Bald Knoll Pits
(Removed from Final Alternatives)

Esplin Pit

Cove Reservoir

Mt. Carmel Irrigation Improvements

Tait Pit

Lamb's Pit

County Pit
(Removed from Final Alternatives)

Glendale

Orderville

GLENDALE BENCH

THE SAND HILLS

WHITE CLIFFS

Cultural Resources Visual Effect Analysis Overview

Cove - East Fork Virgin River Watershed Plan - EIS Project

Legend

- Direct APE
- Visual APE
- Inundation Boundary (Sunny Day)
- Inundation Boundary (Rainy Day)
- Cultural Resources Survey Area

Land Ownership

- BLM
- Private
- SITLA
- UDOT

Utah

N

0 2 Miles

Eocene Environmental Group

Cultural Resources Visual Effect Analysis Panel Maps

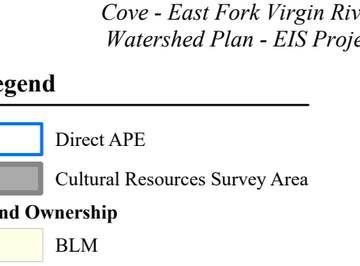
Cove - East Fork Virgin River Watershed Plan - EIS Project

Legend

- Direct APE
- Cultural Resources Survey Area

Land Ownership

- BLM
- Private
- TLA



N

0 3,900 Feet

Eocene Environmental Group

Black Knoll Pit
(Removed from Final Alternatives)

Esplin Pit

KANE COUNTY

T40S R6W
T41S R6W
T40S R5W
T41S R5W

Glendale USGS 7.5 Minute Quadrangle
Bald Knoll USGS 7.5 Minute Quadrangle

Black Knoll
The Falls
Borrow Pit
Kanab Creek
Skutumpah Creek
Hollow
Sink
Valley
Trail
Jeep
Spring
Kanab
Cliffs

Cultural Resources Visual Effect Analysis Panel Maps

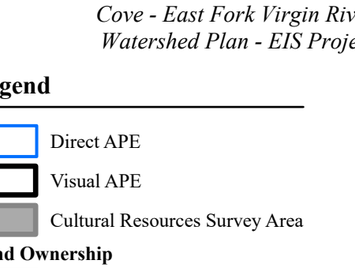
Cove - East Fork Virgin River Watershed Plan - EIS Project

Legend

- Direct APE
- Visual APE
- Cultural Resources Survey Area

Land Ownership

- BLM
- Private
- TLA



Panel 2 of 17

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0 3,900 Feet

Eocene Environmental Group

Supplemental Survey

Orderville USGS 7.5 Minute Quadrangle
Glendale USGS 7.5 Minute Quadrangle

KANE COUNTY

T40S R7W
T41S R7W
T40S R6W
T41S R6W

Bishop Canyon
Long Valley
Glendale
Calf Pasture
Hollow
Gardner Hollow
East Fork
Virgin River
Spring Hollow
Stewart Creek
Bench
Swain

July 6, 2020
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KANE COUNTY

T40S R8W
T41S R8W

T40S R7W
T41S R7W

Cove Reservoir

Orderville

Orderville USGS 7.5 Minute Quadrangle
Glendale USGS 7.5 Minute Quadrangle

Cultural Resources Visual Effect Analysis Panel Maps

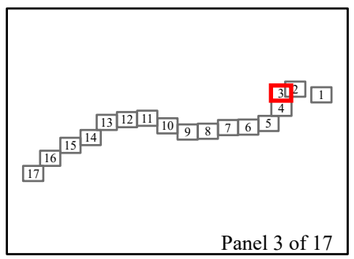
Cove - East Fork Virgin River Watershed Plan - EIS Project

Legend

- Direct APE
- Visual APE
- Inundation Boundary (Sunny Day)
- Inundation Boundary (Rainy Day)
- Cultural Resources Survey Area

Land Ownership

- BLM
- Private
- TLA



Panel 3 of 17

N

0 3,900 Feet

Eocene Environmental Group

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Cultural Resources Visual Effect Analysis Panel Maps

Cove - East Fork Virgin River Watershed Plan - EIS Project

Legend

- Direct APE
- Visual APE
- Inundation Boundary (Sunny Day)
- Inundation Boundary (Rainy Day)
- Cultural Resources Survey Area

Land Ownership

- BLM
- Private
- TLA

KANE COUNTY

Orderville USGS 7.5 Minute Quadrangle
Mount Carmel USGS 7.5 Minute Quadrangle

Orderville USGS 7.5 Minute Quadrangle
Glendale USGS 7.5 Minute Quadrangle

Mount Carmel USGS 7.5 Minute Quadrangle
White Tower USGS 7.5 Minute Quadrangle

Mt. Carmel Irrigation Improvements

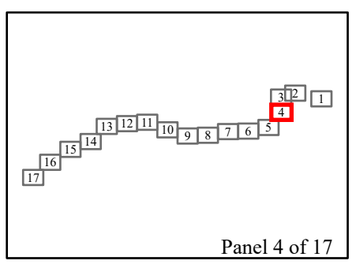
Tait Pit

Lamb's Pit

Mount Carmel Junction

T41S R8W

T41S R7W



Panel 4 of 17

N

0 3,900 Feet

Eocene Environmental Group

KANE COUNTY

The Barracks USGS 7.5 Minute Quadrangle
Mount Carmel USGS 7.5 Minute Quadrangle

T41S R8W
T42S R8W
T41S R7W
T42S R7W

Monument Hollow
East Fork Virgin River
Yellowjacket Canyon
Meeks Cliffs
CLIFFS
Joseph Canyon
Point Canyon
Monroe Spring
State

Cultural Resources Visual Effect Analysis Panel Maps

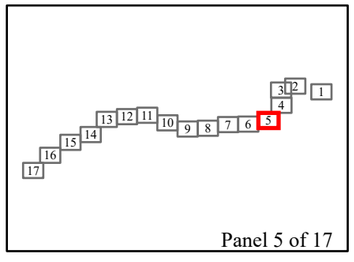
Cove - East Fork Virgin River Watershed Plan - EIS Project

Legend

- Inundation Boundary (Sunny Day)
- Inundation Boundary (Rainy Day)
- Cultural Resources Survey Area

Land Ownership

- BLM
- Private
- TLA
- UDOT



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Eocene Environmental Group

Cultural Resources Visual Effect Analysis Panel Maps

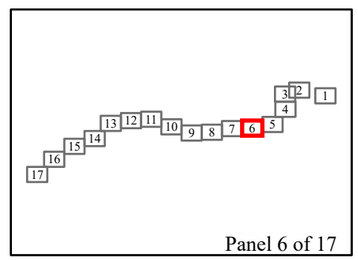
Cove - East Fork Virgin River Watershed Plan - EIS Project

Legend

- Inundation Boundary (Sunny Day)
- Inundation Boundary (Rainy Day)

Land Ownership

- BLM
- TLA



Panel 6 of 17

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Eocene Environmental Group

The Barracks USGS 7.5 Minute Quadrangle

July 6, 2026
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Cultural Resources
Visual Effect Analysis
Panel Maps

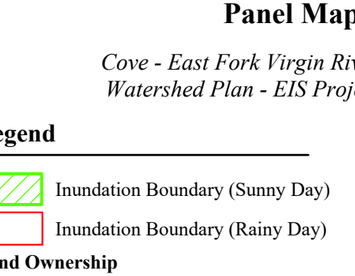
Cove - East Fork Virgin River
Watershed Plan - EIS Project

Legend

- Inundation Boundary (Sunny Day)
- Inundation Boundary (Rainy Day)

Land Ownership

- BLM
- NPS
- TLA



Panel 7 of 17

N

0 3,900 Feet

Eocene Environmental Group

T41S R9.5W
T41S R9W
T42S R9W
T42S R9.5W
WASHINGTON COUNTY
KANE COUNTY
Springdale East USGS 7.5 Minute Quadrangle
The Barracks USGS 7.5 Minute Quadrangle
Dennett Canyon
Parunuweap Can
ARK
RIVER
CANYON

WASHINGTON COUNTY

N A T I O N A L

The Watchman

Johnson Mountain

T41S R10W
T42S R10W

T41S R10W

T41S R9.5W

T41S R9.5W
T42S R9.5W

VIRGIN

PARUNUWEAP

FORK

EAST

Cem

Shunesburg

Shunesburg Mountain

T42S R10W

T42S R9.5W

Shunes Creek

Springdale East USGS 7.5 Minute Quadrangle

Cultural Resources Visual Effect Analysis Panel Maps

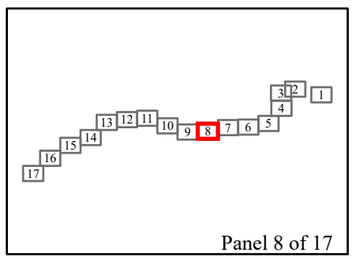
Cove - East Fork Virgin River Watershed Plan - EIS Project

Legend

- Inundation Boundary (Sunny Day)
- Inundation Boundary (Rainy Day)

Land Ownership

- BLM
- NPS
- Private



Panel 8 of 17

N

0 3,900 Feet

Eocene Environmental Group

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Cultural Resources
Visual Effect Analysis
Panel Maps

Cove - East Fork Virgin River Watershed Plan - EIS Project

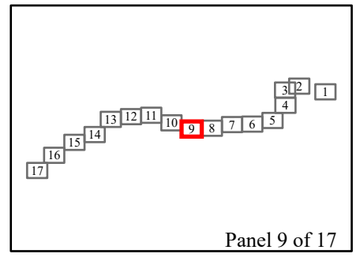
Legend

- Inundation Boundary (Sunny Day)
- Inundation Boundary (Rainy Day)

Land Ownership

- BLM
- NPS
- Private
- UDOT

Springdale West USGS 7.5 Minute Quadrangle
Springdale East USGS 7.5 Minute Quadrangle



Panel 9 of 17

N

0 3,900 Feet

Eocene Environmental Group

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Cultural Resources Visual Effect Analysis Panel Maps

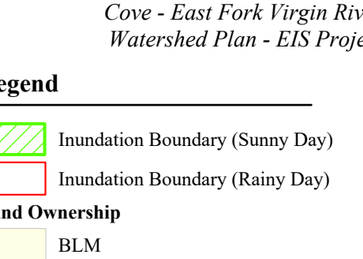
Cove - East Fork Virgin River Watershed Plan - EIS Project

Legend

- Inundation Boundary (Sunny Day)
- Inundation Boundary (Rainy Day)

Land Ownership

- BLM
- NPS
- Private
- TLA



Panel 10 of 17

N

0 3,900 Feet

Eocene Environmental Group

WASHINGTON COUNTY

VIRGIN RIVER

T41S R12W
T42S R12W

T41S R11W
T42S R11W

Virgin USGS 7.5 Minute Quadrangle
Springdale West USGS 7.5 Minute Quadrangle

Gravel Pit

Pasley Ridge

TRAIL

JEEP

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WASHINGTON COUNTY

Observation Tower

Virgin

Water Tank

VIRGIN RIVER

CANAL

T41S R12W

Virgin USGS 7.5 Minute Quadrangle

Cultural Resources Visual Effect Analysis Panel Maps

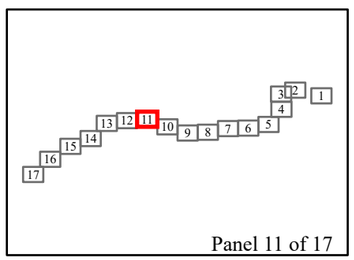
Cove - East Fork Virgin River Watershed Plan - EIS Project

Legend

- Inundation Boundary (Sunny Day)
- Inundation Boundary (Rainy Day)

Land Ownership

- BLM
- Private
- TLA



Panel 11 of 17

N

0 3,900 Feet

Eocene Environmental Group

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Cultural Resources Visual Effect Analysis Panel Maps

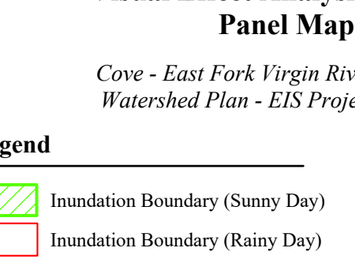
Cove - East Fork Virgin River Watershed Plan - EIS Project

Legend

- Inundation Boundary (Sunny Day)
- Inundation Boundary (Rainy Day)

Land Ownership

- BLM
- Private
- TLA
- UDOT



N

0 3,900 Feet

Eocene Environmental Group

Hurricane USGS 7.5 Minute Quadrangle
Virgin USGS 7.5 Minute Quadrangle

Cultural Resources Visual Effect Analysis Panel Maps

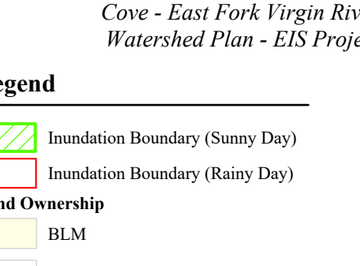
Cove - East Fork Virgin River Watershed Plan - EIS Project

Legend

- Inundation Boundary (Sunny Day)
- Inundation Boundary (Rainy Day)

Land Ownership

- BLM
- Private
- TLA
- UDWR
- OTHER



N

0 3,900 Feet

Eocene Environmental Group

Harrisburg Junction USGS 7.5 Minute Quadrangle
Hurricane USGS 7.5 Minute Quadrangle

T41S R14W
T41S R13W
T42S R14W
T42S R13W

WASHINGTON COUNTY
Harrisburg
Mobile Home Park
Little Purgatory
Boat Ramp
QUAIL CREEK STATE PARK
Quail Creek Reservoir
Harrisburg Gap
Gaging Sta
Berry Springs
AQUADUCT
Washington County Regional Fairpark
East Fork
VIRGIN
VOLCANO MTN
Sullivan Knoll

Cultural Resources
Visual Effect Analysis
Panel Maps

Cove - East Fork Virgin River
Watershed Plan - EIS Project

WASHINGTON COUNTY

Harrisburg Junction USGS 7.5 Minute Quadrangle
Washington Dome USGS 7.5 Minute Quadrangle

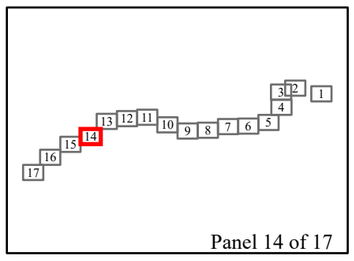
T42S R14W

Legend

- Inundation Boundary (Sunny Day)
- Inundation Boundary (Rainy Day)

Land Ownership

- BLM
- Private
- TLA
- OTHER



Panel 14 of 17

N

0 3,900 Feet

Eocene Environmental Group

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Cultural Resources Visual Effect Analysis Panel Maps

Cove - East Fork Virgin River Watershed Plan - EIS Project

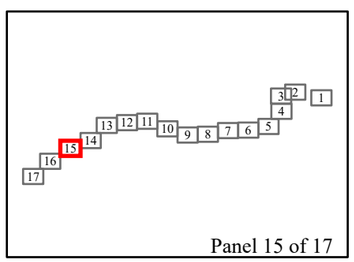
Legend

Inundation Boundary (Rainy Day)

Land Ownership

- BLM
- Private
- TLA
- UDOT
- UDWR

Washington USGS 7.5 Minute Quadrangle
St George USGS 7.5 Minute Quadrangle
St George USGS 7.5 Minute Quadrangle
Washington Dome USGS 7.5 Minute Quadrangle



Panel 15 of 17

N

0 3,900 Feet

Eocene Environmental Group

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Cultural Resources Visual Effect Analysis Panel Maps

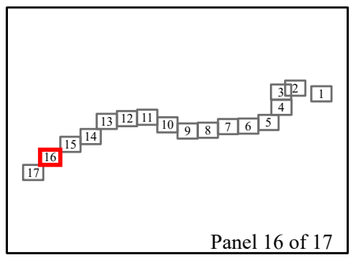
Cove - East Fork Virgin River Watershed Plan - EIS Project

Legend

Inundation Boundary (Rainy Day)

Land Ownership

- BLM
- Private
- TLA
- UDOT



Panel 16 of 17

N

0 3,900 Feet

Eocene Environmental Group

Cultural Resources Visual Effect Analysis Panel Maps

Cove - East Fork Virgin River Watershed Plan - EIS Project

Legend

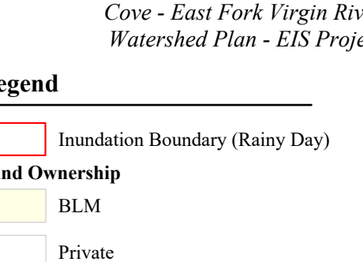
Inundation Boundary (Rainy Day)

Land Ownership

BLM

Private

TLA



N

0 3,900 Feet

Eocene Environmental Group

WASHINGTON COUNTY

T43S R17W

T43S R16W

UTAH

ARIZONA

WASHINGTON CO

MOHAVE CO

Wash

Big Round Valley

Little Round Valley

Atkinville Wash

VIRGIN RIVER

First Narrows

Point

Starvation

POINT OF ROCKS TRAIL

Inspection Station

T 42 N

T 41 N

White Hills USGS 7.5 Minute Quadrangle

St George USGS 7.5 Minute Quadrangle

July 6, 2026 G:\Projects\AlphaCove_Plan_EA_DSI\02_Cove_EFVR_Plan_EIS_DSI\Map_Files\ARCGIS\20250001_Cove_WM_Mxds.aprx

Visual Resources Technical Memorandum
Cove-East Fork Virgin River Plan-EIS – Kane County, Utah

Draft – For Internal Review

Executive Summary - Visual Resources

Visual effects of the proposed Cove-East Fork Virgin River (Cove-EFVR) dam and reservoir were evaluated within a landscape designated entirely as *BLM Visual Resource Management (VRM) Class IV*, (Fig.1) which allows major modification of landscape character where such change is anticipated by land use plans. Although the project would introduce a visible dam and reservoir in localized areas, these changes are consistent with VRM Class IV management intent and are limited by topography and distance. With incorporation of design and mitigation measures, visual impacts would not be significant under NEPA. The proposed measures of this project are not located within BLM-managed areas.

1. Purpose and Scope

This Technical Memorandum documents the assessment of visual resources potentially affected by the Cove Reservoir Project. It supports the NEPA Environmental Impact Statement (EIS) and administrative record by evaluating visual effects, photo-simulation viewpoints, and mitigation commitments.

2. Regulatory Framework

Visual resources were evaluated consistent with NEPA and CEQ regulations at 40 CFR §§1502.15 and 1502.16. The analysis integrates BLM Visual Resource Management (VRM) policy and FHWA Visual Impact Assessment (VIA) guidance.

3. Visual Management Context

Review of BLM Utah VRM spatial data indicates that all lands within the Area of Visual Effect are designated VRM Class IV. Class IV allows major modifications of the existing landscape character provided land use objectives are met.

Visual Resource Management Class IV

All Bureau of Land Management (BLM)–administered lands within the Area of Visual Effect (AVE) are designated *Visual Resource Management (VRM) Class IV.* VRM Class IV areas are managed to provide for management activities that may require *major modification of the existing character of the landscape.* Under Class IV, the degree of visual change **may be high**, and modifications **may attract attention, dominate the view, and become a major focus of viewer attention**. Class IV is typically applied where land use plans anticipate infrastructure development, resource use, or other activities that substantially alter landscape character, while still requiring consideration of visual design measures to support applicable land use objectives.[1]

4. Area of Visual Effect

The Area of Visual Effect (AVE) includes areas from which the dam and reservoir may generally be visible, including portions of U.S. Highway 89, local roads, and downstream canyon viewpoints.

5. Viewer Groups and Key Observation Points (KOP)

Key viewer groups include highway travelers, local road users, nearby landowners, and downstream observers. Three Key Observation Points (KOP-1, KOP-1.1, and KOP-2) were selected for perspective to show most common viewshed for the proposed embankment measures.

6. Visual Effects Summary

The proposed action would introduce a dam and reservoir causing moderate, localized long-term visual change. Effects are consistent with VRM Class IV intent and are not significant under CEQ criteria.

7. Photo-Simulation Captions

KOP-1: Primary Highway 89 corridor view illustrating dam visibility.
KOP-1.1: Secondary Highway 89 view, south of KOP-1 with partial topographic screening.
KOP-2 : View downstream of proposed embankment showing embankment/topography.

8. Mitigation Commitments

Mitigation measures include surface color and texture treatments, contour grading, revegetation of disturbed areas, dust control during construction, and minimization of nighttime lighting.



Figure 1. General location of proposed ~1,900 ft long, 90 feet high earthen embankment *(most visible measure).*

Proposed Earthen Embankment: Slope protection will be required, with rock riprap and bedding planned for the upstream slope and native shallow root seeding planned for the downstream slope.

A 6-inch surface course of untreated road base will be placed to cap the crest of the dam to provide a finished surface. The crest will be sloped at 2 percent downward toward the reservoir to prevent ponding. A crest width of 25 feet, ~1,900 feet long and ~90 feet high has been assumed, with an upstream slope of 3H:1V (Horizontal: Vertical) and downstream slope 2H:1V. The crest of the dam will be 6.5 and 3.0 feet above the crests of the Principal Spillway and Auxiliary Spillway, respectively. Local rock will be used as much as practicable to match the surrounding landscape.

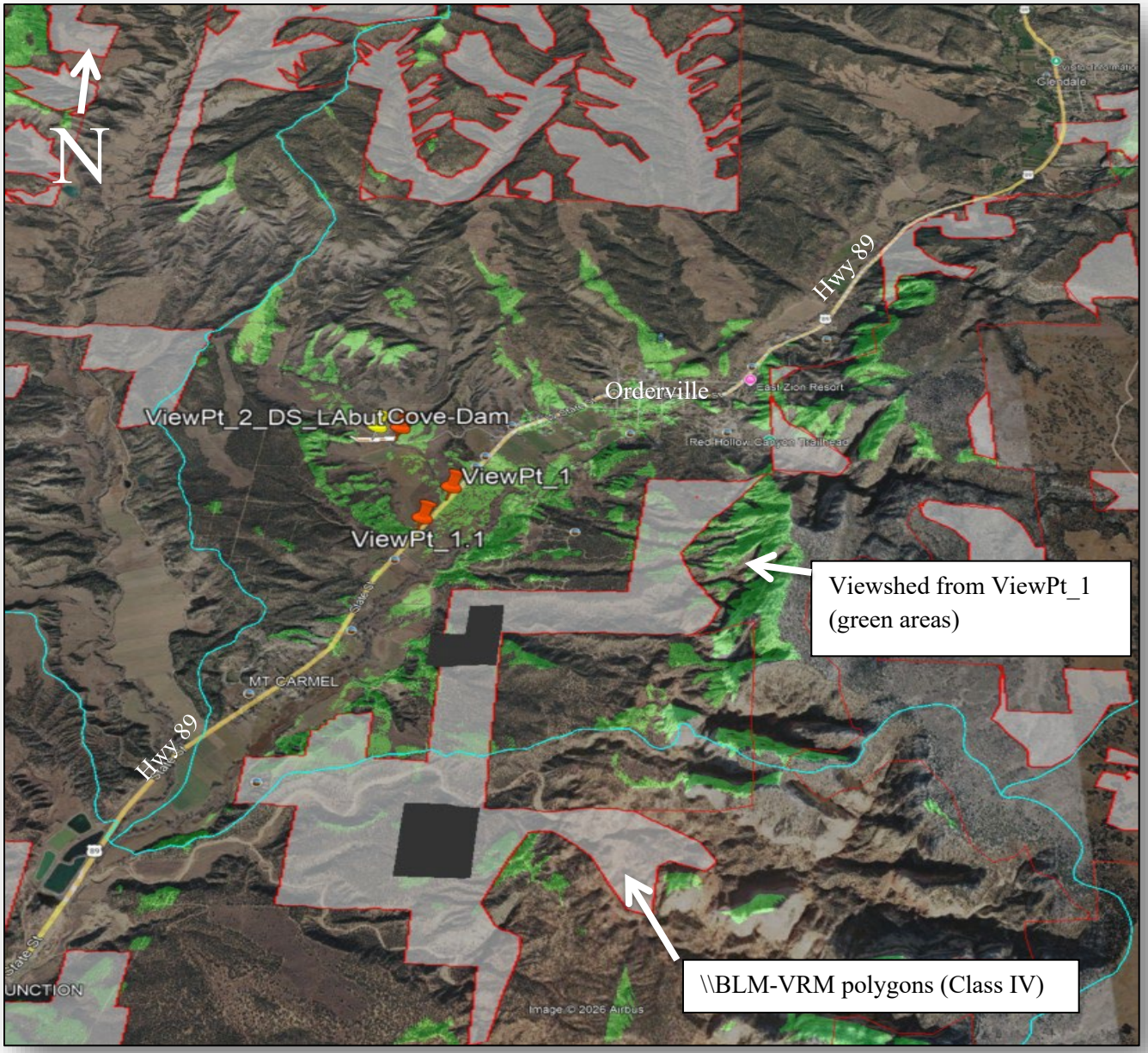


Figure 2. Viewshed from Key Observation Point-1

VRM Class IV: BLM areas that are managed to provide for management activities that may require major modification of the existing character of the landscape. Under Class IV, the degree of visual change may be high, and modifications may attract attention, dominate the view, and become a major focus of viewer attention. Class IV is typically applied where land use plans anticipate infrastructure development, resource use, or other activities that substantially alter landscape character, while still requiring consideration of visual design measures to support applicable land use objectives.



Figure 3. Key Observation Point – 1 -- looking from Hwy 89 toward the proposed earthen embankment dam ~2,800 ft away.



Figure 4. Key Observation Point 1.1 - looking toward proposed earthen embankment ~3,400 ft away



Figure 5. On access road at Key Observation Point-2, downstream of proposed dam near the left abutment - looking upstream.

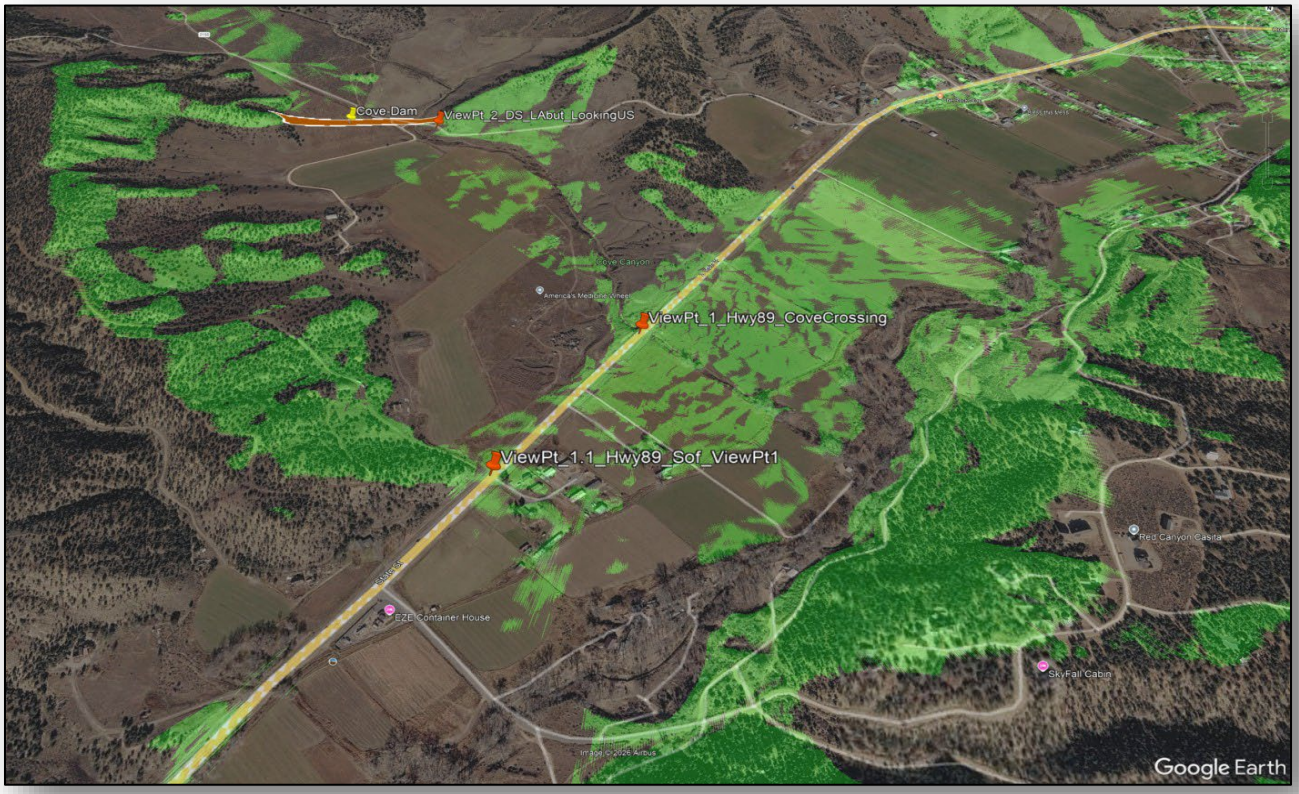


Figure 6. Viewshed from Key Observation Point-1 ***(Google Earth Pro). Green polygons show what is generally visible at View Point 1.1 on Hwy 89.***



Figures 7-8. Simulations at Key Observation Point-2 - looking upstream ~80 ft tall earthen embankment.

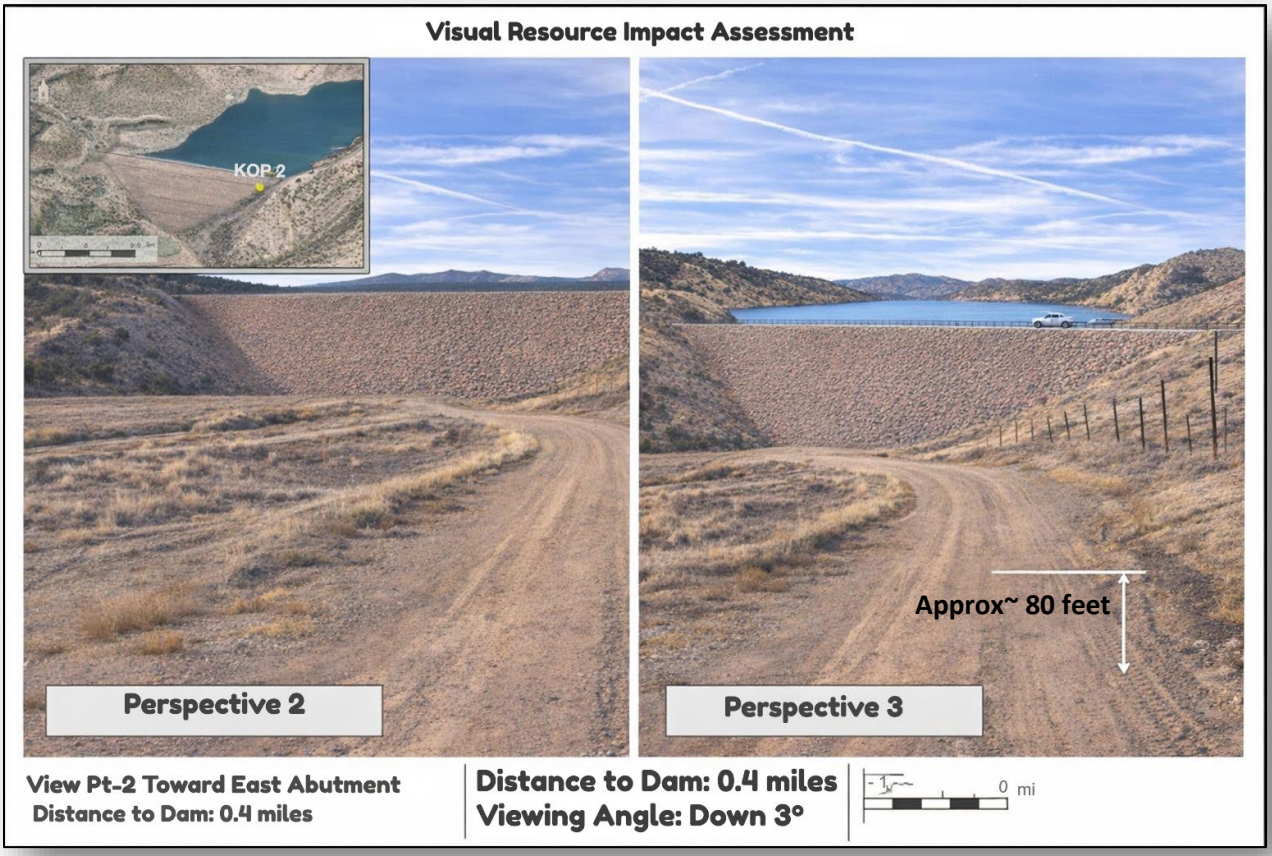




Figure 8. KOP-1 Simulation at 8 ft above Hwy 89 and approximately 2,800 feet to embankment.

From Key Observation Point 1 (KOP-1) located along U.S. Highway 89, approximately 2,800 feet (0.53 mile) at the Cove Canyon crossing, a visual simulation was prepared from an eye-level viewpoint approximately 8 feet above U.S. Highway 89 at an elevation of approximately 5,407 feet to represent typical driver perspectives. From this location, the dam crest at the approximate elevation of 5,560 feet would be viewed at a shallow upward angle and would appear primarily as a thin horizontal line above intervening terrain. The downstream embankment face would be largely obscured by foreground topography, further reducing the apparent scale of the structure. At this distance and viewing angle, the project would not dominate the viewshed and would result in a subtle visual change for most highway travelers.

Visual Impact Conclusion (All Key Observation Points)

Based on evaluation of visual conditions from Key Observation Points representing roadway viewers (KOP-1 along U.S. Highway 89), mid-distance oblique perspectives, and closer localized viewpoints near the project area (KOP 1.1 and KOP-2), the proposed dam would result in localized but limited visual change. From Highway 89, where most of the public viewing would occur, the dam would be viewed from a distance of approximately 2,800 feet at a shallow upward angle, appearing primarily as a thin, horizontal feature partially screened by foreground topography. At these distances, the apparent height and mass of the embankment are substantially reduced, and viewer exposure is brief and transient. Closer KOPs provide clearer views of the embankment face and crest; however, even at these locations the structure blends with surrounding landforms due to the use of earth-toned materials, smooth transitions into abutment slopes, and compatibility with existing landscape character. Visual simulations demonstrate that

the dam would not dominate the viewshed from any evaluated perspective and would not introduce high visual contrast. Considering distance, viewing angle, duration of exposure, and the modified nature of the landscape setting, the project would not result in a significant adverse impact to visual resources under NEPA.

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[1] Bureau of Land Management (BLM). 1984. *Manual 8400 – Visual Resource Management*. U.S. Department of the Interior, Washington, D.C.

[2] Bureau of Land Management (BLM). 2015. *Visual Resource Management Class Objectives and Guidance*, including *Handbook H-8410-1 – Visual Resource Inventory*. U.S. Department of the Interior.

DRAFT PALEONTOLOGICAL RESOURCES SURVEY REPORT

East Fork Virgin River Watershed Project, Kane County, Utah

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PROJECT DESCRIPTION AND LOCATION

Project Description and Location

The Natural Resources Conservation Service (NRCS), in association with the Kane County Water Conservancy District (KCWCD) and Washington County Water Conservancy District as project sponsors, has initiated work on a Watershed Plan-Environmental Impact Statement (Plan-EIS) within the Long Valley portion of the East Fork Virgin River Watershed. The NRCS, KCWCD, and Alpha Engineering (Alpha) contracted Eocene Environmental Group, Inc. (Eocene), formerly Transcon Environmental, Inc., to prepare the Plan-EIS and analyze the East Fork Virgin River Watershed Project (Project) for anticipated impacts to natural and human resources. This includes an analysis of potential impacts to paleontological resources. This paleontological resource survey report was prepared to summarize results from the paleontological field survey and evaluate potential impacts from the proposed Project to paleontological resources.

The purpose of this proposed Project is to provide the Glendale, Mt. Carmel, and Orderville irrigation companies additional water storage capacity to meet present and future irrigation water demands during dry summer months, add a new local water-based recreational opportunity, and provide additional water to the WCWCD for agricultural, municipal, and industrial use.

The Project area is located in Kane County near the towns of Mt. Carmel, Orderville, and Glendale and is shown in **Appendix A**, *Project Overview Map*. The Project is entirely on private property.

The construction of the Project would include the following components:

- 6,055-acre-foot capacity reservoir covering approximately 235 surface acres
- Approximately 90-foot by 1,900-foot earthen and rock fill dam
- Primary spillway (870-foot-long, 30-inch-diameter pipeline)
- Auxiliary spillway (1,070-foot-long, 30-foot-wide open channel)
- Approximately 1.7 miles of pipeline comprising the primary portion of the Glendale irrigation system would be replaced with a new 8- to 16-inch pipeline (Cove Reservoir, Plan of Development)
- Approximately 4.55 miles of new pipeline to access agricultural fields near Mt. Carmel
- Approximately 3.2 miles of access road (construction of new roads or improvement of existing roads) to provide access around the reservoir and maintain access to surrounding properties
- An outdoor recreational area and boat ramp at the reservoir site, including picnic facilities, a pavilion, restrooms, overnight and primitive camping sites, and recreation vehicle sites
- Approximately 700 feet (0.13 mile) of a large diameter concrete-encased steel pipeline that would extend from the existing Orderville irrigation pipeline through the dam to the outlet structure of the proposed reservoir
- Use of three borrow sites would be required
    - The Tait and Lamb pits would provide gravel; they are located on private lands near Mt. Carmel and Mt. Carmel Junction
    - The Esplin pit would provide riprap; it is located near the Glendale Bench Road on private land
- Permanent ground disturbance (approximately 259 acres) would occur where the proposed reservoir, dam, primary and auxiliary spillways, access roads, pipelines, and

recreational features (e.g., campsites, boat ramp, etc.) would be constructed; permanent ground disturbance would also occur where the existing three borrow pit sites would be expanded for project-related use

- Temporary ground disturbance (approximately 64 acres) would occur during replacement of the existing pipeline and installation of new pipelines, adjacent to where the permanent spillways would be constructed

Paleontological Survey Area

In support of the Plan-EIS, a paleontological survey was conducted within Potential Fossil Yield Classification (PFYC) 4–5 (high to very high potential) geologic formations that underlay the Project area. The survey area was determined in coordination with the NRCS and Utah Geological Survey (UGS). Areas that were surveyed include the following:

- **Tropic Shale Formation (PFYC 4):** Proposed reservoir and associated features; pipeline replacement to the west of Glendale
- **Naturita Formation (PFYC 5):** Tait Pit and Mt. Carmel irrigation improvement pipeline

PFYC 1–3 and Unknown potential areas were not surveyed.

The paleontological survey was conducted within the below U.S. Geological Survey (USGS) 7.5-minute topographic quadrangle maps and Public Land Survey System (PLSS) divisions:

TABLE 1
LOCATION OF PALEONTOLOGICAL SURVEY AREA

Prime Meridian	Township	Range	Sections	USGS Topographic Quadrangle
Salt Lake	40 South	7 West	26, 27	Glendale, Orderville
Salt Lake	41 South	7 West	5, 6, 8, 17	Mount Carmel, Orderville

FEDERAL ACTS AND PROFESSIONAL GUIDANCE

This paleontological resource evaluation follows federal regulations governing paleontological resources as well as professional guidance, described below.

Paleontological Resources Preservation, Omnibus Public Lands Management Act, Public Law 111-011, Title VI, Subtitle D 16 United States Code 470aaa (2009)

The Paleontological Resources Preservation Act (PRPA) of 2009 states that paleontological resources on federal lands will be protected and managed using scientific principles and expertise. The act establishes a management framework for paleontological resources and declares that paleontological resources on federal property must be preserved and protected. The PRPA also provides minimum requirements for paleontological resource use permit holders, criminal penalties for illegal collection of fossils on federal lands, and necessary curation protocols of federal fossils at approved repositories.

National Environmental Policy Act of 1969 Public Law 91-190, 83 Stat. 852, 42 United States Code 4321

The National Environmental Policy Act (NEPA) of 1969 was signed into law to "preserve important historic, cultural, and natural aspects of our national heritage." Paleontological resources are evaluated during NEPA analyses when there is potential for adverse impacts.

Federal Land Policy and Management Act of 1976 (Public Law 94-579)

The Federal Land Policy and Management Act of 1976 (FLPMA) provides direction for management, protection, and development of public lands.

Professional Paleontological Guidance

Society of Vertebrate Paleontology Professional Standards

The Society of Vertebrate Paleontology (SVP) Standard Procedures for the Assessment and Mitigation of Adverse Impacts to Paleontological Resources details procedures for evaluating potential impacts of proposed actions on paleontological resources and describes ways of mitigating those impacts through surveys, salvage, reporting, and curation (SVP 1995, 2010). The SVP details standard best practice measures for assessing potential impacts to paleontological resources and mitigating these impacts. The professional standards designated by the SVP were used as a guidance document for this project.

Best Practices in Mitigation Paleontology

The "Best Practices in Mitigation Paleontology" paper was also used as a guidance document for this Project (Murphy et al. 2019). This paper is more recent than the SVP guidance and details standard operating procedures in the field of mitigation paleontology. The paper promotes best practices in the field through using rigorous scientific standards to preserve and protect paleontological resources (Murphy et al. 2019).

ANALYSIS OF EXISTING DATA

Potential Fossil Yield Classification

The Bureau of Land Management (BLM) PFYC was developed to assist with paleontological planning. In this system, geologic units are assigned a class based on occurrence of significant paleontological resources (BLM 2022). This system is widely used in the field of mitigation paleontology and by agencies to determine the likelihood of encountering scientifically significant paleontological resources; it was used to guide the need for paleontological resources surveys for this Project. The classification ranks geologic units between 1 and 5, 1 being very low probability and 5 being very high probability of encountering scientifically significant fossils. Areas of Unknown PFYC are poorly studied, and fossil potential has not been assessed yet in those regions. The BLM PFYC guidance provided by BLM PIM 2022-009 can be found in **Appendix B**. The BLM PFYC Utah Statewide GIS data was used for the PFYC values for this project.

Geological and Paleontological Review

The Project area is underlain by the PFYC 5 Dakota (Naturita) Formation; PFYC 4 Tropic Shale Formation; PFYC 3 Carmel Formation (Crystal Creek Member and Co-op Creek Limestone Member); PFYC 4 Straight Cliffs Formation; PFYC 2 Carmel Formation (Winsor Member); PFYC 1 basalt lava flows and cinder cones; and PFYC Unknown alluvial gravel. The geologic formations

that were surveyed are described in detail below and shown on the panel maps in **Appendix A**. Geologic abbreviations are listed after the formation names in the below sections. The geologic map used in this study was from Doelling 2008 and was mapped at a 1:100,000 scale. Since only the PFYC 4–5 geologic formations were designated for paleontological survey, only those formations are described in detail below.

Naturita Formation (formerly Dakota Formation; Kcdm)

The Naturita Formation is a middle Cretaceous sedimentary unit found on the Colorado Plateau. The geologic unit is mainly composed of reddish-brown to tan sandstones, shale, and limestone. The sandstones are fine- to medium-grained with cross-bedding, indicating fluvial deposition. Dark shales are also present, suggesting low-oxygen conditions. The lower portion of the formation contains mudstones and sandstones, representing river channel and floodplain deposits. The upper portion of the formation contains deposits indicative of estuaries, lagoons, and swamps on a coastal plain. Thick coal beds are also present in the formation. Stratigraphically, in Utah the Naturita Formation overlies the Cedar Mountain Formation and underlies the Mancos Shale Formation, representing a shift from terrestrial to marine-influenced deposits as the western interior seaway expanded (Phillips et al. 2021). The Naturita Formation is the lateral equivalent of the Dakota Formation, which is present on the opposite (eastern) side of the Western Interior Seaway in states like Iowa, Kansas, and Nebraska. The Naturita Formation was previously referred to as the Dakota Formation in the west and is still referred to as the Dakota Formation in the geologic map used by this study. The use of the name Naturita Formation for the western deposits has become more popular due to the deposit's spatial separation and different sediment sources from the Dakota Formation (Carpenter et al. 2014).

The Naturita Formation is known to contain microfossil localities that have preserved a diverse mammalian fauna of multituberculates and marsupials (Eaton 1999). Vertebrate fossils are known from the Naturita Formation, including fragmentary remains of dinosaurs such as sauropods, ceratopsians, ankylosaurs, and theropods, as well as turtles and crocodyliformes (Kirkland et al. 2025). Tracks from dinosaurs and other archosaurs are known from the Naturita Formation (Lockley et al. 2018).

Tropic Shale Formation (Kt)

The Tropic Shale Formation, found in southern Utah, is an Upper Cretaceous (Cenomanian to Turonian) geologic unit (Albright et al. 2013). The formation is predominantly composed of dark gray shale, siltstone, and sandstone. Bentonite layers are also present throughout the Tropic Shale Formation. The shales are indicative of low-oxygen depositional conditions and were deposited in a marine environment from the Western Interior Seaway. Septarian nodules are found throughout the lower and middle portions of the formation. Stratigraphically, the Tropic Shale overlies the terrestrial Naturita Formation and is overlain by the Straight Cliffs Formation.

The Tropic Shale Formation was initially known for a diverse record of marine invertebrates that have been used for biostratigraphy (Kirkland 1991). Marine invertebrates known from the Tropic Shale Formation include ammonites, bivalves, oysters, and gastropods. More recently, the Tropic Shale Formation has been found to include a diverse vertebrate assemblage as well, preserving fossils of at least five different shorted necked plesiosaur genera (marine reptiles), marine turtles, many species of chondrichthyans (sharks), and osteichthyians (fish) (Albright et al. 2013). The Museum of Northern Arizona houses an extensive collection of Tropic Shale Formation plesiosaurs, including several holotypes. Occasional dinosaurs are also found within the Tropic Shale Formation, thought to be preserved through a "bloat and float" method in which the

terrestrial animal fills up with air after death and floats out to sea, being deposited and preserved in the marine formation. This was the case with the therizinosaur *Nothronychus graffami* (Zanno et al. 2009) found in the Tropic Shale Formation near Big Water, Utah.

Straight Cliffs Formation (Ksl and Ksu)

The Straight Cliffs Formation, located in southern Utah, is an Upper Cretaceous sedimentary unit spanning the Turonian to early Campanian. It consists of four members listed from youngest to oldest: Tibbet Canyon Member, Smokey Hollow Member, John Henry Member, and Drip Tank Member (Foster et al. 2001). The formation tends to form long bands of cliffs overlying the Tropic Shale Formation and underlying the Wahweap Formation. The Straight Cliffs Formation was deposited in a marginal marine environment on the western side of the Western Interior Seaway and marks a transition from marine to terrestrial deposition. Its lithology consists predominantly of fine- to medium-grained sandstones with lesser components of mudstones, siltstones, and coals. The sandstones show cross-bedding, indicative of fluvial, deltaic, or shallow marine deposition. During the Western Interior Seaway's maximum extent, the unit records a mix of terrestrial and marine environments. The sandstones suggest high-energy environments like river channels and deltas, while the mudstones and limestone reflect lower-energy floodplains, lagoons, or shallow marine embayments.

The Straight Cliffs Formation preserves a diverse invertebrate fauna including ammonites, oysters, ostracods, ammonites, and bivalves such as inoceramids. Many vertebrates are also known from the formation including sharks, fish, mammals, crocodyliforms, amphibians, turtles, lizards, and dinosaurs (Foster et al. 2001).

Paleontology Resource Records Review

A paleontological record search was conducted with the UGS on November 12, 2024. There were no previously known paleontological localities within the Project area, but there were many localities known from the vicinity. Within approximately 2 miles of the Project area, there were 47 previously known localities in UGS's database. There were 23 in the Tropic Shale Formation, one in the Straight Cliffs Formation, 16 in the Carmel Formation, and seven in the Naturita Formation. The Tropic Shale Formation localities were to the west of the proposed reservoir area and included an articulated plesiosaur found in a septarian nodule mine (Gillette et al. 1999), a possible dinosaur limb bone, ammonites, and bivalves. Localities within the Carmel Formation include fossils of bivalves, gastropods, echinoderms, bryozoans, skolithos trace fossils, conifers, and algal stromatolites. Localities within the Naturita Formation include fossils of crocodyliforms, turtles, fish, and possible dinosaur tracks.

METHODS

The paleontological field survey was conducted on November 21 and 22, 2024, by paleontological Principal Investigator Larkin McCormack and Field Technician James Lotts. An additional day of survey was conducted on February 10, 2025, by Larkin McCormack. Prior to beginning the field survey, a literature review, locality search, and geologic review were conducted. The geologic formations that underlay the Project, the PFYC, and previously known paleontology localities were reviewed to determine which areas of the Project have the potential to contain significant fossils and should be surveyed for paleontological resources. The survey area, depicted in **Appendix A** Project Overview Map, was evaluated using aerial imagery to determine likely areas for outcrops of sensitive geologic formations.

The survey area boundaries were identified in the field using ArcGIS Field Maps, and all the areas shown as being within the paleontological survey area were pedestrian surveyed. Areas containing outcrops of exposed bedrock were inspected in detail to document any evidence of vertebrate fossils, invertebrate fossils, trace fossils, and plant fossils. All outcrops were inspected for in situ fossils, which represent fossils observed in place within the bedrock, as well as surface fossils, which have eroded out of the geologic formation and are preserved outside of their original context.

Fossil localities were documented using a Bad Elf GPS unit, photographs, field notes, and locality sheets. Significance was assessed using the criteria of BLM IM 2009-011, “Any paleontological resource that is considered to be of scientific interest, including most vertebrate fossil remains and traces, and certain rare or unusual invertebrate and plant fossils. A significant paleontological resource is considered to be scientifically important because it is a rare or previously unknown species, it is of high quality and well-preserved, it preserves a previously unknown anatomical or other characteristic, provides new information about the history of life on earth, or has identified educational or recreational value” (BLM 2008).

FIELD SURVEY RESULTS

New Paleontological Localities

Twelve new non-significant paleontological localities were documented during the paleontological survey. Most of the fossils were discovered in the Upper Cretaceous Tropic Shale Formation. A list of the new paleontological localities is below in **Table 2**, and more detailed information is included in the locality forms in **Appendix C**.

TABLE 2. NEW PALEONTOLOGICAL LOCALITIES FROM THE COVE RESERVOIR FIELD SURVEYS						
Eocene Field Number	**Scientific Significance**	**Type**	**Identification**	**Geologic Formation**	**PLSS**	**Description**
11212024-LMC-01	Non-significant	Invertebrate; Possible Vertebrate	Clam and possible fish scale	Tropic Shale Formation	T41S R7W Sec 5	Partial shell in tan sandstone and possible fish scale fragment in gray septarian nodule
11212024-LMC-02	Non-significant	Invertebrate	Oyster	Tropic Shale Formation	T41S R7W Sec 5	Partial shell in tan medium-grained sandstone
11212024-LMC-03	Non-significant	Invertebrate	Gastropods including *Turritella*	Tropic Shale or Straight Cliffs Formations	T41S R7W Sec 5	Fragmented shells in coarse-grained tan sandstone
11212024-LMC-04	Non-significant	Invertebrate	Inoceramid clam	Tropic Shale Formation	T41S R7W Sec 5	Fragmented shell preserved in a septarian nodule
11212024-LMC-05	Non-significant	Invertebrate Trace	Burrows	Tropic Shale Formation	T41S R7W Sec 5	Burrow casts in tan medium-grained sandstone
11222024-LMC-01	Non-significant	Invertebrate	Inoceramid clam	Tropic Shale Formation	T41S R7W Sec 6	Shell cast in mudstone
11222024-JCL-01	Non-significant	Invertebrate	Ammonite impression	Tropic Shale Formation	T41S R7W Sec 5	Shell impression in septarian nodule in popcorn weathered mudstone
11222024-LMC-02	Non-significant	Plant	Petrified wood	Straight Cliffs Formation	T41S R7W Sec 6	Petrified wood fragment observed on mudstone slope with sandstone cobbles and boulders
11222024-JCL-02	Non-significant	Invertebrate	Oyster and inoceramid clam hash	Straight Cliffs Formation	T41S R7W Sec 6	Oyster shells, shell hash, and inoceramid shell impression observed in medium grained sandstone
11222024-LMC-03	Non-significant	Invertebrate	Inoceramid clam cast	Tropic Shale Formation	T41S R7W Sec 5	In situ layer of clam shells in gray to tan mudstone
02102025-LMC-01	Non-significant	Invertebrate	Shell hash	Unknown	T41S R7W Sec 8	Block of tan sandy limestone preserved ex situ
02102025-LMC-02	Non-significant	Invertebrate	Oyster impression	Quaternary alluvial conglomerate	T42S R7W Sec 17	Oyster impression preserved in a cobble in the Tait Pit

Paleontological and Geological Field Results by Formation

Naturita Formation (Kdcm)

The Naturita Formation was mapped as underlying the Project area in a couple of locations, including the northwest corner of the Tait Pit and the Mt. Carmel irrigation improvement to the north of the Tait Pit. The Tait Pit is a gravel mine that is partially mapped as Naturita Formation and partially mapped as Pleistocene to Holocene alluvial gravel (Doelling 2008). Based on our field observations, there were no outcrops of the Naturita Formation exposed within the Tait Pit or adjacent undisturbed slope (**Figures 1–3**). If the adjacent undisturbed slope did belong to the Naturita Formation, the Naturita Formation would be exposed in the excavations above this, and that was not the case.

While known to be fossiliferous, there were not extensive fossil localities in the Naturita Formation within the field survey area because there were not good exposures of the formation. There were two ex situ localities documented in or near areas that were mapped as the Naturita Formation, but both were found ex situ and in areas of variable geology, making it uncertain which formation they originated from. These localities were both invertebrates, one consisting of an isolated oyster impression preserved in a cobble from the Tait Pit and the other shell hash preserved in a small limestone block within the Mt. Carmel irrigation pipeline survey corridor. Both were poorly preserved.



Figure 1. Overview of the Tait Pit looking at the area mapped as the Naturita Formation. The pit appears to be all Quaternary gravel with no Naturita Formation exposed. Larkin McCormack, 2/10/2025.



Figure 2. Closeup on alluvial gravel, cobbles, and sand present within the Tait Pit in an area mapped as the Naturita Formation. Larkin McCormack, 2/10/2025.



Figure 3. Undisturbed northwest corner of the Tait Pit which is mapped as the Naturita Formation. Difficult to discern if the formation is actually present because the surface of the hillside is covered in brown soils and alluvial cobbles. Larkin McCormack, 2/10/2025.

Tropic Shale Formation (Kt)

The Tropic Shale Formation had the best exposures within the Project area near the perimeter of the proposed Cove Reservoir footprint and along the access road grading and recreational features that encircle the outside of the reservoir area. The interior of the proposed Cove

Reservoir was covered in more recent quaternary sediment, soils, and vegetation including sage brush and grasses (**Figure 4**). The Tropic Shale Formation was also mapped as underlying the proposed 16-inch pipeline to the south of Glendale on the west side of State Street; however, outcrops of the formation in this area were very sparse, and some of the area was covered in agricultural fields.

Within the Project area, the Tropic Shale Formation was represented by gray to tan mudstone badlands in a sparse pinyon-juniper forest (**Figure 5**). Septarian nodules were observed throughout the Tropic Shale Formation, and these were checked for fossils when observed (**Figure 6**). Popcorn weathering on the badlands was also observed in some areas (**Figure 7**). The Tropic Shale becomes sandier going upward as it nears its contact with the Straight Cliffs Formation, which was only preserved in the distance on the northern side of the proposed reservoir.



Figure 4. Photo taken from the southern boundary of the Cove Reservoir looking out into the vegetation- and soil-covered interior of the proposed reservoir, with Tropic Shale Formation badlands in the distance. Larkin McCormack, 11/22/2024.



Figure 5. Overview of a typical outcrop of the Tropic Shale Formation within the Project area, taken from the northeastern portion of the proposed Cove Reservoir area. Larkin McCormack, 11/21/2024.



Figure 6. Example of one of the septarian nodules that was found across the Cove Reservoir survey area in the Tropic Shale Formation. Larkin McCormack, 11/22/2024.



Figure 7. Popcorn weathering was observed in some areas of the Tropic Shale Formation. Larkin McCormack, 11/22/2024.

Eight new fossil localities were discovered in the Upper Cretaceous aged Tropic Shale Formation. These included shelled invertebrates (inoceramid clams, ammonites, turritella, oysters, and bivalves; **Figures 8–11**), invertebrate burrow trace fossils (**Figure 12**), and possible fish scales (**Figure 13**). Locality 11222024-LMC-04 was the sole locality found in situ. The locality consisted of two exposed horizons with inoceramid clam shells preserved in gray to tan mudstone layers. This locality was carefully looked over to see if any vertebrate fossil material might be present, but none was found.

All localities documented within the Tropic Shale Formation were from within the proposed Cove Reservoir and associated features, and none were found within the proposed pipeline corridor.



Figure 8. Inoceramid clam within the Tropic Shale Formation from the lower horizon of 11222024-LMC-03. Larkin McCormack, 11/22/2024.

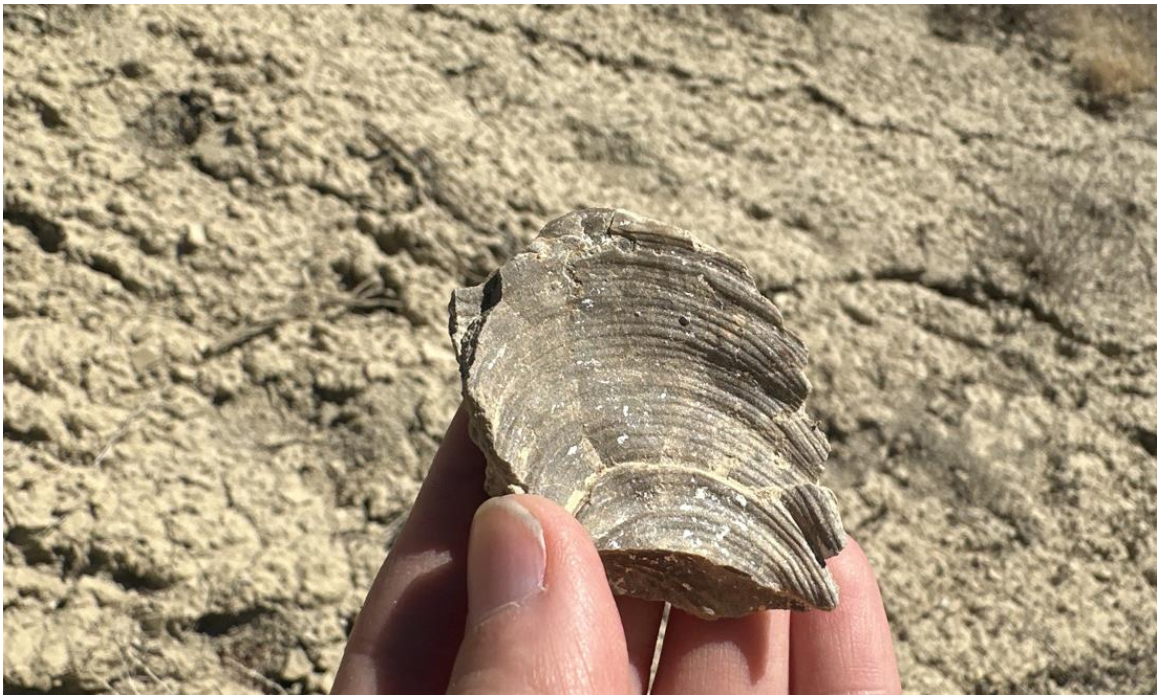

Figure 9. Larger partial inoceramid clam from upper layer at 11222024-LMC-03. Larkin McCormack, 11/22/2024.



Figure 10. Partial oyster within the Tropic Shale Formation at 11212024-LMC-02. Larkin McCormack, 11/21/2024.



Figure 11. *Turritella* and other gastropods preserved in coarse-grained sandstone in the Tropic Shale or Straight Cliffs formations at locality 11212024-LMC-03. Larkin McCormack, 11/21/2024.

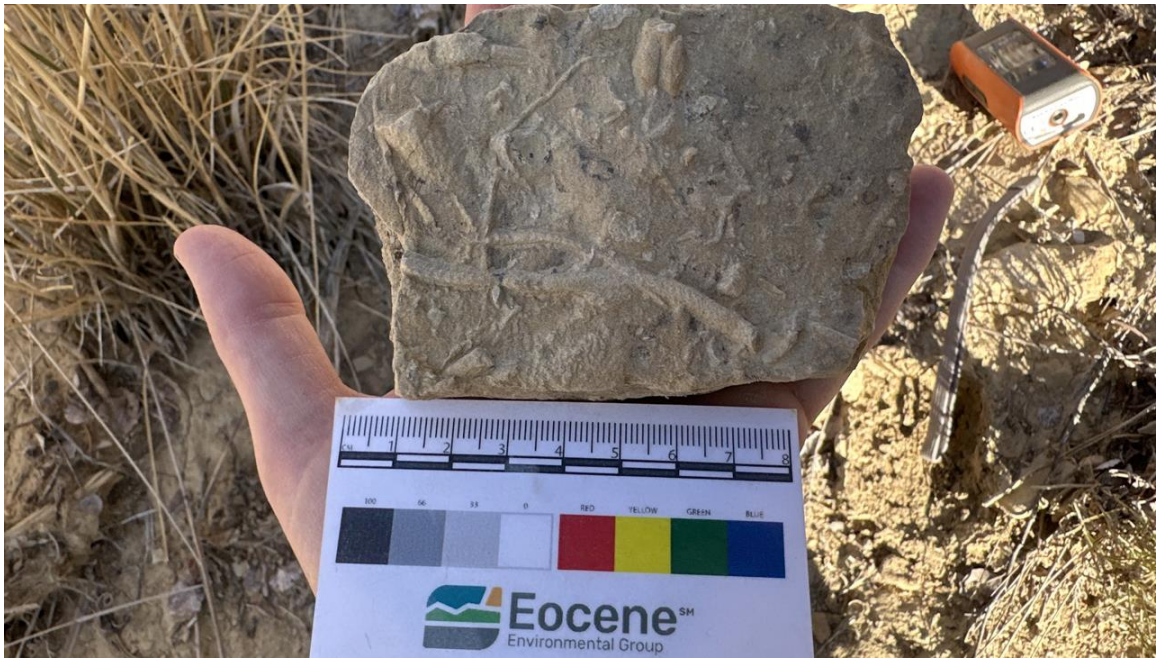

Figure 12. Invertebrate burrows within the Tropic Shale from 11212024-LMC-05. Larkin McCormack, 11/21/2024.



Figure 13. Possible fish scale preserved in a septarian nodule within the Tropic Shale from 11212024-LMC-01. Larkin McCormack, 11/21/2024.

Straight Cliffs Formation (Ksl and Ksu)

While not specifically mapped in the Project area, there were sandstone boulders and cobbles that can likely be attributed to the Straight Cliffs Formation due to erosion of the formation onto the underlying Tropic Shale Formation (**Figure 14**). The geologic contact between the Straight Cliffs Formation and Tropic Shale Formation can be gradational, making it hard to determine an exact point where one stops and the other begins. This combined with the ex situ nature of the cobbles and boulders make the attribution to the Straight Cliffs Formation tentative. The Straight Cliffs Formation lithology observed in the field was a tan medium- to coarse-grained sandstone with crossbedding present in some areas (**Figure 15**).

The Straight Cliffs Formation boulders and cobbles produced two new non-significant paleontological localities, including petrified wood and shells. Petrified wood fragments were found as float on a mudstone slope covered in sandstone cobbles and boulders (**Figure 16**). Oyster shells, shell hash, and inoceramid shell impressions were documented in medium-grained sandstone blocks overlying Tropic Shale Formation mudstone badlands (**Figures 17–18**).



Figure 14. Tan boulders and cobbles likely belonging to the Straight Cliffs Formation overlying the Tropic Shale Formation gray mudstone slopes. Larkin McCormack 11/21/2024.



Figure 15. Closeup on a sandstone boulder overlying the Tropic Shale Formation mudstone, likely belonging to the Straight Cliff Formation. Medium-grained tan sandstone with crossbedding. Larkin McCormack, 11/21/2024.



Figure 16. Petrified wood fragment likely eroded from the Straight Cliffs Formation overlying the Tropic Shale from 11222024-LMC-02. Larkin McCormack, 11/22/2024.



Figure 17. Fragmented bivalve shells, shell hash, and shell impressions eroded from the Straight Cliffs Formation overlying the Tropic Shale from 11222024-JCL-02. James Lotts, 11/22/2024.



Figure 18. Oyster shells and shell hash likely from the Tropic Shale Formation, from 11222024-JCL-02. James Lotts, 11/22/2024.

CONCLUSIONS AND MANAGEMENT RECOMMENDATIONS

This paleontological field survey generated 12 new non-significant paleontological localities on privately owned land located in Kane County between the towns of Mt. Carmel and Orderville in southern Utah. The most fossiliferous geologic unit in the survey area was the Tropic Shale Formation. Fossils found in this formation included shelled invertebrates (inoceramid clams, ammonites, turritella, oysters, and bivalves), invertebrate burrows, and possible fish scales. While not represented on the geologic map for the area, the Straight Cliffs Formation overlies the Tropic Shale Formation and was likely observed eroding over mudstone slopes within the Project area. The Straight Cliffs Formation produced two new paleontological localities, including petrified wood and bivalves. Fossils found near the Naturita Formation that were not attributed to a specific formation included shell hash and an oyster. All new localities were determined to be non-significant based on their commonality and poor preservation of the fossils, and none of the fossils were collected. Two horizons found in the Tropic Shale Formation consisting of inoceramid clam layers were of note due to their in situ preservation.

The Naturita Formation is mapped as underlying a portion of the Tait Pit and the and the Mt. Carmel irrigation improvements. The Naturita Formation is known to produce significant paleontological microsites near this area in Orderville. Based on field observations, the Tait Pit was fully Pleistocene to Holocene gravel deposits and the Naturita Formation was not exposed within disturbed areas of the Tait Pit. We recommend that the construction contractors are instructed to only excavate from previously disturbed areas of the pit, and if they notice a lithology change from gravel to finer grained sediments that could be indicative of the Naturita Formation they should not work in that area or should contact a paleontological monitor. The Mt. Carmel irrigation improvements within the Naturita Formation mapped area have experienced previous disturbance. If the improvements stay within these previously disturbed areas paleontological monitoring is not needed. If new disturbance is needed outside of these boundaries, a paleontological monitor should be present.

The Tropic Shale Formation underlies the outer perimeters of the proposed Cove Reservoir and associated features. No significant fossil localities were found during the pre-construction survey, but there are known vertebrate localities including a plesiosaur from the surrounding area. Based on the lack of fossils found during the pre-construction survey, full time paleontological monitoring is not needed but spot check paleontological monitoring during ground disturbance is recommended to observe spoils and disturbed materials, helping to mitigate potential risks to paleontological resources that could be unearthed by construction. Specific attention should be given to the area of locality 11222024-LMC-03 which preserved an in situ clam layer, suggesting that there could be more fossils preserved within this layer.

A pre-construction paleontological training with the construction contractor is recommended. If any fossils are found and a paleontological monitor is not on site, all activities should be stopped within 100 feet of the discovery, and the project paleontologist should be contacted.

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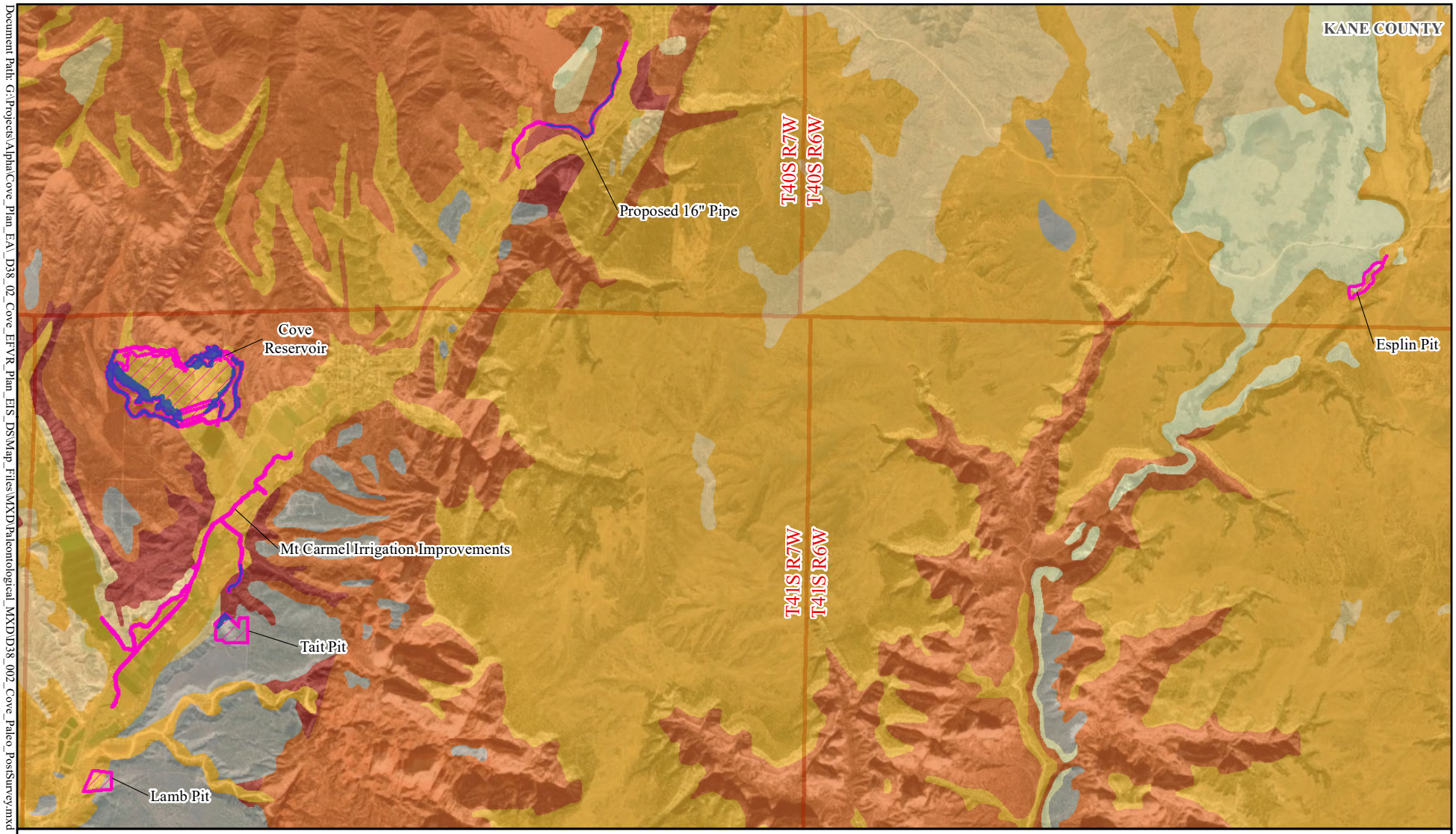
APPENDIX A
PROJECT MAPS



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Legend

- Paleontological Survey Area
- Project Area
- PFYC Class 1
- PFYC Class 2
- PFYC Class 3
- PFYC Class 4
- PFYC Class 5
- PFYC Unknown

0 2,000,000

Feet

1:26,836,491

Paleontological Overview

Alpha Engineering
Cove Reservoir Project

Date: 3/3/2025
Projection: NAD_1983_UTM_Zone_12N

Eocene Environmental Group

APPENDIX B

POTENTIAL FOSSIL YIELD CLASSIFICATION

Potential Fossil Yield Classification System

Introduction.
The Potential Fossil Yield Classification (PFYC) system allows Bureau of Land Management (BLM) employees to make initial assessments of paleontological resources in order to plan for multiple uses of public lands, consider disposal or acquisition of lands, analyze potential effects of a proposed action under the National Environmental Policy Act (NEPA) or conduct other BLM resource-related activities. The PFYC system can also highlight areas where paleontological research efforts may be warranted or predict illegal collecting. The system provides a consistent approach to land use planning or to determine if a proposed action may affect paleontological resources on public lands.

The PFYC system provides baseline guidance for assessing paleontological resources. The classification should be considered early in an analysis and should be used to assist in determining the need for further assessment or actions. When considering proposed actions, the PFYC system should be used in conjunction with an analysis of known fossil localities.

Occurrences of paleontological resources are known to be correlated with mapped geologic units (i.e., formations). The PFYC is created from available geologic maps and assigns a class value to each geological unit, representing the potential abundance and scientific importance of paleontological resources that occur in that geological unit. PFYC assignments should be considered as only a first approximation of the potential presence of paleontological resources, subject to change based on ground verification.

In the PFYC system, geologic units are assigned a class based on the known relative abundance of scientifically important paleontological resources and their sensitivity to adverse impacts. This classification is applied to the geologic formation, member, or other mapped unit. The classification is not intended to be applied to specific paleontological localities or small areas within units. Although important localities may occasionally occur in a geologic unit that has been assigned a lower PFYC classification, widely scattered fossils or localities do not necessarily indicate a higher class assignment. Instead, the overall abundance of scientifically important localities is intended to be the major determinant for the assigned classification.

The descriptions for the class assignments below serve as guidelines rather than as strict definitions. Knowledge of the geology and the paleontological potential for individual geological units are considered when developing PFYC assignments. These assignments must be developed using scientific expertise with input from a BLM paleontologists, but may include collaboration or peer review from outside researchers who are knowledgeable about both the geology and the nature of paleontological resources that may be found in each geologic unit. Each state has unique geologic maps and so also has unique PFYC assignments. It is possible, and occasionally desirable, to have different assignments for a similar geologic unit across separate states.

Class 1—Very Low. Geologic units that are not likely to contain recognizable paleontological resources. Units assigned to Class 1 typically have one or more of the following characteristics:

- Geologic units are igneous or metamorphic, excluding air-fall and reworked volcanic ash units
- Geologic Units are Precambrian in age

1) Management concerns for paleontological resources in Class 1 units are usually negligible or not applicable.

2) Paleontological mitigation is unlikely to be necessary except in very rare or isolated circumstances that result in the unanticipated presence of paleontological resources, such as unmapped geology contained within a mapped geologic unit. For example, young fissure-fill deposits often contain fossils but are too limited in extent to be represented on a geological map, a lava flow that preserves evidence of past life, or caves that contain important paleontological resources. Such exceptions are the reason that no geologic unit is assigned a Class 0.

Overall, the probability of impacting significant paleontological resources is very low and further assessment of paleontological resources is usually unnecessary. An assignment of Class 1 normally does not trigger further analysis unless paleontological resources are known or found to exist. However, standard stipulations should be put in place prior to authorizing any land use action in order to accommodate an unanticipated discovery.

Class 2—Low. Geologic units that are not likely to contain paleontological resources. Units assigned to Class 2 typically have one or more of the following characteristics:

- Field surveys have verified that significant paleontological resources are not present or are very rare
- Units are generally younger than 10,000 years before present
- Recent aeolian deposits
- Sediments exhibit significant physical and chemical changes (i.e., diagenetic alteration) that make fossil preservation unlikely

1) Except where paleontological resources are known or found to exist, management concerns for paleontological resources are generally low and further assessment is usually unnecessary except in occasional or isolated circumstances.

2) Paleontological mitigation is only necessary where paleontological resources are known or found to exist.

The probability of impacting significant paleontological resources is low. Localities containing important paleontological resources may exist but are occasional and should be managed on a case-by-case basis. An assignment of Class 2 may not trigger further analysis unless paleontological resources are known or found to exist. However, standard stipulations should be put in place prior to authorizing any land use action in order to accommodate unanticipated discoveries.

Class 3—Moderate. Sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence. Units assigned to Class 3 have some of the following characteristics:

- Marine in origin with sporadic known occurrences of paleontological resources
- Paleontological resources may occur intermittently, but abundance is known to be low
- Units may contain significant paleontological resources, but these occurrences are widely scattered
- The potential for an authorized land use to impact a significant paleontological resource is known to be low to moderate

1) Management concerns for paleontological resources are moderate because the existence of significant paleontological resources is known to be low. Common invertebrate or plant fossils may be found in the area, and opportunities may exist for casual collecting.

2) Paleontological mitigation strategies will be proposed based on the nature of the proposed activity.

This classification includes units of moderate or infrequent occurrence of paleontological resources. Management considerations cover a broad range of options that may include record searches, pre-disturbance surveys, monitoring, mitigation, or avoidance. Surface-disturbing activities may require assessment by a qualified paleontologist to determine whether significant paleontological resources occur in the area of a proposed action, and whether the action could affect the paleontological resources.

Class 4—High. Geologic units that are known to contain a high occurrence of paleontological resources. Units assigned to Class 4 typically have the following characteristics:

- Significant paleontological resources have been documented but may vary in occurrence and predictability
- Surface-disturbing activities may adversely affect paleontological resources
- Rare or uncommon fossils, including nonvertebrate (such as soft body preservation) or unusual plant fossils, may be present
- Illegal collecting activities may impact some areas

1) Management concerns for paleontological resources in Class 4 are moderate to high, depending on the proposed action.

2) Paleontological mitigation strategies will depend on the nature of the proposed activity, but field assessment by a qualified paleontologist is normally needed to assess local conditions.

The probability for impacting significant paleontological resources is moderate to high and is dependent on the proposed action. Mitigation plans must consider the nature of the proposed disturbance, such as removal or penetration of protective surface alluvium or soils, potential for future accelerated erosion, or increased ease of access that could result in looting. Detailed field assessment is normally required, and on-site monitoring or spot-checking may be necessary during land-disturbing activities. In some cases, avoidance of known paleontological resources may be necessary.

Class 5—Very High. Highly fossiliferous geologic units that consistently and predictably produce significant paleontological resources. Units assigned to Class 5 have some or all of the following characteristics:

- Significant paleontological resources have been documented and occur consistently
- Paleontological resources are highly susceptible to adverse impacts from surface-disturbing activities
- Unit is frequently the focus of illegal collecting activities

1) Management concerns for paleontological resources in Class 5 areas are high to very high.

2) A field survey by a qualified paleontologist is almost always needed. Paleontological mitigation may be necessary before or during surface-disturbing activities.

The probability for impacting significant paleontological resources is high. The area should be assessed prior to land tenure adjustments. Pre-work surveys are usually needed, and on-site monitoring may be necessary during land use activities. Avoidance or resource preservation through controlled access, designation of areas of avoidance, or special management designations should be considered.

Class U—Unknown Potential. Geologic units that cannot receive an informed PFYC assignment. Characteristics of Class U may include:

- Geological units may exhibit features or preservational conditions that suggest significant paleontological resources could be present, but little information about the actual paleontological resources of the unit or area is known
- Geological units represented on a map are based on lithologic character or basis of origin but have not been studied in detail
- Scientific literature does not exist or does not reveal the nature of paleontological resources
- Reports of paleontological resources are anecdotal or have not been verified
- Area or geologic unit is poorly or under-studied
- BLM staff has not yet been able to assess the nature of the geologic unit

1) Until a provisional assignment is made, geologic units that have an unknown potential have medium to high management concerns.

2) Lacking other information, field surveys are normally necessary, especially prior to authorizing a ground-disturbing activity.

An assignment of “Unknown” may indicate the unit or area is poorly studied, and field surveys are needed to verify the presence or absence of paleontological resources. Literature searches or consultation with professional colleagues may allow an unknown unit to be provisionally assigned to another Class, but the geological unit should be formally assigned to a Class after adequate survey and research is performed to make an informed determination.

Class W—Water.
Includes any surface area that is mapped as water. Bodies of water do not normally contain paleontological resources. However, shorelines should be carefully considered for uncovered or transported paleontological resources. Reservoirs are a special concern because important paleontological resources are often exposed during low water intervals. In areas of karst, sinkholes and cenotes may trap animals and contain paleontological resources. Dredging river systems may result in the disturbance of sediments that contain paleontological resources.

Class I—Ice.
Includes any area that is mapped as ice or snow. Receding glaciers, including exposed lateral and terminal moraines, should be considered for their potential to reveal recentlyexposed paleontological resources. Other considerations include melting snow fields that may contain paleontological resources with possible soft-tissue preservation.

Special Notes.
When developing PFYC assignments, the following should be considered:

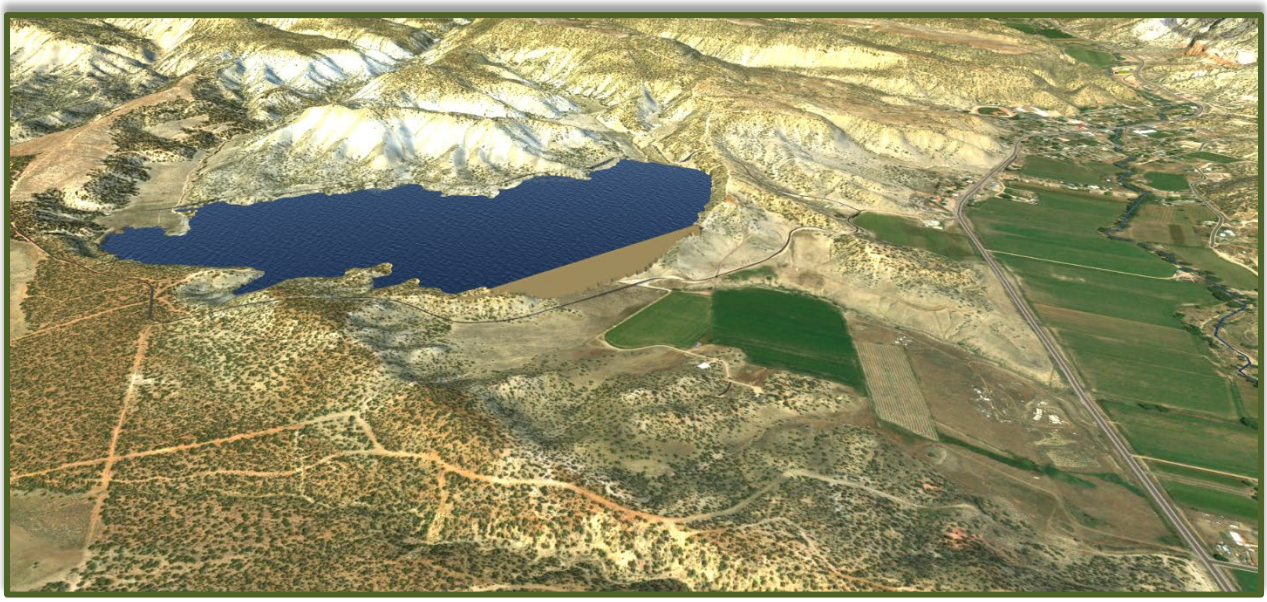
- Standard stipulations should always be put in place prior to authorizing any land use action in order to accommodate an unanticipated discovery.

- Class 1 and 2 and Class 4 and 5 units may be combined for broad applications, such as largescale planning, programmatic assessments, or when geologic mapping at an appropriate scale is not available. Resource assessment, mitigation, and other management considerations will need to be addressed when actual land disturbing activities are proposed.
- Where large projects impact multiple geologic units with different PFYC Classes, field survey and monitoring should be applied appropriately. For example, the authorized officer may determine that on-the-ground (pedestrian) surveys are necessary for the Class 4 and 5 formations, but not for Class 2 formations along a specific project.
- Based on information gained by surveys, the BLM may adjust PFYC assignments appropriately. Actual survey and monitoring intensities, as well as the extent of discoveries, should be included in any assessment, mitigation, or permit report so the BLM may reevaluate PFYC assignments.
- Some areas are difficult to evaluate, such as talus, colluvium, tailings, fill, borrow, and other mapped features. A PFYC assignment should be made for each area using available information, or the area should be assigned to Class U as appropriate.
- The BLM-wide PFYC assignments are maintained and periodically updated by the BLM paleontology team and may be obtained by contacting the BLM state or regional paleontologist assigned to an area.

APPENDIX C

LOCALITY FORMS (CONFIDENTIAL)

Kane County
Water Conservancy District



Submitted to
Natural Resources
Conservation Service
125 South State Street, Room 4010
Salt Lake City, Utah 84138

Submitted by
Kane County Water
Conservancy District
725 E Kaneplex Drive
Kanab, Utah 84741

Updated July 2024

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Part I. Introduction

A. Background

The Kane County Water Conservancy District (KCWCD) is proposing to construct a reservoir with associated facilities on property owned by the KCWCD as well as additional private land located near Orderville, Utah. Material borrow areas for construction of the dam are located on Bureau of Land Management (BLM) lands and private land. The dam is situated 0.6 miles from Highway 89 southwest of downtown Orderville (see **Figure 1**). As proposed, the reservoir would be constructed by the KCWCD. The Washington County Water Conservancy District (WCWCD) may participate in funding a portion of the water storage created by the project. The WCWCD participation would provide for: 1) storage of their water rights at higher elevation to reduce evaporation rates; 2) water releases during periods of low stream flows to augment peak summer uses and provide in stream flows for native and threatened and endangered fish species; and 3) more efficient use of the Quail Lake and Sand Hollow pipeline delivery system by releasing water when there is excess capacity in the pipeline system. This site was identified in the mid- to late-1980s during a reconnaissance level inventory of potential dam sites associated with tributaries of the Virgin River. Starting in 1996, the KCWCD and WCWCD have further explored constructing a dam at this location.

A feasibility study of the dam was performed in 2004 by RB&G Engineering. There were five borings along the dam alignment and 13 test pits completed during the investigation. The report concluded that the site is suitable for a dam and reservoir, there are available materials within a five- to 20-mile radius and the reservoir would be cost effective to construct.

The project will serve current water right holders and store water from the East Fork of the Virgin River during months with high river flow and then provide water during months with high demand. The components of the project include (see **Figure 2a** and **Figure 2b**):

- Reservoir
- Dam
- Low Level Outlet
- Principal Spillway
- Auxiliary Spillway
- Pipeline
- Pump Station
- Access Road
- Borrow Areas
- Recreation Area

The dam will be designed to maximize storage capacity with principal/auxiliary spillways to sustain the improvements during storm events. At full capacity, the reservoir would have a surface elevation of approximately 5545.5 feet above mean sea level (amsl) and a capacity of approximately 6,055 acre-feet. Rock, gravel, and clay borrow sources from nearby pits will be utilized to construct the facility. Approximately 3.2 miles of new and existing roads will be constructed and/or improved to provide access around the reservoir and replace access to properties surrounding the reservoir. Approximately 1.2 miles of existing roadway will be graded and improved from its current width of approximately 12 to 16 feet and improved with road base to a width of 28 feet. Approximately 2.0 miles of new roadway will be constructed to a width of 28 feet of road base.

Approximately 700 feet of large diameter pipe is required to extend from the existing irrigation transmission line, near the reservoir, to the outlet works of the reservoir. This extension will allow the use of the existing diversion dam and transmission line to fill the reservoir and allow use of the stored water during the irrigation season. This extension will also serve as the emergency drain for the reservoir. It is also proposed to replace approximately 1.7 miles of existing 4-inch to 8-inch lines in the Glendale irrigation system with a larger transmission line from the current hydro plant location to a new location next to the Orderville Diversion Dam. Excess water from the Glendale Irrigation System will then be combined with water diverted from the Orderville Diversion Dam to provide use of the existing irrigation pipeline system to fill the Cove Reservoir.

The existing Glendale and Orderville irrigation systems have limited capacity to deliver flows from the river and no capacity for storage during non-use and high flow periods. The Orderville Hydro Plant currently uses excess head available from the piping system and will continue to be used after the construction of the Cove Reservoir. Currently the hydro plant generates power during the winter months. With the construction of the Cove Reservoir, water will be stored during the winter and released during the irrigation season as water is needed for irrigation and to generate power during the summer. The construction of the proposed Cove Reservoir with its associated facilities provide a drought buffer, improve water quality, increase and maintain a more consistent reliable flow for the pressurized irrigation system, provide a water-energy nexus, and provide for more efficient irrigation methods. This will allow the KCWCD to take advantage of existing water rights and provide a more stable and sustainable supply of water for the area. Water storage at higher elevations also reduces evaporation losses that occur in lower reservoirs operated by the WCWCD. In addition, water can be released from the reservoir to provide for in-stream flows during periods of low flow in the Virgin River for endangered fish species.

Since the original concept of the Cove Reservoir and piping of a portion of the Glendale Irrigation Company piping the Mt. Carmel Irrigation Company has approached the KCWCD to pressurize the remainder of their irrigation system. There is approximately 24,000 feet of pipeline varying

in size from 8 to 16 inches in diameter and a booster pump station required to provide pressurized irrigation for the irrigation company.

This Plan of Development (POD) includes descriptions of and guidelines for the design, construction, operation, maintenance, and reclamation of the Project. The KCWCD and WCWCD would construct and operate the project in conformity with the approved POD.

B. Diversion & Water Rights

The proposed system will store water from the Glendale Irrigation Company, the Orderville Irrigation Company and the Mt. Carmel Irrigation Company. Water rights held by the respective irrigation companies include points of diversion from the East Fork Virgin River.

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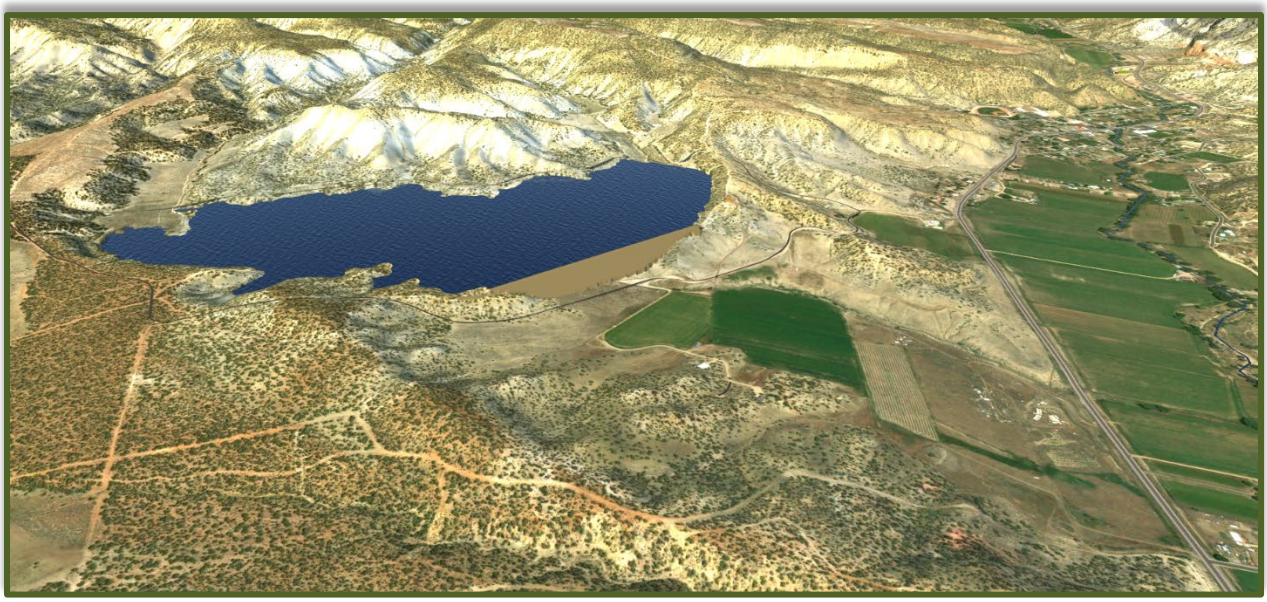
Mt. Carmel Irrigation Company	6.58 cfs	2,020 ac-ft	404
Total	**18.494 cfs**	**5,620 ac-ft**	**1,124**

Table 1 Water Rights Summary

Kane County
Water Conservancy District



Submitted to
Natural Resources
Conservation Service
125 South State Street, Room 4010
Salt Lake City, Utah 84138

Submitted by
Kane County Water
Conservancy District
725 E Kaneplex Drive
Kanab, Utah 84741

Updated July 2024

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Part I. Introduction

A. Background

The Kane County Water Conservancy District (KCWCD) is proposing to construct a reservoir with associated facilities on property owned by the KCWCD as well as additional private land located near Orderville, Utah. Material borrow areas for construction of the dam are located on Bureau of Land Management (BLM) lands and private land. The dam is situated 0.6 miles from Highway 89 southwest of downtown Orderville (see **Figure 1**). As proposed, the reservoir would be constructed by the KCWCD. The Washington County Water Conservancy District (WCWCD) may participate in funding a portion of the water storage created by the project. The WCWCD participation would provide for: 1) storage of their water rights at higher elevation to reduce evaporation rates; 2) water releases during periods of low stream flows to augment peak summer uses and provide in stream flows for native and threatened and endangered fish species; and 3) more efficient use of the Quail Lake and Sand Hollow pipeline delivery system by releasing water when there is excess capacity in the pipeline system. This site was identified in the mid- to late-1980s during a reconnaissance level inventory of potential dam sites associated with tributaries of the Virgin River. Starting in 1996, the KCWCD and WCWCD have further explored constructing a dam at this location.

A feasibility study of the dam was performed in 2004 by RB&G Engineering. There were five borings along the dam alignment and 13 test pits completed during the investigation. The report concluded that the site is suitable for a dam and reservoir, there are available materials within a five- to 20-mile radius and the reservoir would be cost effective to construct.

The project will serve current water right holders and store water from the East Fork of the Virgin River during months with high river flow and then provide water during months with high demand. The components of the project include (see **Figure 2a** and **Figure 2b**):

- Reservoir
- Dam
- Low Level Outlet
- Principal Spillway
- Auxiliary Spillway
- Pipeline
- Pump Station
- Access Road
- Borrow Areas
- Recreation Area

The dam will be designed to maximize storage capacity with principal/auxiliary spillways to sustain the improvements during storm events. At full capacity, the reservoir would have a surface elevation of approximately 5545.5 feet above mean sea level (amsl) and a capacity of approximately 6,055 acre-feet. Rock, gravel, and clay borrow sources from nearby pits will be utilized to construct the facility. Approximately 3.2 miles of new and existing roads will be constructed and/or improved to provide access around the reservoir and replace access to properties surrounding the reservoir. Approximately 1.2 miles of existing roadway will be graded and improved from its current width of approximately 12 to 16 feet and improved with road base to a width of 28 feet. Approximately 2.0 miles of new roadway will be constructed to a width of 28 feet of road base.

Approximately 700 feet of large diameter pipe is required to extend from the existing irrigation transmission line, near the reservoir, to the outlet works of the reservoir. This extension will allow the use of the existing diversion dam and transmission line to fill the reservoir and allow use of the stored water during the irrigation season. This extension will also serve as the emergency drain for the reservoir. It is also proposed to replace approximately 1.7 miles of existing 4-inch to 8-inch lines in the Glendale irrigation system with a larger transmission line from the current hydro plant location to a new location next to the Orderville Diversion Dam. Excess water from the Glendale Irrigation System will then be combined with water diverted from the Orderville Diversion Dam to provide use of the existing irrigation pipeline system to fill the Cove Reservoir.

The existing Glendale and Orderville irrigation systems have limited capacity to deliver flows from the river and no capacity for storage during non-use and high flow periods. The Orderville Hydro Plant currently uses excess head available from the piping system and will continue to be used after the construction of the Cove Reservoir. Currently the hydro plant generates power during the winter months. With the construction of the Cove Reservoir, water will be stored during the winter and released during the irrigation season as water is needed for irrigation and to generate power during the summer. The construction of the proposed Cove Reservoir with its associated facilities provide a drought buffer, improve water quality, increase and maintain a more consistent reliable flow for the pressurized irrigation system, provide a water-energy nexus, and provide for more efficient irrigation methods. This will allow the KCWCD to take advantage of existing water rights and provide a more stable and sustainable supply of water for the area. Water storage at higher elevations also reduces evaporation losses that occur in lower reservoirs operated by the WCWCD. In addition, water can be released from the reservoir to provide for in-stream flows during periods of low flow in the Virgin River for endangered fish species.

Since the original concept of the Cove Reservoir and piping of a portion of the Glendale Irrigation Company piping the Mt. Carmel Irrigation Company has approached the KCWCD to pressurize the remainder of their irrigation system. There is approximately 24,000 feet of pipeline varying

in size from 8 to 16 inches in diameter and a booster pump station required to provide pressurized irrigation for the irrigation company.

This Plan of Development (POD) includes descriptions of and guidelines for the design, construction, operation, maintenance, and reclamation of the Project. The KCWCD and WCWCD would construct and operate the project in conformity with the approved POD.

B. Diversion & Water Rights

The proposed system will store water from the Glendale Irrigation Company, the Orderville Irrigation Company and the Mt. Carmel Irrigation Company. Water rights held by the respective irrigation companies include points of diversion from the East Fork Virgin River.

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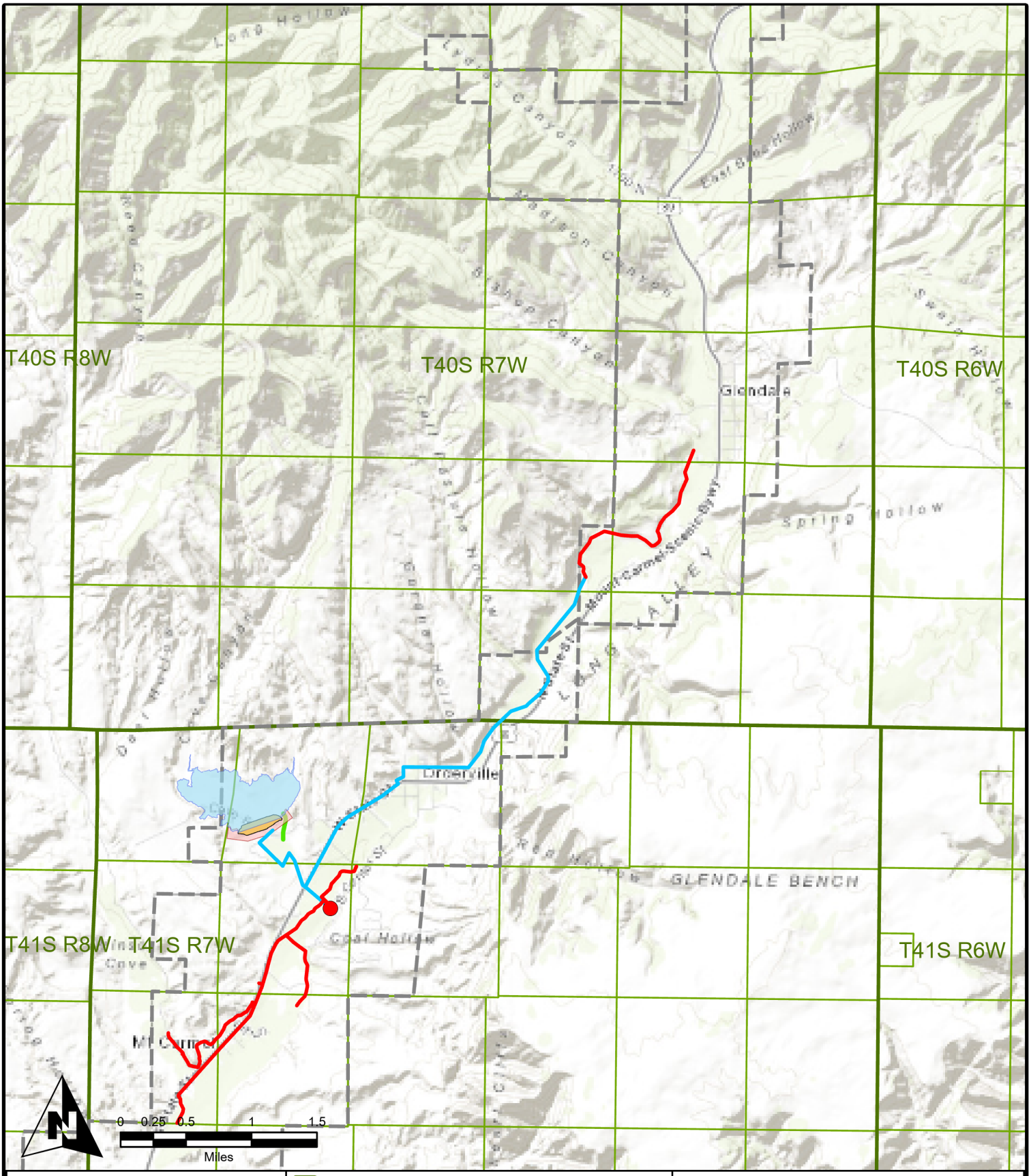
Table 1 Water Rights Summary



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ALPHA ENGINEERING

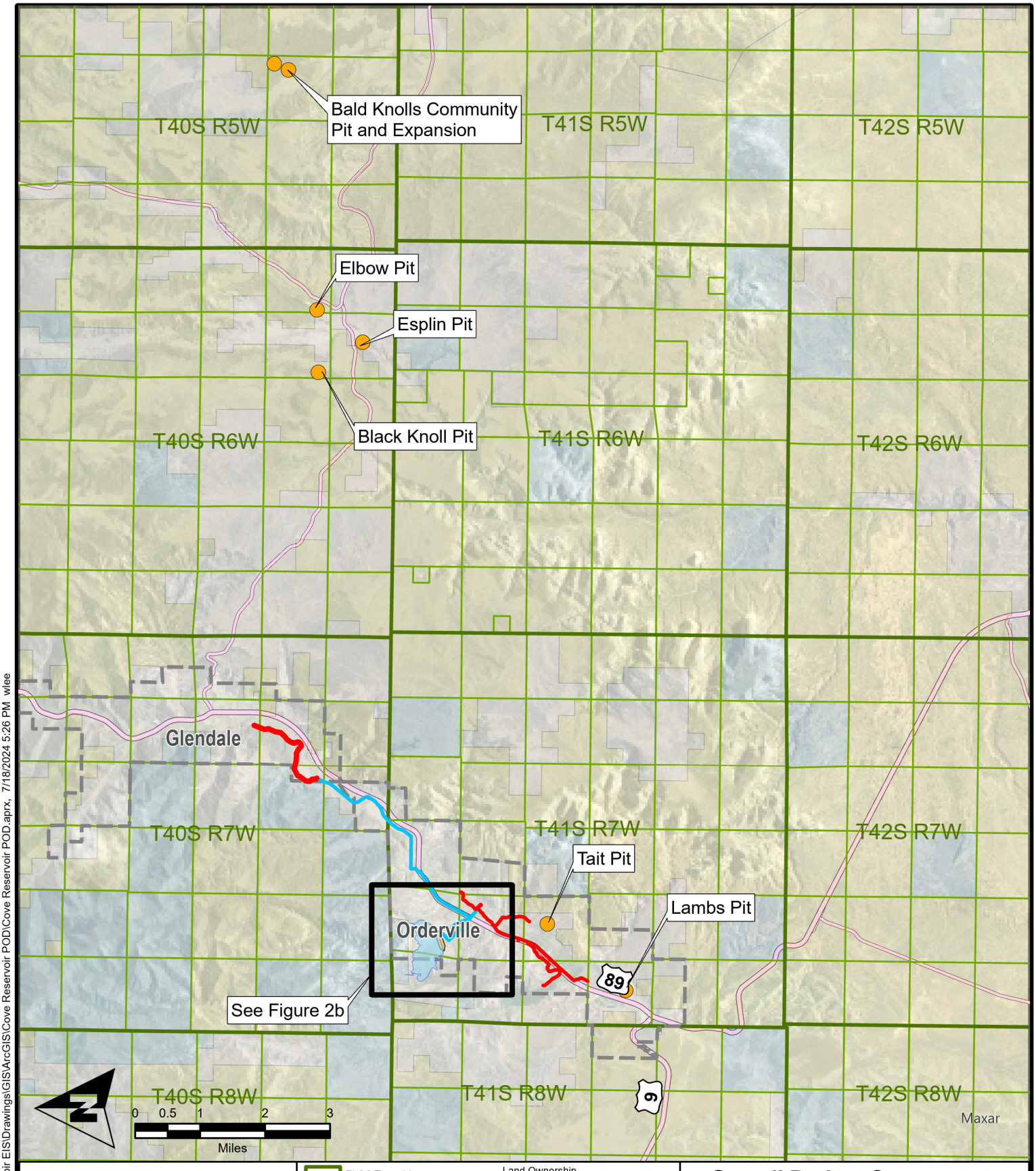
RB&G ENGINEERING, INC.

- PLSS Townships
- PLSS Sections
- Municipalities
- Cove Reservoir
- Existing Transmission Pipeline
- New 8" to 16" Diameter Pipes
- Existing Hydroplant & Proposed Pump Station

Project Location

Figure 1 - Cove Reservoir POD

Spatial Reference:	UT83-SF
Drawn By:	JTM
Scale:	1:63,360
Date:	July 18, 2024



ALPHA ENGINEERING

RB&G ENGINEERING, INC.

PLSS Townships
PLSS Sections
Municipalities
Roads
Cove Reservoir
Existing Transmission Pipeline
New Transmission Line
Borrow Areas

Land Ownership
Federal
Private
State
Tribal

E-852

Overall Project Components

Figure 2a - Cove Reservoir POD

Spatial Reference:	UT83-SF
Drawn By:	JTM
Scale:	1:126,720
Date:	July 18, 2024

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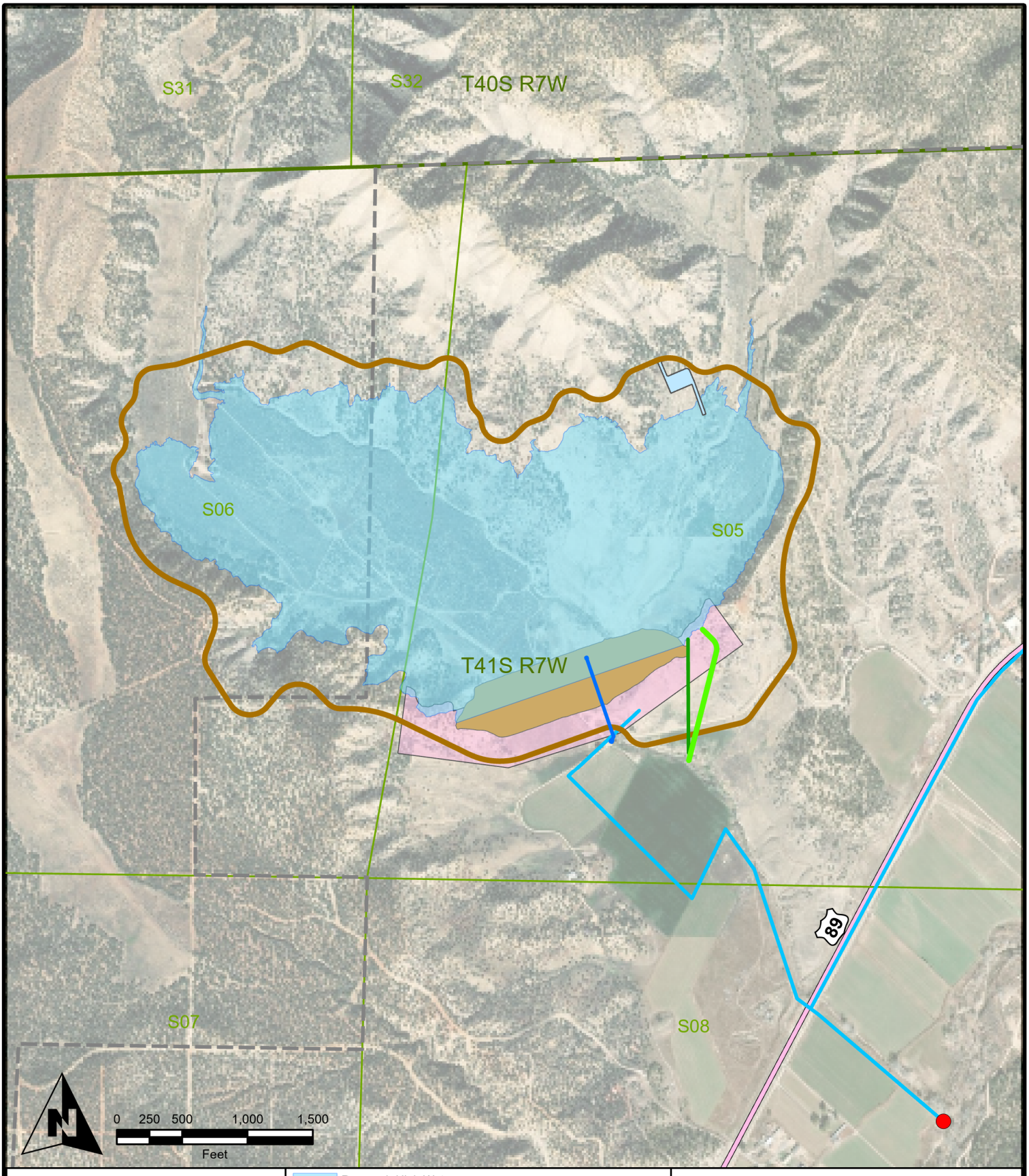

ALPHA ENGINEERING

RB&G ENGINEERING, INC.

- Reservoir High Water
- Dam Structure
- Principal Spillway
- Auxiliary Spillway
- Outlet Works
- Access Road
- Highway 89
- Existing Hydroplant & Proposed Pump Station
- Existing Pipeline
- Contingency Disturbance Area

Reservoir Project Components

Figure 2b - Cove Reservoir POD

Spatial Reference:	UT83-SF
Drawn By:	JTM
Scale:	1:12,000
Date:	July 18, 2024

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Part II. Purpose and Need for Facility

The primary purpose of the project is to serve the current water users by providing for enhanced conservation and beneficial use of water. This purpose would be achieved by increasing water availability through collecting and storing water during non-use periods and providing flows during the irrigation season. As mentioned, the existing irrigation facilities have limited capabilities to divert water from the East Fork Virgin River and store water during high flows. This project creates a drought buffer for sustained time periods of low flows in the East Fork Virgin River. The water storage can also provide recreation opportunities for the area including fishing, camping, and small watercraft. In addition, flows from the reservoir may be released during drought conditions to provide additional instream flows in the Virgin River to help decrease high water temperatures that affect certain threatened and endangered species.

Secondary to water conservation, there are other purposes for the reservoir. The existing Orderville Hydro Plant will also maintain a more consistent output with the creation of the reservoir to allow generation with releases from the reservoir which otherwise may not be available during drought conditions. The reservoir allows for storage of water at higher elevations, which reduces evaporation rates. The reservoir improves water conditions for water users as water quality is a concern in the area due to periodic high sediment loads from the upstream basin. Finally, the water surface elevation will provide pressure head that will increase and maintain pressures throughout the irrigation system. With improved water quality and pressure, more efficient irrigation methods are enabled for the system users.

Part III. Project Description and Land Ownership

A. Project Description and Land Ownership

The proposed reservoir and pipelines would be located on private lands. Permanent facilities would consist of a 190-acre reservoir, principal and auxiliary spillways, an access road, recreation facilities and pipelines. **Table 3** depicts the length, width and acreage for each of the facility components with permanent and temporary disturbance, including a final right-of-way required for each facility. The project layout with land ownership is shown on **Figure 2a**.

B. Right of Way

A 560-acre area would is potentially required for construction of the reservoir and dam, shown as the Contingency Disturbed Area in **Figure 1**. The temporary disturbance, permanent disturbance and right-of-ways for each component of the project are listed below.

- The reservoir area is comprised of the maximum water surface area, the dam and the low level outlet. A buffer area has been approximated to allow for instrumentation, which is also included in the reservoir area. Finally, portions of the spillways and recreation area are included in the reservoir area. The reservoir area requires 235 acres of temporary disturbance, permanent disturbance and right-of-way.
- The principal spillway is 870 lineal feet in length. 385 lineal feet of the spillway is accounted for within the reservoir disturbance and right-of-way. The principal spillway requires 100 feet of temporary disturbance and 14 feet of permanent disturbance (road) with a 50-foot right-of-way.
- The auxiliary spillway is 1,070 lineal feet in length. 355 lineal feet of the spillway is accounted for within the reservoir disturbance and right-of-way. The auxiliary spillway requires 100 feet of temporary disturbance and 30 feet of permanent disturbance (channel) with a 30-foot right-of-way.
- The Glendale Irrigation Company pipeline is 8,980 lineal feet in length and requires 50 feet of temporary disturbance but would not create permanent disturbance or require additional right-of-way as it will be located within an existing roadway. The Mt. Carmel Irrigation Company Pipeline is approximately 24,000 feet in length and requires 50 feet of temporary disturbance but would not create permanent disturbance or require additional right-of-way as it will be located within existing roadways, open canals, or through existing fields.

- The access road around the reservoir is 16,900 lineal feet in length. It will be located within existing roads where possible. Approximately 6,200 lineal feet of road will be located within existing dirt roads without a dedicated right-of-way and 10,700 lineal feet of road will be new roadway. The access road requires 100 feet for construction disturbance and 36 feet of permanent disturbance (road) with a 50-foot right-of-way.
- There are a total of six borrow areas being considered for the project. Two borrow areas (Lamb Pit and Tait Pit) are located on private property within existing pits and will require additional permanent disturbance and right-of-way of approximately 0.5 acres for Lamb Pit and 0.7 acres for Tait Pit. One of these pits will be selected for the project so there will be a maximum disturbance of 0.7 acres. Black Knoll Pit is located on BLM-administered property in an undisturbed area and will potentially require up to 5.0 acres of permanent disturbance and right-of-way. Elbow Pit is located on BLM-administered property within an existing pit and will not require additional permanent disturbance and right-of-way. The fifth site (Bald Knolls Pit) is located on BLM-administered property within an existing pit that will be required to be expanded with this project to include an additional 5.0 acres of permanent disturbance and right-of-way. Either the Bald Knoll or the Black Knoll Pit will be used so the maximum disturbance will be 5.0 acres. The sixth pit has been recently added to the project and is on private property and will require additional permanent disturbance of and right-of-way of approximately 5 acres but would eliminate the need from borrowing from the Bald Knoll or Black Knoll Pit.
- The recreation area will require approximately 4.3 acres of area. 0.2 acres of the recreation area is accounted for within the reservoir disturbance and right-of-way. It requires 4.1 acres of temporary disturbance, permanent disturbance and right-of-way.

Table 3 provides disturbance and right-of-way acreages for the project components. The temporary disturbance acreages shown in the table are calculated as the additional area after the permanent disturbance acreages have been calculated. The right-of-way acreages do not take into account any disturbance acreages. In total, the project requires 259.1 acres of permanent disturbance, 64 acres of temporary additional disturbance and 264.5 acres of right-of-way.

Component	Linear ROW (feet)	Permanent Disturbance (acres)			Add'l Temporary Disturbance (acres)			ROW (acres)		
		Private	BLM	Total	Private	BLM	Total	Private	BLM	Total
Reservoir	-	235.0	0.0	**235.0**	0.0	0.0	**0.0**	235.0	0.0	**235.0**
Principal Spillway	385	0.1	0.0	**0.1**	0.8	0.0	**0.8**	0.1	0.0	**0.1**
Auxiliary Spillway	355	0.2	0.0	**0.2**	0.6	0.0	**0.6**	0.2	0.0	**0.2**
Pipeline	32,980	0.0	0.0	**0.0**	37.9	0.0	**37.9**	0.0	0.0	**0.0**
Access Road	16,900	14.0	0.0	**14.0**	24.8	0.0	**24.8**	19.4	0.0	**19.4**
Borrow Areas	-	0.7	5.0	**5.7**	0.0	0.0	**0.0**	0.7	5.0	**5.7**
Recreation Area	-	4.1	0.0	**4.1**	0.0	0.0	**0.0**	4.1	0.0	**4.1**
Total	**50,620**	254.1	5.0	**259.1**	64.0	0.0	**64.0**	259.5	5.0	**264.5**

Table 2 Summary of Surface Disturbance.

C. Government Agencies Involved

The government agencies potentially involved include:

- Kane County Water Conservancy District
- Washington County Water Conservancy District
- Bureau of Land Management
- Utah Division of Wildlife Resources
- Kane County
- Town of Orderville
- Town of Glendale
- US Army Corps of Engineers
- Utah State Division of Water Rights, Dam Safety

Part IV. Facility Construction & Design

A. Schedule

Construction would commence after necessary permits are obtained and all plans are finalized. Construction of the pipelines and reservoir is estimated to take up to 15 months to complete. Construction of the pipelines and reservoir would occur simultaneously. **Table 4** provides an estimated sequence of construction activities:

Reservoir	Other Facilities
Clear & Grub Vegetation	Access Road
Develop Staging Areas	Install Pipelines
Construct Dam Trench	Principal & Auxiliary Spillway
Install Outlet Works	Recreation Area
Construct Dam (Haul Clay, Rock and Filter)	

Table 3 Estimated Sequence of Construction Activities

B. Construction of Facilities

i. Reservoir and Dam

The reservoir would be created by the construction of an earthen and rock fill dam having a central clay core. The length of the dam would be approximately 1,900 feet with a maximum dam height of 90 feet and a crest elevation of 5552 feet amsl.

Staging areas for the construction of the dam would be located within the footprint of the reservoir and will eventually be covered with water. An additional 200- to 300-foot buffer downstream of the dam will be used for instrumentation and additional staging. Construction of the dam would require large earth moving machinery, a portable gravel pit operation, water and multiple personnel.

The initial phase of construction would be to prepare the foundation, which will include excavation of overburden soils to varying degrees to mitigate settlement, excavation of a cutoff trench extending into bedrock, and installation of a grout curtain where conditions warrant, expected as a minimum, to be up both abutments. Borrow sources for the materials to construct the dam are discussed in **Section vi**, and large machinery will make continual trips between the reservoir and borrow sites as the dam is constructed. Operations to separate and produce engineer-specified material to be

used for the dam will occur on-site within the project staging areas. Watering activities will continue throughout the construction of the dam as necessary to allow optimum compaction of the excavated material and maintain air quality.

A concrete encased pipeline will be used as the low level outlet works with a screened intake structure at the upstream end and an energy dissipater structure at the downstream end. The outlet works excavation will extend to bedrock through the embankment footprint, near the left abutment, and will be constructed in conjunction with the dam.

The estimated personnel and equipment required for the construction of the reservoir and dam are shown in **Table 5**.

Task	# of People	Equipment
Construction Engineering	4 - People	3 - Pickup Trucks, 1 - Four-wheeler
Foundation Preparation	9 - People	1 - Bulldozer, 1 - Track hoe, 2 - Scrapers, 2 - Pickup Trucks 1 - Drill, 1- Grout Plant
Dam Embankment	6 - People	1 - Bulldozer, 1 - Compactor, 1 - Grader, 1 - Water Truck
Embankment Borrow	6 - People	1 - Bulldozer, 1 - Track Hoe, 4 - Scrapers
Filter and Drain	3 - People	2 - Dump Trucks, 1 - Compactor
Outlet Works	4 - People	1 - Concrete Truck

Table 4 Estimated Personnel and Equipment for Reservoir and Dam Construction

ii. Principal Spillway

A pipeline will be used as the principal spillway, including an intake screen and structure at the intake and an energy dissipater structure at the outfall. The alignment for the pipeline will be located near the left abutment and will convey flows away from the dam structure. This pipeline has an approximate length of 870 lineal feet.

Pipeline installation activities would include staking, clearing and grubbing, trenching, hauling equipment and materials, pipeline assembly, backfill and access road construction, in this order. Prior to construction, the exact centerline of the pipeline ROW would be staked. The ROW boundaries would also be flagged in some areas (e.g., thick vegetation). Following staking, vegetation within the ROW would be cleared and grubbed to the extent necessary to provide for equipment clearance, construction, and maintenance operations.

The pipeline would be bedded and buried to a minimum depth of four feet to the top of pipe. The trench width and depth would vary depending upon the final design of the pipeline but will be sloped to gravity drain. The trench would generally be two feet wider than the pipe.

In areas where the pipelines would parallel or be within existing roads, the surface would be brought back to an as-good-as or better condition or replaced according to the governing agency's recommended specifications and requirements. The estimated personnel and equipment required for the construction of the principal spillway are shown in **Table 6**.

Task	# of People	Equipment
Survey and Staking	2 - People	1 - Pickup Truck
Trenching	1 - People	1 - Track Hoe
Pipe and Materials Hauling	2 - People	1 - Semi-truck and Flatbed Trailer
Pipeline Assembly & Burying	4 - People	1 - Bulldozer, 3 - Track Hoe, 1 - Dump Truck, 1 - Loader, 2 - Pickup Trucks
New Road Construction	1 - People	1 - Bulldozer

Table 5 Estimated Personnel and Equipment for Principal Spillway Construction

iii. Auxiliary Spillway

The auxiliary spillway will comprise a trapezoidal earthen channel, including a concrete weir structure a few hundred feet west of the left abutment of the dam. The auxiliary spillway will extend into an existing drainage channel west of the dam. Where the grade of the spillway becomes too steep for natural stabilization, additional armoring or riprap will be installed to prevent erosion of the spillway or adjacent grades.

The spillway will be constructed simultaneously with the dam as needed for additional access to the left abutment. This will allow easier access for the construction of the dam. The spillway ROW will be staked and cleared of all vegetation. The estimated personnel and equipment required for the construction of the spillway are shown in **Table 7**.

Task	# of People	Equipment
Survey and Staking	2 - People	1 - Pickup Truck
Concrete Weir Construction	2 - People	1 - Concrete Mixer
Channel Grading	3 - People	1 - Bulldozer, 1 - Track Hoe

Task	# of People	Equipment
Channel Armoring	2 - People	1 - Track Hoe

Table 6 Estimated Personnel and Equipment for Auxiliary Spillway Construction

iv. Pipeline

Additional pipeline is required to meet the project objectives. The additional pipeline will complete the transmission system to and from the reservoir. The pipeline will be located at the south end of the Town of Glendale near the East Fork Virgin River. The pipeline would replace the existing 4 to 8-inch pipelines and be installed adjacent to the existing lines. Additional piping will also be installed to provide pressurized irrigation to areas within the Mt. Carmel area that will vary in size from 8 to 16 inches in diameter.

Appropriate air valves would be installed along the pipeline at approximately 1/2-mile intervals and at major grade changes. In-line valves would be required at all pipeline intersections. Drain-lines or blow-off valves would also be located periodically along the pipeline at low points in the pipeline and would drain to existing channels. The pipeline would also be provided with tracer wire for locating the underground piping. Above-ground fiberglass markers would also be placed at strategic locations to provide public notice of the underground piping to avoid conflicts with future construction.

Pipeline installation activities would include staking, clearing and grubbing, trenching, hauling equipment and materials, pipeline assembly, and backfill, in this order. Prior to construction, the exact centerline of the pipeline ROW would be staked. The ROW boundaries would also be flagged in some areas (e.g., thick vegetation). Following staking, vegetation within the ROW would be cleared and grubbed to the extent necessary to provide for equipment clearance, construction, and maintenance operations.

Where the pipeline parallels existing utilities, care would be taken to protect existing infrastructure and coordination would take place among affected entities. Where the pipeline would be installed under existing asphalt or where it would cross paved roads, asphalt would be replaced according to the governing agency's recommended specifications and requirements.

In areas where the pipelines would parallel or be within existing non-paved roads, the surface would be brought back to an as-good-as or better condition, or replaced according to the governing agency's recommended specifications and requirements. Where there would be air valves or other pipeline appurtenances, construction would follow standard safety guidelines, including distance from roads or installation of barriers.

The pipelines would be bedded and buried to a minimum depth of three feet to the top of pipe and deeper under streambed crossings. The trench width and depth would vary depending upon the size of the pipe being installed. The trench would generally be two feet wider than the pipe. The estimated personnel and equipment required for the construction of the pipeline are shown in **Table 8**.

Task	# of People	Equipment
Survey and Staking	2 - People	1 - Pickup Truck
Trenching	1 - Person	1 - Track Hoe
Pipe and Materials Hauling	2 - People	1 - Semi-truck and Flatbed Trailer
Pipeline Assembly & Burying	4 - People	1 - Bulldozer, 3 - Track Hoe, 1 - Dump Truck, 1 - Loader, 2 - Pickup Trucks
New Road Construction	1 - Person	1 - Bulldozer

Table 7 Estimated Personnel and Equipment for Pipeline Construction

v. Access Road

The access road will be located around the perimeter of the reservoir using existing roads where possible. Approximately 3.2 miles of new and existing roads will be constructed and/or improved to provide access around the reservoir and replace access to properties surrounding the reservoir. Approximately 1.2 miles of existing roadway will be graded and improved from its current width of approximately 12 to 16 feet and improved with road base to a width of 28 feet. Approximately 2.0 miles of new roadway will be constructed to a width of 28 feet of road base. The cross-section of the roadway would be constructed to permit two-way traffic for the construction and access of the dam. Due to the hilly terrain, a minimal section will be used in order to reduce cuts and fills. A borrow ditch and culverts will be installed as needed to allow drainage without damage to the access road. The access road will be covered with a graded and compacted road base material.

The access road will be constructed early in the construction process to allow access for upstream property owners. This will also facilitate construction of the dam. The road ROW and grade slopes will be staked and cleared of all vegetation. Watering equipment will be kept on-site for compaction and to control air quality. The estimated personnel and equipment required for the construction of the access road are shown in **Table 9**.

Task	# of People	Equipment
Survey and Staking	2 - People	1 - Pickup Truck
Rough Grading	2 - People	1 - Track Hoe, 1 – Bulldozer, 1 - Water Truck
Final Road Grading	2 - People	1 – Bulldozer, 1 - Dump Truck

Table 9 Estimated Personnel and Equipment for Access Road Construction

vi. Borrow Areas

Borrow sources would include (1) the Lambs Pit located 0.5 miles north of Mt Carmel Junction off of Highway 89; (2) the Tait Pit located 2.0 miles north of Mt Carmel Junction off of Highway 89; (3) the Black Knoll Pit located 6.0 miles east of the Town of Glendale off of Glendale Bench Road (partial dirt road); (4) the Elbow Pit located 7.1 miles east of the Town of Glendale off of Glendale Bench Road (partial dirt road); and (5) the Bald Knolls Community Pit located 11 miles east of the Town of Glendale off of Glendale Bench Road (partial dirt road) and the Esplin Pit located 5.9 miles east of the Town of Glendale off Glendale Bench Road (partial dirt road). The transportation path to and from the borrow areas will run along existing roadways, including smaller county dirt roads. Additional right-of-ways to access the borrow areas will not be required. The approximate quantities for the dam are provided in **Table 10**.

Type	Quantity
Excavation	644,000 cubic-yards
Earthfill	1,575,000 cubic-yards
Filter/Drain	82,000 cubic-yards
Riprap Bedding	19,000 cubic-yards
Riprap	28,000 cubic-yards
Total	**2,348,000 cubic-yards**

Table 80 Estimated Earthwork Quantities

vii. Recreation Area and Boat Ramp

Initial discussions have identified the area as an overnight and day-use facility equipped with picnic tables, restrooms, campgrounds, a pavilion and a boat ramp for small-engine (trolling motors) boat access. No utilities will be extended to the recreation facilities. A detailed recreation plan would be prepared by a committee that involves all stakeholders. The KCWCD would anticipate contracting with a separate state or local governmental entity to manage the recreation area. A parking area and boat ramp have been identified on Figure 2b. A camp host for overnight camping, who would maintain the facility, is being considered.

C. Resource Value and Environmental Concerns

KCWCD will contract the services of an environmental consultant to complete required resource surveys and to prepare National Environmental Policy Act (NEPA) related documents.

Cultural resources that would be directly or indirectly impacted would be subject to evaluation and determination through Section 106 consultation (under the National Historic Properties Act). Project engineers would work with archaeologists to avoid or minimize impacts to any identified cultural resources. As necessary, specific mitigation measures for biological resources would also be developed as part of the EA, and if necessary, additional surveys and Section 7 consultation (under the Endangered Species Act) would be conducted.

Implementation of the project would comply with all applicable federal and state laws and any local zoning and building ordinances during all phases of the project. Potential impacts to the environment are expected to be minimal as standard Best Management Practices (BMPs) would be followed (**Appendix A**) and the Environmental Protection Measures (EPMs) listed below would be implemented. EPMs would also apply to operation and maintenance of the completed facility. The NRCS is expected to inspect the project both during and after project completion to ensure compliance with EPMs and other requirements.

Air Resources: The generation of fugitive dust from surface activities, including earth moving and hauling and handling of materials, would be controlled by implementing BMPs. When needed, water would be applied during construction to control fugitive dust levels on access roads and construction sites.

Water Resources: BMPs would be used as needed to control storm water discharges. These practices would include material handling and temporary storage procedures that minimize the exposure of potential pollutants to storm water, spill prevention and response, sediment and erosion controls, and physical storm water controls. Site runoff would be controlled and managed in accordance with regulation. A Storm Water Pollution Prevention Plan would be prepared prior to construction and followed during construction.

Hazardous Materials and Wastes: Construction sites, staging areas, and access roads would be kept in an orderly condition throughout construction. Refuse and trash, including stakes and flags, would be removed and disposed. Covered dumpsters located in the Project Area would contain all refuse. Refuse would be removed on a regular basis to an approved disposal facility. No open burning of construction trash would occur. Portable toilets would be used on site, and would be maintained on a regular schedule.

No construction equipment oil or fuel would be drained on the ground. Oils or chemicals would be hauled to an approved site for disposal. The only significant sources of potential petroleum or

other hazardous material spills are from mobile equipment. If a fuel/oil or other hazardous material spill were to occur, the required regulatory agencies would be contacted as soon as possible, and actions would be taken to minimize the amount and spread of the spill material. Such measures may include straw bale plugs, earthen berms, or use of other absorbent materials. If necessary, soil remediation would be conducted and would include the removal of contaminated soils to an approved facility and a soil sample(s) would be taken to verify the success of the site remediation. In addition, the KCWCD would follow any other local, state, or Federal regulations related to the use, handling, storing, transporting, and disposing of hazardous materials.

Fire Prevention and Protection: All construction personnel would have fire tools and extinguishers available at all times for use if the occasion arises. Construction staff would adhere to any local fire prevention and suppression requirements.

Cultural Resources: If during any project activities, cultural, historical, or prehistoric resources, including any of Native American religious interest, are inadvertently discovered, the appropriate authorized officer would be notified, and all work in the area would cease. A professionally trained archeologist would work with the SHPO and affiliated or interested Tribes to determine eligibility for the National Register of Historic Places. If needed, a mitigation plan would be developed in consultation with the SHPO, KCWCD, construction crews, and interested Tribes. Construction personnel would be instructed to watch for cultural artifacts while working on the project. In the event significant vertebrate paleontological resources are discovered, including human remains, the authorized officer would be notified.

Human Health and Safety: Blasting will not be allowed at the dam site, however it may be an option for the Hydro Plant. The contractor performing blasting would comply with applicable regulations and standards established by the regulatory agencies, codes, and professional societies, including the rules and regulations for storage, transportation, delivery, and use of explosives. Whenever blasting operations are in progress, explosives would be stored, handled, and used as provided by law, including safety and health regulations for construction. No explosives would be stored on the Project Area.

Construction sites would be managed to prevent harm to any person and property. During construction, all employees, project managers, supervisors, inspectors, contractors, and subcontractors would be required to conform to contractor safety procedures. All personnel would be adequately trained to perform their tasks. Heavy equipment would be outfitted with Occupational Safety and Health Administration (OSHA) required safety devices such as backup warnings and seat belts. Hard hats, safety boots, ear and eye protection, and other personal

safety equipment would be available to any personnel requesting it. All accidents and injuries would be reported to the appropriate contractor safety officer.

Noxious Weeds/Invasive Species: All equipment, including pickup trucks and passenger vehicles, would be cleaned of soils, seeds, vegetative matter, or other debris or matter that could contain or hold noxious seeds prior to entering the Project Area. The cleaning of equipment would also be done any time thereafter if the equipment leaves the Project Area, is used on another project, and reenters the Project Area. The KCWCD would follow any regulations pertaining to control of noxious weeds on state- or federal-administered land. Vegetation in the Project Area would be monitored periodically for the establishment of noxious weeds or undesirable plant species. The KCWCD would be responsible for any future weed control work, if needed, as a result of the implementation of this Project. Any use of herbicides would comply with local requirements.

Stabilization and Rehabilitation: All areas subject to temporary ground disturbance would be restored to original contours to the extent determined by the governing agency. Temporarily disturbed areas would be seeded using a certified weed-free seed mix approved by the governing agency. Seed would be hand broadcasted and lightly covered with soil by hand using a rake or by pulling a chain-link fence with an all-terrain vehicle. All soil removed during construction would be reused. Vegetation removal would be kept to that necessary to construct the project. Any brush removed during construction would be used as mulch after reclamation activities. Any trees felled would either be left on site as down woody debris or removed if preferred by the governing agency. The reservoir area would be smoothed and cleaned up prior to filling the reservoir with water. The borrow areas would be cleaned up of all debris and smoothed out.

Raptors and Migratory Birds: In order to avoid or reduce impacts on nesting success of raptors, activities would not occur within recommended spatial and seasonal buffers, and would follow Utah BLM BMPs for Raptors and Their Associated Habitats in Utah [BLM 2006]. If existing topography limits actual line-of-sight of between an active nest (i.e., the nest has eggs or young) and construction activities, the spatial and seasonal buffer may be reduced.

To avoid or minimize potential short-term and long-term impacts to migratory birds, construction activities would be either limited during the migratory bird nesting period (generally defined as 15 May – July 15 [BLM 2008], but could start as early as March/April depending on elevation and latitude), or a migratory bird nesting survey would be completed in areas proposed for disturbance during this time period. If an active nest were discovered, the appropriate agency biologist would be notified and an appropriate buffer area around the nest would be established to prevent nest abandonment until after the migratory bird nesting period is over and/or young have fledged.

Wildlife: No firearms, air guns, or archery equipment would be allowed on the project sites. No pets would be permitted on project sites. To prevent entrapment of wildlife during construction, any open pits or trenches would be monitored throughout the construction day. Excavated pits and trenches more than 2 feet deep would be covered at the close of each day. Alternatively, fencing may be erected around open pits or trenches. At the beginning of the construction day and before pits or trenches are filled, they would be inspected for trapped animals. If any animals are found, they would be moved out of harm's way. No rodenticides would be used on project sites. Encounters with a protected species (e.g., raptors, migratory birds, listed or sensitive species) would be reported to the appropriate oversight agency (e.g., USFWS). Any contractor or employee who inadvertently kills or injures a protected species would immediately report the incident to the appropriate oversight agencies.

D. Operation and Maintenance

It is anticipated that routine maintenance would include the following, and as summarized in **Table 11**:

- The reservoir requires water management practices of maintaining water levels.
- The reservoir dam would require regular inspection and maintenance.
- A grader would be used to grade the spillway as necessary to maintain functionality.
- The pipeline air valves would need to be inspected at least annually to ensure that they are functioning properly.
- The pipeline would likely need to be cleaned with a poly pig on an annual basis.
- The pipeline system is estimated to have a 100-year life before major pipeline repair would be required.
- The existing hydro plant would require regular inspection and maintenance to maintain turbines, valves, and other mechanical equipment.
- The recreation area would require regular inspection and maintenance to maintain hard surfaces and erosional protection and to keep site free of debris and excessive vegetation.

Task	Number of People	Equipment
Reservoir Inspection & Maintenance	1 - Person	1 - Pickup Truck
Dam Inspection & Maintenance	1 - Person	1 - Pickup Truck
Flushing Pipeline	2 - People	1 - Pickup Truck
Road Maintenance	1 - Person	1 - Grader 1 - Pickup Truck
Pipeline Maintenance	2 - People	1 - Pickup Truck

Task	Number of People	Equipment
Hydro Plant Inspection & Maintenance	1 - Person	1 - Pickup Truck
Recreation Area	1 - Person	1 - Pickup Truck

Table 9 Estimated Personnel and Equipment to Perform Operation and Maintenance

E. Termination and Restoration

If the project is to be terminated or abandoned, a joint inspection would be held with the authorized officer(s) of the NRCS prior to termination. This would be held to agree upon an acceptable rehabilitation plan for the area.

Part V. References

Bureau of Land Management (BLM). 2006. Best management practices for raptors and their associated habitats in Utah. Recommendations for implementing the U.S. Fish and Wildlife Service, Utah Field Office's Guidelines for Raptor Protection from Human and Land Use Disturbances [Romin and Muck 2002]. BLM Utah State Office, Salt Lake City. August 2006.

Bureau of Land Management. 2008. Instruction Memorandum No. 2008-050: Migratory Bird Treaty Act – Interim Management Guidance.

Appendix A. Best Management Practices

Best Management Practices

As part of standard operating procedures, standard BMPs would be implemented throughout the project in order to reduce potential adverse environmental impacts. Most of the impacts are short term and generally occur during the construction period. Project design and implementation of site-specific or selectively recommended BMPs would minimize the effect of the project where the potential for long-term, adverse impacts may occur.

STANDARD BMPs
1. All construction vehicle movement outside of the right-of-way would be restricted to pre-designated access, contractor acquired access, or public roads.
2. The limits of construction activities would be predetermined, with activity restricted to and confined within those limits. No paint or permanent discoloring agents would be applied to rocks or vegetation to indicate survey or construction activity limits. The right-of-way boundary would be flagged in environmentally sensitive areas described in the plan of development to alert construction personnel that those areas would be avoided.
3. In construction areas where re-contouring is not required, vegetation would be left in place wherever possible to avoid excessive root damage and allow for re-sprouting.
4. In construction areas where ground disturbance is significant or where re-contouring is required, surface restoration would occur as required by the landowner or land management agency. The method of restoration typically would consist of returning disturbed areas to their natural contour (to the extent practical) and reseeding or re-vegetating with native plants. Seed viability would be tested and seed mixes would be certified to contain no noxious weeds.
5. Prior to construction, all construction personnel would be instructed on the protection of cultural, paleontological, and ecological resources. To assist in this effort, the construction contract would address (a) federal and state laws regarding antiquities, fossils, and plants and wildlife, including collection and removal; and (b) the importance of these resources and the purpose and necessity of protecting them.
6. An initial intensive cultural resource inventory survey would be conducted prior to construction. Impact avoidance and mitigation measures developed in consultation with appropriate land management and regulatory agencies and other interested parties would be implemented subsequent to the completion of the NEPA compliance document.
7. Any cultural and/or paleontological resource discovered during construction by the KCWCD or any person working on their behalf on public or federal land would be reported immediately to the authorized officer. The KCWCD would suspend operations in the area until an evaluation is completed to prevent the loss of cultural or scientific values.
8. All construction and maintenance activities would be conducted in a manner that would minimize disturbance to vegetation, drainage channels, and intermittent and perennial stream banks. In addition, dust-control measures would be utilized as necessary during construction in sensitive areas. Any used existing roads would be left in a condition equal to or better than their condition prior to construction.

STANDARD BMPs
9. All requirements of those entities having jurisdiction over air quality matters would be adhered to and any necessary permits for construction activities would be obtained. Open burning of construction trash (cleared trees, etc.) would not be allowed on BLM- or USFS-administered lands.
10. Fences and gates, if damaged or destroyed by construction activities, would be repaired or replaced to their original pre-disturbed condition as required by the landowner or the land management agency. Temporary gates would be installed only with the permission of the landowner or the land management agency.
11. Totally enclosed containment would be provided for all hazardous materials (if needed) and trash. All construction waste including trash, litter, garbage, other solid waste, petroleum products, and other potentially hazardous materials would be removed to a disposal facility authorized to accept such materials.
12. Third-party environmental contractors would be used throughout the construction effort, from clearing through rehabilitation.
13. The KCWCD would trim trees in preference to cutting trees, and would cut trees in preference to bulldozing them.
14. Construction holes left open overnight would be covered to prevent livestock or wildlife from harm.
15. The contractor would clean off-road equipment (power or high-pressure cleaning) of all mud, dirt, and plant parts prior to moving equipment onto public land.

ADDITIONAL STIPULATIONS

The following additional stipulations would be implemented throughout the construction and operation of the project and would be included as part of the standard operating procedures.

STIPULATIONS – STANDARD OPERATING PROCEDURES
1. KCWCD would construct, operate, and maintain the facilities, improvements, and structures within this ROW in strict conformity with the plan of development as it is approved. Any relocation, additional construction, or use that is not in accord with the approved plan of development would not be initiated without the prior written approval of the authorized officer. A copy of the complete ROW grant or acknowledgment, including all stipulations and approved plan of development, would be made available on the ROW area during construction, operation, and maintenance to the authorized officer. Noncompliance with the above shall be grounds for an immediate temporary suspension of activities if it constitutes a threat to public health and safety or a material threat to the environment.
2. This plan of development describes in detail the construction, operation, maintenance of the ROW and its associated improvements and/or facilities. An approved plan of development may be referred to for interpretation of the right-of-way grant.
3. KCWCD would contact the authorized officer at least 10 days prior to the anticipated start of construction and/or any surface-disturbing activities. The authorized officer may require and

STIPULATIONS – STANDARD OPERATING PROCEDURES
schedule a preconstruction conference with the KCWCD prior to commencement of construction and/or surface-disturbing activities on the ROW. The KCWCD, its contractor(s), or agents involved with the construction and/or surface-disturbing activities on the ROW should attend this conference to review the stipulations of the grant and the plan(s) of development.
4. KCWCD would designate a representative(s) who would have the authority to act upon and implement instructions from the authorized officer within a reasonable time when construction or other surface-disturbing activities are underway.
5. KCWCD would protect all survey monuments found within the right-of-way. Survey monuments include but are not limited to General Land Office and BLM Cadastral Survey Corners, reference corners, witness points, U.S. Coastal and Geodetic benchmarks and triangulation stations, military control monuments, and recognizable civil (both public and private) survey monuments. In the event of obliteration or disturbance of any of the above, the KCWCD would immediately report the incident, in writing, to the authorized officer and the respective installing authority, if known. Where General Land Office or BLM ROW monuments or references are obliterated during operations, KCWCD shall secure the services of a registered land surveyor or a BLM cadastral surveyor to restore the disturbed monuments and references using surveying procedures found in the *Manual of Surveying Instructions for the Survey of the Public Lands of the United States*, latest edition. KCWCD shall record such survey in the appropriate county and send a copy to the authorized officer. If the BLM cadastral surveyors or other federal surveyors are used to restore the disturbed survey monument, KCWCD would be responsible for the survey cost.
6. The KCWCD or the successor in interest shall comply with Title VI of the Civil Rights Act of 1964 (42 U.S.C. 2000d et. seq.) and the regulations of the Secretary of Interior issued pursuant hereto.
7. KCWCD would mark the exterior boundaries of the ROW with a stake and/or lath. The intervals may be varied at the time of staking at the discretion of the authorized officer. The tops of the stakes and/or laths would be painted and the laths flagged in a distinctive color as determined by the holder. The survey station numbers would be marked on the boundary stakes and/or laths at the entrance to and exit from public land. Holder would maintain all boundary stakes and/or laths in place until final cleanup and restoration are completed and approved by the authorized officer. The stakes and/or laths would then be removed at the direction of the authorized officer.
8. KCWCD would conduct all activities associated with the construction, operation, and maintenance of the right-of-way within the authorized limits of the ROW and approved plan of development.
9. KCWCD would survey and clearly mark the centerline and/or exterior limits of the ROW, as determined by the authorized officer.
10. All design, material, and construction, operation, maintenance, and termination practices would be in accordance with safe and proven engineering practices.
11. KCWCD would inform the authorized officer within 48 hours of any accidents on federal lands that require reporting to the Department of Transportation as required by 49 CFR Part 195.
12. During conditions of extreme fire danger, operations may be suspended or limited in certain areas.
13. KCWCD would be liable for damage or injury to the United States to the extent provided by 43 CFR Sec. 2803.1-4. KCWCD would be held to a standard of strict liability for damage or injury to the

STIPULATIONS – STANDARD OPERATING PROCEDURES
United States resulting from fire or soil movement (including landslides and slumps as well as wind and water-caused movement of particles) caused or substantially aggravated by any of the following within the ROW or permit area: • Activities of the holder including but not limited to construction, operation and maintenance of the facility. • Activities of other parties acting under color of authority from the KCWCD, including but not limited to: - land clearing - earth-disturbing and earth-moving work - blasting
14. Within 30 days of completion, KCWCD would submit to the authorized officer, as-built drawings and a certification of construction verifying that the facility has been constructed (and tested) in accordance with the design, plans, specifications, and applicable laws and regulations.
15. Construction sites would be maintained in a sanitary condition at all times; waste materials at those sites would be disposed of promptly at an appropriate waste disposal site. “Waste” means all discarded matter including but not limited to human waste, debris, garbage, refuse, oil drums, petroleum products, ashes, and equipment.
16. Prior to preconstruction activities on the subject parcel, KCWCD would identify all noxious weeds present. A list of the weeds would be provided to the authorized officer. A determination would be made by the authorized officer of any noxious weeds that may require flagging for treatment. KCWCD shall treat the noxious weeds as required by the authorized officer.
17. KCWCD would clean off-road equipment (power or high-pressure cleaning) of all mud, dirt, and plant parts prior to moving equipment onto public land authorized under this lease.
18. Gravel and/or fill material to be placed in relatively weed-free areas must come from weed-free sources. Prior to obtaining gravel and/or fill material, the authorized officer would inspect the source for weeds and determine adequacy of site.
19. KCWCD would identify a road maintenance program, which would include monitoring for noxious weeds. If KCWCD identifies any noxious weeds, KCWCD would notify the authorized officer immediately. A treatment program would be identified and KCWCD would be responsible for weed abatement.

EAST FORK VIRGIN RIVER
COVE RESERVOIR
WATERSHED PLAN - EIS

Kane County, Utah

RB&G ENGINEERING, INC.

MEMORANDUM

To: Brent Gardner, P.E., Alpha Engineering

From: Brandon Horrocks, P.E. and Brad Price, P.E.

Date: September 8, 2021

RE: ALTERNATIVE SITE EVALUATION

Site visits and a review of available information have been performed to assist the project team with evaluation of potential reservoir sites for the East Fork Virgin River – Cove Reservoir Watershed Plan – EIS. A summary of the observations and available information relating to the geotechnical and geological conditions for each of the sites evaluated is provided below. The locations of the sites are shown on Figures 1, 2A, 2B, and 2C. Descriptions of the geologic units shown on Figures 2A-2C are provided on Figure 3. The site visits were performed on July 22, 2021 with representatives of Kane County Water Conservancy District, Washington County Water Conservancy District, NRCS, Alpha Engineering, Transcon Environmental, and RB&G Engineering.

MUDDY CREEK – LOWER (FIGURE 2A)

The right abutment of the dam site evaluated is near the mapped contact of the Winsor member (Jcw) and Paria River member (Jcp) of the Carmel formation, with the Winsor member overlying Paria River member. Geologic descriptions indicate that gypsum deposits are present within the upper portion of the Winsor member and lower portion of the Paria River member.

A gypsum deposit with an exposed thickness of about 5 feet was observed near the base of the right abutment of the dam alignment (lower portion of Winsor member/upper portion of Paria River member). Additional gypsum deposits several feet thick were observed along the right side of the possible reservoir site and within the erosion channel near the center of the basin, particularly near the location of the historic flume. Defining the lateral and vertical limits of the gypsum deposits will require detailed foundation investigations. Foundation treatment required to mitigate potential dissolution and erosion of gypsum deposits will likely be extensive, Depending on the extents of the gypsum deposits, it may not be feasible to construct a safe dam at the location evaluated.

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An erosion channel visually estimated to be 20 to 30 feet deep was observed within the center of the basin at this location. It is likely that a cutoff will need to be excavated to a depth of at least 30 feet to expose the bedrock formation prior to treating the foundation bedrock. .

Considering the availability of other potential reservoir sites, this site is not the preferred alternative for the project. A photo below shows the gypsum deposit observed near the right abutment of the dam alignment.



MUDDY CREEK – UPPER (FIGURE 2A)

The right and left abutments of the dam site are near the mapped contact of the Paria River member of the Carmel formation and Dakota and Cedar Mountain (undivided) formations (Kdcm), with the Dakota and Cedar Mountain formations overlying the Carmel formation. Gypsum deposits were not observed at this site; however, based on the Paria River member geologic description referenced above, gypsum deposits may be present at relatively shallow depths within the dam foundation.

Using the USGS online StreamStats tool, we estimate that the drainage basin for this reservoir site would have an area of about 35 mi^2. Based on previous sediment studies for the nearby Cove Dam reservoir site, we estimate that average sedimentation into the Upper Muddy Creek reservoir would be between 0.5 and 1.0 ac-ft per year per square mile of drainage basin. Using an average value of

0.75 ac-ft/yr/mi^2, we recommend that a 50-yr sediment volume of 1,300 ac-ft be used for conceptual evaluations of this reservoir site.

We understand that several factors, including purpose and need, estimated costs, and impacts to human and natural environments are being considered by the project team to determine viable alternatives for the project. If conceptual evaluations indicate that construction of a reservoir at this site is a viable project alternative, we recommend that geological and geotechnical field investigations be performed to evaluate foundation conditions.

Based on the observed depth of the Muddy Creek erosion channel at this site, we recommend that conceptual evaluations assume a cutoff trench will be excavated to a depth of 25 feet for construction of a dam at this site.

A review of topography at this site indicates that a dam with a maximum height of about 92 feet (crest el. 5,518 ft) will need to be constructed to store 3,000 ac-ft, and a dam with a maximum height of about 115 feet (crest el. 5,541 ft) will need to be constructed to store 6,000 ac-ft. These estimates assume the dam would have 10 feet of freeboard above the normal high-water elevation.

COVE (FIGURE 2A)

Preliminary design evaluations were performed for the Cove Dam site during the 2019-2020 Environmental Assessment. Geotechnical and geological feasibility studies for a dam at this site were performed in 2004. Previous studies have indicated that constructing a dam at the Cove site is a viable project alternative. The foundation for the dam previously evaluated would be founded on Tropic Shale formation bedrock. A dam at the Cove site will have a maximum height of about 67 feet (crest el. 5,526 ft) to store 3,000 ac-ft, and a maximum height of about 86 feet (crest el. 5,552 ft) to store 6,000 ac-ft of water.

DRY WASH (FIGURE 2B)

From the geologic map shown on Figure 1B and assuming overburden deposits were excavated, it is apparent that a dam within Dry Wash would be founded on Cretaceous age Straight Cliffs formation or Tropic Shale bedrock. As shown on Figure 2B, there are multiple fault traces mapped within the Dry Wash area. Based on the available information, we believe that the mapped faults would be considered inactive, and their presence does not necessarily preclude this site as a feasible location for a dam and water storage reservoir. It is likely that the bedrock formations in the area are fractured due to past faulting, and the faulting increases the risk that seepage from the reservoir would be greater at this site compared to other sites.

We believe that the Utah Division of Water Resources investigated geologic conditions at a possible dam alignment within Dry Wash in the 1990's. To date, we have not been able to locate the results of the investigations that have been performed.

Using the USGS online StreamStats tool, we estimate that the drainage basin for this reservoir site would have an area of about 6.8 mi^2. For conceptual evaluations, we recommend that an average sedimentation rate of 1 ac-ft/yr/mi^2 be used. This sedimentation rate is likely conservative.

As stated above, we understand that multiple factors are being considered to evaluate project alternatives. If conceptual evaluations indicate that construction of a reservoir at this site is a viable project alternative, we recommend that geological and geotechnical field investigations be

performed to evaluate foundation conditions. Past studies performed by Water Resources would be a valuable resource for evaluation of this alternative if the reports or test hole logs could be obtained. It is likely that studies to evaluate potential activity of the mapped faults would be required if this site is determined to be a possible preferred alternative for the project.

A review of topography at this site indicates that a dam with a maximum height of about 112 feet (crest el. 5,944 ft) will need to be constructed to store 3,000 ac-ft, and a dam with a maximum height of about 139 feet (crest el. 5,971 ft) will need to be constructed to store 6,000 ac-ft. These estimates assume the dam would have 7 feet of freeboard above the normal high-water elevation.

LYDIA'S CANYON – LOWER (FIGURE 2B)

The lower portion of Lydia's Canyon has been developed with several residential structures on both sides of the canyon. Several small ponds have been constructed within the center portion of the canyon. Impacts to current residents will likely preclude this site as a viable location for a water storage reservoir.

The Upper unit of the Straight Cliffs Formation mapped in the area of this site is described as interbedded sandstone, mudstone, and siltstone. The information available to us is not sufficient to determine the geological and geotechnical suitability of this site for a storage reservoir.

From visual observation of the erosion channel on the south side of Lydia's Canyon, we recommend that conceptual evaluations assume a cutoff trench will be excavated to a depth of 25 feet within the foundation of a dam at this site. Geological and geotechnical field investigations should be performed to evaluate foundation conditions if initial evaluations indicate a reservoir in the lower portion of Lydia's Canyon is a viable project alternative.

Using the USGS online StreamStats tool, we estimate that the drainage basin for this reservoir site will have an area of about 15 mi^2. For conceptual evaluations, we recommend that an average sedimentation rate of 1 ac-ft/yr/mi^2 be used. This sedimentation rate is likely conservative.

A review of topography at this site indicates that a dam with a maximum height of about 126 feet (crest el. 6,076 ft) would need to be constructed to store 3,000 ac-ft, and a dam with a maximum height of about 162 feet (crest el. 6,112 ft) would need to be constructed to store 6,000 ac-ft. These estimates assume the dam will have 10 feet of freeboard above the normal high-water elevation.

LYDIA'S CANYON – UPPER (FIGURE 2B)

We are aware of one residential dwelling within the area that would be inundated by a reservoir at the location shown on Figure 2B. The geological, assumed cutoff depth, and sedimentation rate for conceptual evaluation provided above for the lower Lydia's Canyon site are applicable to the upper site. The drainage basin for this upper site is about 12 mi^2. Aerial imagery indicates that soil materials have been borrowed from the vicinity of this site within the last few years.

A review of topography at this site indicates that a dam with a maximum height of about 142 feet (crest el. 6,402 ft) will need to be constructed to store 3,000 ac-ft, and a dam with a maximum height of about 185 feet (crest el. 6,445 ft) will need to be constructed to store 6,000 ac-ft. These estimates assume the dam will have 10 feet of freeboard above the normal high-water elevation.

STOUT CREEK – LOWER (FIGURE 2C)

The Wahweap formation bedrock mapped within the Stout Creek Canyon area consists of interbedded mudstone, claystone, sandstone, siltstone and conglomerate rock. The information available to us is not sufficient to determine the geological and geotechnical suitability of this site for a storage reservoir.

The current erosion channel in the bottom of Stout Creek Canyon is shallower than the erosion channels observed at the other sites described above. We recommend that conceptual evaluations assume a cutoff trench will be excavated to a depth of 20 feet within the foundation of a dam at this site. Geological and geotechnical field investigations should be performed to evaluate foundation conditions if initial evaluations indicate a reservoir in the lower portion of Stout Creek Canyon is a viable project alternative.

Using the USGS online StreamStats tool, we estimate that the drainage basin for this reservoir site will have an area of about 23 mi^2. For conceptual evaluations, we recommend that an average sedimentation rate of 1 ac-ft/yr/mi^2 be used. This sedimentation rate is likely conservative.

A review of topography at this site indicates that a dam with a maximum height of about 118 feet (crest el. 6,418 ft) will need to be constructed to store 3,000 ac-ft, and a dam with a maximum height of about 158 feet (crest el. 6,458 ft) will need to be constructed to store 6,000 ac-ft. These estimates assume the dam will have 10 feet of freeboard above the normal high-water elevation.

STOUT CREEK – UPPER (FIGURE 2C)

The geological, assumed cutoff depth, and sedimentation rate for conceptual evaluation provided above for the lower Stout Creek Canyon site are applicable to the upper site. The drainage basin for this upper site is about 19 mi^2.

A review of topography at this site indicates that a dam with a maximum height of about 116 feet (crest el. 6,546 ft) will need to be constructed to store 3,000 ac-ft, and a dam with a maximum height of about 152 feet (crest el. 6,582 ft) will need to be constructed to store 6,000 ac-ft. These estimates assume the dam will have 10 feet of freeboard above the normal high-water elevation.

LOWER SWAPP (FIGURE 2C)

Tertiary age Pink member of the Claron formation bedrock is mapped at the Lower Swapp site. This formation contains limestone, limey mudstone, dolomite, mudstone, and conglomerate materials. The information available to us is not sufficient to determine the geological and geotechnical suitability of this site for a storage reservoir. A small reservoir named McDonald lake is currently present at this site.

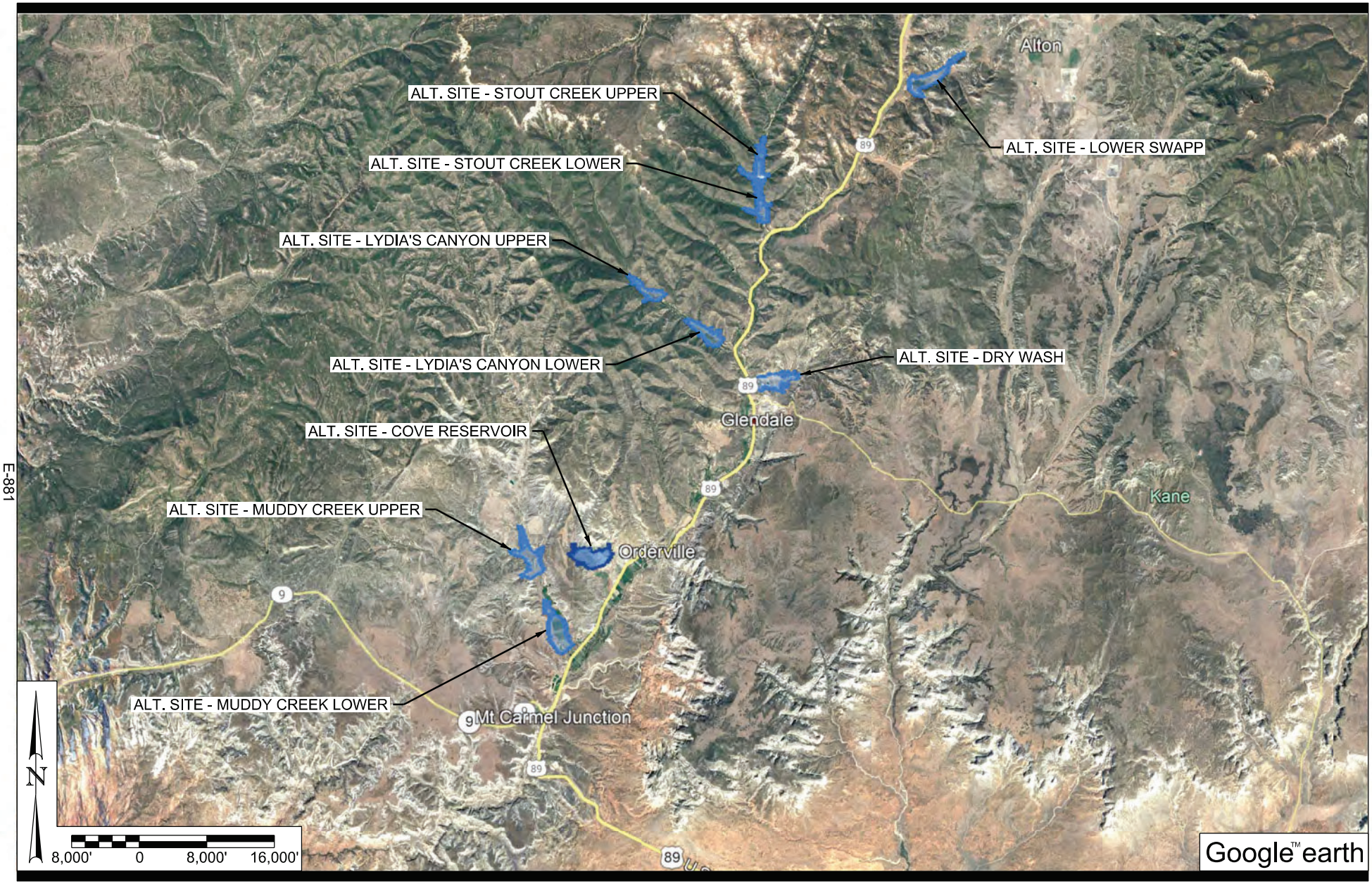
There is not a deep erosion channel at this site which could provide an indication of the depth of bedrock below the overburden deposits. We recommend that conceptual evaluations assume a cutoff trench will be excavated to a depth of 30 feet within the foundation of a dam at this site. Geological and geotechnical field investigations should be performed to evaluate foundation conditions if initial evaluations indicate at this site is a viable project alternative.

Using the USGS online StreamStats tool, we estimate that the drainage basin for this reservoir site will have an area of about 2.3 mi^2. For conceptual evaluations, we recommend that an average sedimentation rate of 1 ac-ft/yr/mi^2 be used. This sedimentation rate is likely conservative.

A review of topography at this site indicates that a dam with a maximum height of about 70 feet (crest el. 7,012 ft) will need to be constructed to store 3,000 ac-ft, and a dam with a maximum height of about 97 feet (crest el. 7,039 ft) will need to be constructed to store 6,000 ac-ft. These estimates assume the dam will have 7 feet of freeboard above the normal high-water elevation.

CONCEPTUAL DAM CROSS SECTION

A multi-zoned earthfill dam will likely be the most efficient structure for the dam sites discussed above. It is recommended that conceptual design for dams less than 100 feet high consider an upstream slope of 3H:1V (three horizontal to one vertical) and a downstream slope of 2H:1V. For dams between 100 and 150 feet, we recommend using an upstream slope of 3.5H:1V and a downstream slope of 2.5H:1V for conceptual design. We recommend that conceptual evaluations assume a dam crest width of 26 feet. We also recommend that a unit price of $\$25/yd^3$ be used to estimate costs of earthfill dam embankments for conceptual level cost comparisons. This cost is intended to provide an approximate average of earthfill, drainfill, riprap, and other materials which would be used for construction of a dam embankment.



E-881

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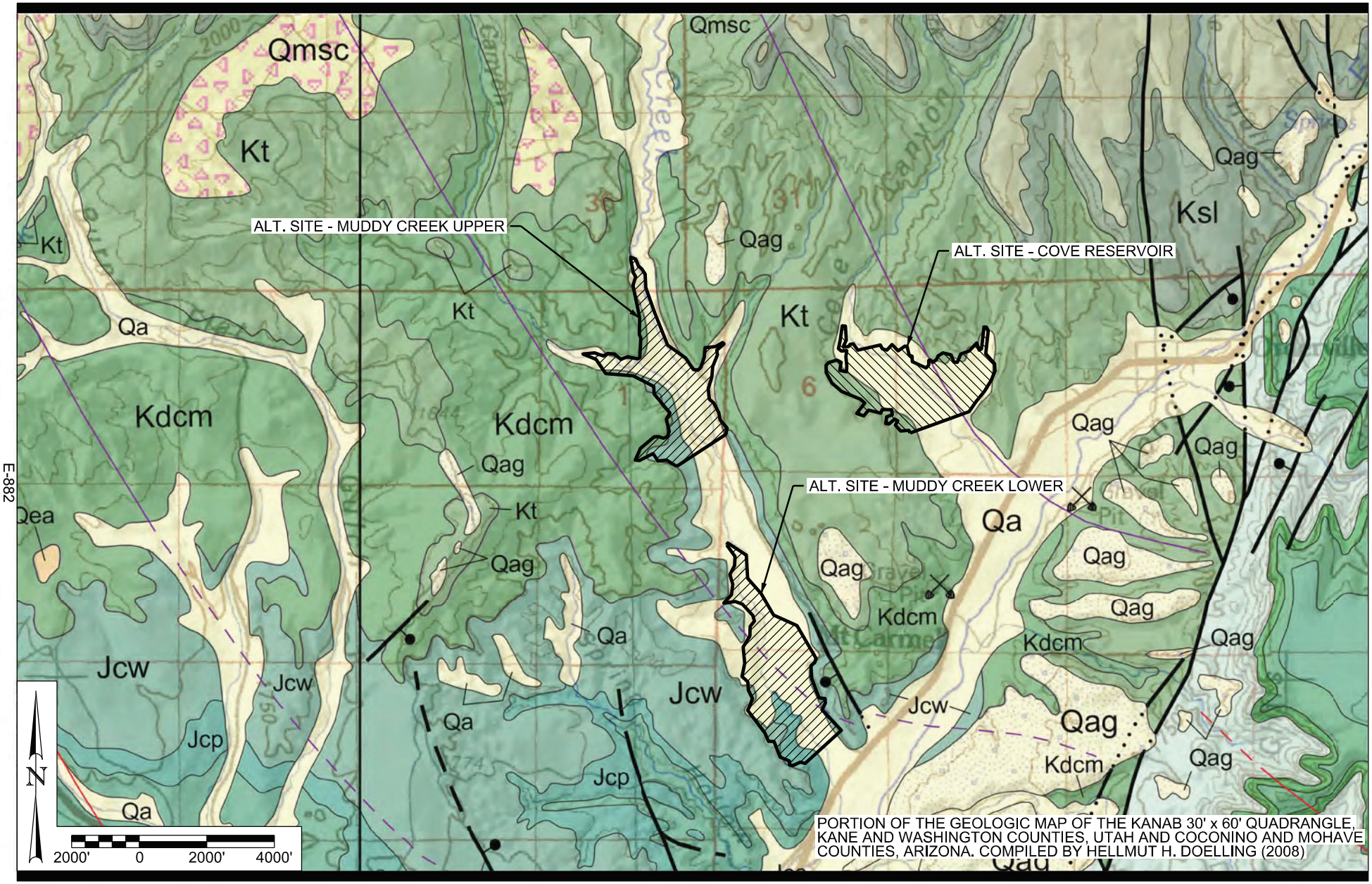
Figure 1 VICINITY MAP

East Fork Virgin River - Cove Reservoir Watershed Plan - EIS

near Orderville, Kane County, Utah



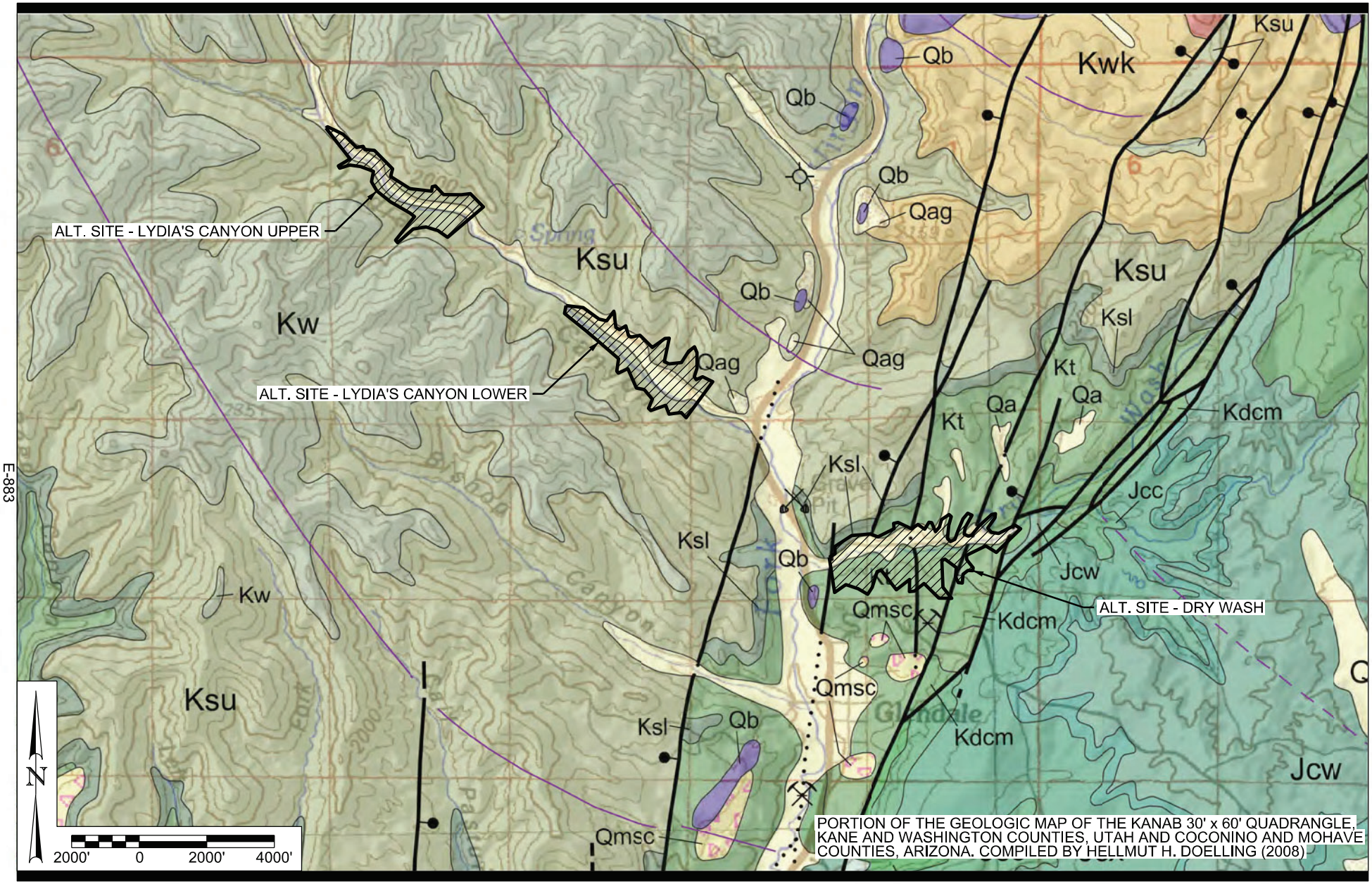
E-882

RB&G ENGINEERING, INC.

Figure 2A GEOLOGIC MAP

East Fork Virgin River - Cove Reservoir Watershed Plan - EIS

near Orderville, Kane County, Utah



E-883

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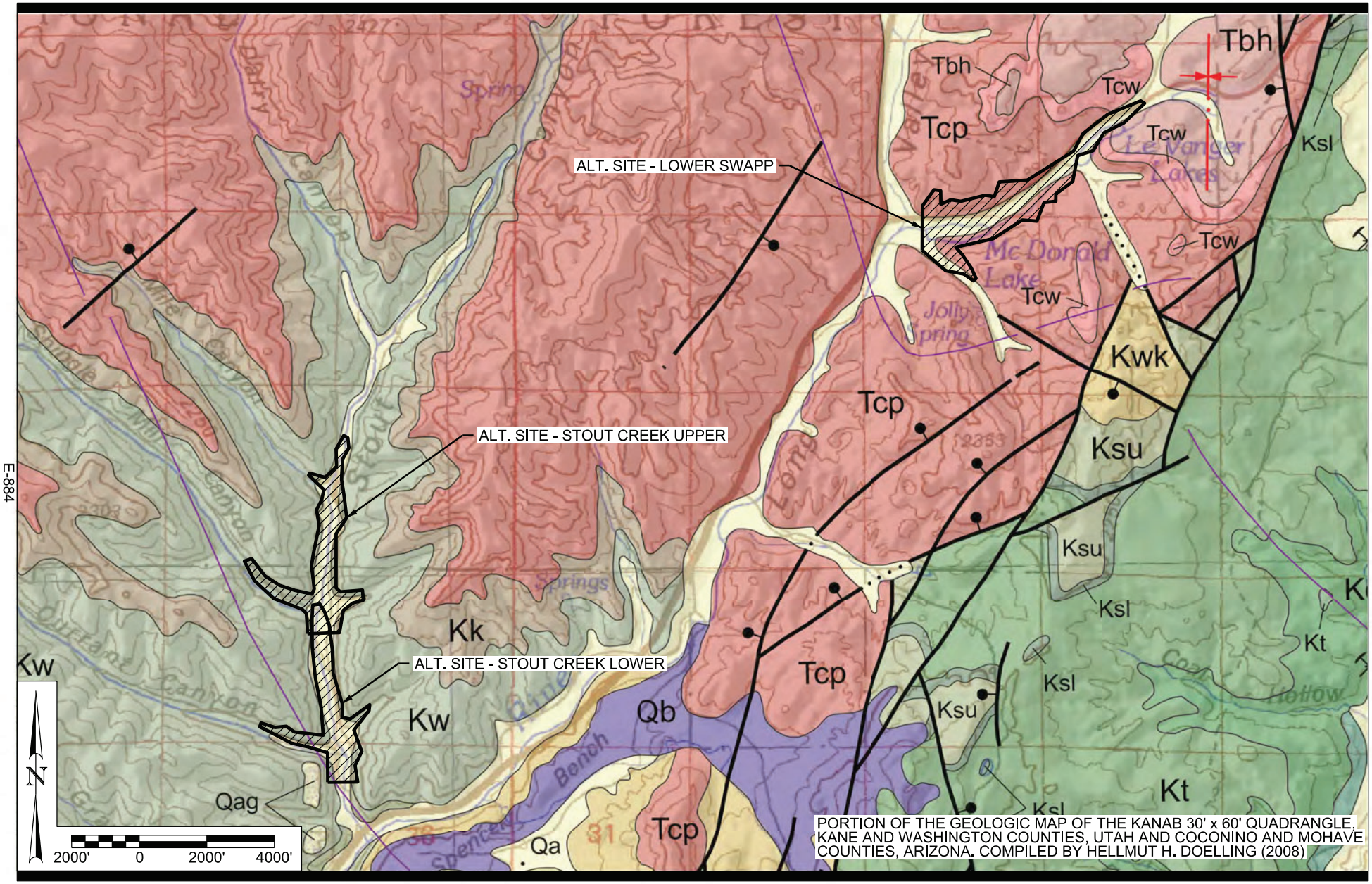
Figure 2B GEOLOGIC MAP

East Fork Virgin River - Cove Reservoir Watershed Plan - EIS

near Orderville, Kane County, Utah



E-884

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Figure 2C GEOLOGIC MAP

East Fork Virgin River - Cove Reservoir Watershed Plan - EIS

near Orderville, Kane County, Utah

Utah Geological Survey
a division of
Utah Department of Natural Resources

DESCRIPTION OF GEOLOGIC UNITS

QUATERNARY DEPOSITS

Qa **Alluvium** – Mostly sand with lenses of silty clay, sandy silt, and gravel deposited in stream beds, washes, adjacent floodplains, and on low alluvial slopes; includes lower terrace and alluvial fan deposits; 0 to 36 m (0-120 ft) thick.

Qes **Windblown sand** – Sand in active to partially stabilized dunes and sheets; mostly fine to medium grained; generally derived from and deposited on and downwind of large exposures of eolian sandstone formations (primarily Navajo and Entrada Sandstones); locally includes alluvial deposits; 0 to 30 m (0-100 ft) thick.

Qea **Mixed eolian and alluvial sand** – Mostly sand with minor amounts of clay, silt, and gravel; stabilized sand sheets locally reworked by alluvial processes and with well-developed calcic soil; 0 to 30 m (0-100 ft) thick.

Qag **Alluvial gravel** – Poorly to well-sorted gravel, sand, and boulders with interlayers of silt and mud; present on pediments and higher river terraces, and as older erosional remnants; 0 to 20 m (0-60 ft) thick.

Qls **Lacustrine sand** – Well stratified sand, clay, silt, and minor gravel deposited where drainage was blocked by a landslide in Zion Canyon; also mapped in a human-made reservoir on South Creek near southwest corner of the quadrangle; 0 to 40 m (0-135 ft) thick.

Qmsc **Mass-movement deposits, undifferentiated** – Includes landslides, slumps, colluvium, talus, and other mass-movement deposits; very poorly sorted; nonstratified; common on moderate to steep slopes; only larger deposits mapped; 0 to 75 m (0-250 ft) thick.

Qb **Basalt lava flows and cinder cones** – Blocky vesicular basalt and basaltic andesite lava flows and cinder cones, commonly partially covered by a thin veneer of eolian silt and sand; phenocrysts include olivine, labradorite, titaniferous augite, plagioclase, and iron-titanium oxides (Sable and Hereford, 2004; Biek and Hylland, 2007); remnants of four flows are preserved near the Sevier fault and southwest to southeast of the Paunsaugunt Plateau (Sable and Hereford, 2004; Tilton, 1991a,b) – Best and others (1980) obtained K-Ar ages of 0.56±0.05 Ma on the Spencer Bench (Black Mountain) flow and 1.1±0.1 Ma on the Tenny Creek flow (26 km [16 mi] east-northeast of Glendale); Schiefelbein (2002) obtained $^{40}Ar/^{39}Ar$ ages of 0.58+0.05 Ma and 0.564+0.02 Ma on the Spencer Bench (Black Mountain) flow; remnants of six or more flows are preserved in the Markagunt Plateau area in the northwest part of the quadrangle – Best and others (1980) obtained K-Ar ages of 1.2±0.6 Ma on the Hornet Point flow (age is probably unreliable – note large standard error), 0.81±0.05 Ma on the Horse Knoll flow, and 0.36±0.08 Ma on the Volcano Knoll flow; Biek and Hylland (2007) obtained $^{40}Ar/^{39}Ar$ ages of 0.74±0.05 Ma on the Hornet Point flow, 0.37±0.02 Ma on the Virgin Flats flow, and 0.34±0.03 on the Volcano Knoll flow, and estimated the Three Creeks flow (near China Point) at less than 0.3 Ma; other flows have not been dated but are probably similar in age to the dated flows; some flows are cut by post-flow movement on Quaternary faults.

TERTIARY ROCKS

Ta **Older Boulder Gravel Deposits** (Miocene?) – Unconsolidated, very poorly sorted, clay- to large boulder-size sediment characterized by very large quartz monzonite boulders as much as 30 feet (10 m) long; also includes large boulders of limestone, sandstone, and quartzite; probably deposited by debris flows originating in the Pine Valley Mountains west of the quadrangle (Biek and Hylland, 2007); 0 to 90 feet (0-27 m) thick.

Tbh **Brian Head Formation** (Oligocene - late Eocene) – Yellow-gray to pale-orange tuffaceous sandstone, conglomerate, mudstone, and minor limestone, shale, and claystone; weathers to drab gray and brown slopes; sandstone is mostly poorly sorted and cross-bedded; lower part is largely yellow-orange weathering siltstone and claystone; lower contact may be an unconformity; as much as 120 m (400 ft) thick.

unconformity

Claron Formation (Eocene - Paleocene)

Tcw **White member** – White to light-gray limestone and chalky claystone; calcite-filled vugs and fractures are common; forms massive rough-weathering cliffs; contains some limy shale partings; 20 to 40 m (60-120 ft) thick.

Tcp **Pink member** – Pink, orange, and pale gray, commonly stained limestone, limey mudstone, dolomite, mudstone, and conglomerate; irregularly bedded; nodular and mottled paleosols common; weathers into picturesque cliffs, columns, spires, and pinnacles; commonly overlying limestone breccia and a basal conglomerate; basal beds of map unit locally equivalent to Pine Hollow and Canaan Peak Formations (Bowers, 1972); unit forms the Pink Cliffs of the Grand Staircase; 150 to 250 m (490-820 ft) thick.

unconformity

CRETACEOUS ROCKS

(see Eaton, 1991, for additional discussion of Cretaceous units and contacts in this quadrangle and surrounding area)

Kk **Kaiparowits Formation** (Upper Cretaceous) – Drab-gray, olive-gray, brown-gray, and green-gray sandstone, mudstone, and siltstone; sandstone is very fine to fine grained; bedding is poorly defined and lenticular; forms ledgy steep slopes and badlands; lesser amounts of thin light-gray mudstone and light yellow-gray calcareous siltstone are interbedded; locally contains molluscan fragments, plant debris, and dinosaur bones; 0 to 75 m (0-250 ft) thick; absent or thin and mapped with the Wahweap Formation (Kwk) in Paunsaugunt Plateau area.

Kwk **Wahweap and Kaiparowits Formations, undivided**

Kw **Wahweap Formation** (Upper Cretaceous) – Mostly gray to yellow-gray, interbedded mudstone, claystone, sandstone, siltstone, and conglomerate with some brown fine- to medium-grained sandstone beds; forms slopes and ledges; 100 to 200 m (330-660 ft) thick below and south of the Paunsaugunt Plateau and 245 to 300 m (800-1000 ft) thick south of the Markagunt Plateau.

Straight Cliffs Formation (Upper Cretaceous)

Ksu **Upper unit** – Interbedded yellow-gray to light-brown sandstone and gray mudstone and siltstone; forms ledges, cliffs, and slopes; sandstone is fine to coarse grained and locally conglomeratic; upper part commonly forms a sandy conglomeratic cliff that may correlate with the Drip Tank Member of the Straight Cliffs Formation in the Kaiparowits Plateau; mudstones are locally carbonaceous and contain thin coal beds, especially toward the east; 300 to 380 m (900-1250 ft) thick.

Ksl **Lower unit** – Yellow-gray, orange-gray, and light-brown sandstone interbedded with lesser quantities of mudstone, siltstone, and claystone; generally forms a cliff or a series of ledges; locally contains carbonaceous mudstone and very thin beds of coal and coaly shale in upper part, especially toward the east; locally intertongues with the Tropic Shale below; 26 to as much as 100 m (85-330 ft) thick.

Kt **Kt** **Tropic Shale** (Upper Cretaceous) – Mapped as single line where thin in western part of map area. Drab-gray, marine shale with subordinate gray sandstone; generally forms a steep slope; sandstone becomes more abundant in the upper part and to the west; thins to the west where unit interfingers with non-marine sandstone beds and contains carbonaceous mudstone and very thin coaly beds; lower contact placed stratigraphically higher to west (see Dakota discussion); 90 to 300 m (300-1000 ft) thick; thickness varies irregularly, but generally is thicker to the east.

Kdcm **Dakota and Cedar Mountain Formations, undivided** (Upper-Lower Cretaceous; Cenomanian to Albian?) (Cedar Mountain beds locally present at base of unit) – Yellowish-brown, gray, and white, thin- to thick-bedded, interbedded sandstone, sandy shale, carbonaceous shale, shaly sandstone, conglomerate, smectitic mudstone, coal, and marl; forms a moderate to steep slope with ledgy cliffs; sandstone is fine to medium grained; smectitic strata become more common westward; oysters, clams, and gastropods are common; map unit is conducive to landsliding and complete, undeformed exposures are uncommon; lower contact is a regional unconformity; forms the Gray Cliffs of the Grand Staircase with the cliff-forming units of the Straight Cliffs Formation; 60 to 270 m (200-900 ft) thick; thickens westward across quadrangle; in western part of quadrangle (west of 112°45' W.) upper contact is placed at top of "sugarledge sandstone" (Hylland, 2000; Biek and Hylland, 2007; also see Gustason, 1989; Elder and others, 1994), making contact stratigraphically higher than in central part of map area where sugarledge sandstone is included in Tropic Shale (Cashion, 1961; Doelling and Davis, 1989; Sable and Hereford, 2004). Lower part of unit is 0 to 30 m (0-100 ft) of yellowish-brown, brown, pale-olive-gray, and gray, commonly variegated, thin- to medium-bedded sandstone, smectitic mudstone, and pebble conglomerate with a local thick basal conglomerate ledge; overall, this lower interval is thin, locally not present, and commonly difficult to distinguish from remaining Dakota strata; Hylland (2000) and Biek and Hylland (2007) mapped this interval as Cedar Mountain Formation because lithologic similarity and age data suggest it is correlative with the Cedar Mountain Formation of central Utah, while some workers consider it the basal part of the Dakota Formation (Titus and others, 2005).

unconformity

JURASSIC ROCKS

Je **Entrada Sandstone** (Middle Jurassic) – Pale-yellow to pale-green-gray sandstone and siltstone, very fine to fine-grained sandstone, and coarse siltstone in exposures between Indian Hollow and Adams Wash; forms earthy weathering steep slopes or mud-plastered cliffs; in the extreme northeast corner of the quadrangle, the lower part of the unit is present and is red-brown, fine-grained sandstone that forms smooth rounded, "slickrim" cliffs; 0 to 170 m (0-560 ft) thick; thins westward and is entirely "cut out" beneath a pre-Cedar Mountain unconformity west of Adams Wash; in the northeast corner of the quadrangle only the lower 88 m (290 ft) of the formation is exposed.

Jc **Carmel Formation** (Middle Jurassic) (cross section only)

Carmel Formation – upper part (Middle Jurassic)

Jcw **Winsor Member –** Red and yellow silty sandstone; contains a few thin gypsum beds near the top in the extreme northeast part of the quadrangle; red colors dominate to the east and yellow colors dominate to the west; forms earthy-weathering steep slopes; 60 to 85 m (200-280 ft) thick; thins to the west.

Jcp **Paria River Member** – White alabaster gypsum at base with overlying red siltstone, white sandstone, and chippy weathering white to pink microgranular limestone at the top; locally the basal gypsum is missing; limestone at top locally contains casts and molds of pelecypods; overlies the Thousand Pockets Tongue of the Page Sandstone to the east and the Crystal Creek Member of the Carmel Formation to the west; 18 to 50 m (60-165 ft) thick; unit thins and thickens irregularly in relation to the thickness of gypsum, but generally thins westward; thickest gypsum bed is about 12 m (40 ft) thick.

Page Sandstone (Middle Jurassic)

Jpt **Thousand Pockets Tongue** – Yellow, white, or brown sandstone; generally massive and cross-bedded with thin red siltstone intercalations; overlies the Crystal Creek Member of the Carmel Formation to the west and the Judd Hollow Tongue of the Carmel Formation east of the Paunsaugunt fault; 0 to 30 m (0-100 ft) thick; thins westward and pinches out near Skutumpah Creek.

Carmel Formation – lower part (Middle Jurassic)

Jcx **Crystal Creek Member –** Brown-banded sandstone, siltstone, and mudstone; generally earthy weathering; forms slopes and mounds; common gypsum as cement or veinlets; 15 to 55 m (50-180 ft) thick where not mapped as part of the Judd Hollow Tongue; thickens westward.

Jcc **Co-op Creek Limestone Member** – Light-gray limestone and tan limey shale; forms thick limestone ledges at base and top with steep limestone shale in the middle; 3 to 4 m (9-12 ft) of red to brown siltstone interbedded with thin limestone beds common at base; locally fossiliferous with pelecypods, gastropods, and star-shaped crinoid columnals; unconformably overlies Navajo Sandstone to the east and Temple Cap Sandstone to the west; 15 to 80 m (50-260 ft) thick where not mapped as part of the Judd Hollow Tongue; thickens westward.

Jci **Judd Hollow Tongue** – Combined Crystal Creek and Co-op Creek Members where thin in the east part of the quadrangle underlying the Thousand Pockets Tongue of the Page Sandstone (Jpt); mostly forms a lower red slope and an upper white bench between Jpt and the Navajo Sandstone; unconformably overlies the Navajo Sandstone; 30 to 60 m (100-200 ft) thick; thins eastward.

unconformity

Jt **Temple Cap Sandstone** (Middle Jurassic) – Light-pink-gray, cross-bedded, cliff-forming sandstone with a few intercalations of dark-red siltstone (White Throne Member) overlying dark-red siltstone and silty sandstone (Sinawava Member) at the base; present only in the west part of the quadrangle where unconformably overlies Navajo Sandstone; 0 to 60 m (0-200 ft) thick; thickens westward.

unconformity

Jn **Navajo Sandstone** (Lower Jurassic) – White, pink, and brown sandstone; forms cliffs, domes, and bare-rock outcrops; famous for high-angle cross-beds in sets to 10 m (30 ft) thick or more; generally divisible into an upper white, cliff-forming, calcareous part recognized as the White Cliffs in the Grand Staircase, a less resistant pink part commonly covered with sand and cemented with iron oxides, and a lower cliff-forming brown part that contains many planar beds (not mapped separately); the Navajo is an excellent aquifer; 395 to 670 m (1300-2200 ft) thick; thickens westward.

Jkt **Jnl** **Tenney Canyon Tongue of the Kayenta Formation** (Lower Jurassic) – (Mapped as single line between Jn and Jnl where thin or locally missing on the Wygaret Terrace west of the Paunsaugunt fault in eastern part of map area.) Red-brown siltstone, mudstone, and fine-grained sandstone; generally forms a steep slope, but locally contains thick to massive, planar, ledge-forming sandstone beds at the top of the unit; 0 to 98 m (0 to 320 ft) thick; pinches out eastward. The type locality (never officially defined) and name source of this unit is a small canyon about 6 km (4 mi) north of Kanab called Tenney Canyon on plate 2 of Gregory (1950) that is now called Tiny Canyon on modern U.S. Geological Survey topographic maps. (This "Tenney" differs from spelling of Tenny Creek in basalt lava flows unit description).

Jnl **Jnl** **Lamb Point Tongue of the Navajo Sandstone** (Lower Jurassic) – (Mapped as single line between Jk and Jkt where thin in western part of map area.) White to light-gray, mostly fine-grained sandstone; massive with high-angle cross-beds; red-brown and locally planar bedded in far west exposures; pinches out in southwest part of quadrangle; merges into main part of Navajo Sandstone in eastern part of quadrangle; excellent aquifer in the Kanab area; 0 to 125 m (0-410 ft) thick; thickens eastward.

Jk **Main body of the Kayenta Formation** (Lower Jurassic) – Red to red-brown sandstone, siltstone, and claystone with lesser amounts of limestone and intraformational conglomerate; locally, especially to the east, lavender, white, and brown sandstone is common; sandstone is dominant in eastern exposures, siltstone and claystone in western exposures; forms ledges and slopes to the east and steep slopes to the west; constitutes the entire formation where the Lamb Point Tongue is not present. All of the Kayenta Formation, including the Tenney Canyon Tongue, thickens westward; the entire formation along the Cockscomb is 60 to 90 m (200-300 ft) thick, near Kanab the Tenney Canyon Tongue is about 28 m (90 ft) thick and the main body is about 95 m (315 ft) thick, in the Zion Canyon area the Tenney Canyon Tongue is about 96 m (315 ft) thick and the main body is nearly 106 m (350 ft) thick, and in the southwest corner of the quadrangle the Kayenta Formation (where there is no Lamb Point Tongue) is about 183 m (600 ft) thick.

JURASSIC-TRIASSIC ROCKS

JRmo **Moenave Formation and Springdale Sandstone Member of Kayenta Formation** (Lower Jurassic - Upper Triassic) – Generally red-orange to brown sandstone, siltstone, and shale; sandstone is mostly fine grained and commonly forms ledges and cliffs; generally divisible into two or three members (not mapped separately): in descending order – Springdale Sandstone Member, Whitmore Point Member, and Dinosaur Canyon Member. At the time source mapping was done, the Springdale was a member of the Moenave Formation; it was recently reassigned to the Kayenta Formation (see discussion and references in Biek and Hylland, 2007); the Springdale Sandstone generally forms cliffs and with the main body of the Kayenta Formation forms the Vermilion Cliffs of the Grand Staircase. In the west part of the quadrangle, the Whitmore Point Member forms a slope or a recess beneath the Springdale Sandstone and commonly contains fish fossil fragments; it pinches out east of Kanab near Johnson Canyon (Hayden, 2006). The Dinosaur Canyon Member forms ledges and steep slopes and rests unconformably on the Triassic Chinle Formation. As far west as Kitchen Corral Wash a thin layer of the Wingate Sandstone may be recognized at the base of the Dinosaur Canyon Member. The Springdale Sandstone is 27 to 60 m (90-200 ft) thick and unconformably overlies lower units, the Whitmore Point is 0 to 24 m (0-80 ft) thick, and the Dinosaur Canyon is 43 to 76 m (140-250 ft) thick.

unconformity

TRIASSIC ROCKS

Tc **Chinle Formation** (Upper Triassic) (cross section only)

Tcu **Upper members (Church Rock, Owl Rock, Petrified Forest, and Monitor Butte Members)** – Picturesque, varicolored and banded mudstone, claystone, sandstone, siltstone, limestone, and conglomerate; generally forms a steep slope; prone to landsliding that commonly involves the overlying Dinosaur Canyon Member of the Moenave Formation; locally contains petrified wood and siliceous nodules; 130 to 240 m (425-800 ft) thick.

Trcl **Lower member (Shinarump Conglomerate Member and locally part of Monitor Butte Member)** – Gray, yellow-gray, and gray-orange conglomeratic sandstone, sandstone, and minor gray mudstone; massive and generally forms cliff; remobilized iron oxides commonly form Liesegang bands; upper part (locally part of Monitor Butte Member) commonly forms ledges or steep slopes rather than cliffs; locally contains large amounts of petrified logs and branches; unconformable with Moenkopi Formation below; 0 to 47 m (0-155 ft) thick; discontinuous and thins and thickens in paleochannels to the east.

unconformity

Trm **Moenkopi Formation** (Lower Triassic) – Entire formation on cross section. Does not include Timpoweap Member along Kaibab monocline in southeast part of map area.

Trmu **Upper red member** – Dark-brown to dark-red sandstone in thin to thick beds; micaceous; forms cliffs and steep slopes; 38 to 50 m (99-165 ft) thick.

Trms **Shnabkaib Member** – Light-brown and white, interbedded sandstone, shale, and impure gypsum; earthy weathering; forms ledges and slopes; individual gypsum beds as much as 2 m (6 ft) thick; member is about 50 to 67 m (165-220 ft) thick.

Trmm **Middle red member** – Light red-brown to orange-brown, lightly banded sandstone, and red siltstone and mudstone; sandstone is fine grained; thin to thick bedded; crisscrossed with gypsum veinlets and upper part cemented with gypsum; earthy weathering, forming gentle to steep slopes; 85 to 113 m (280-370 ft) thick.

Trml **Lower red member** – Red sandstone and siltstone capped by about 10 m (30 ft) of calcareous sandstone (Virgin Limestone Member equivalent); sandstone is fine grained and the unit forms gentle to steep slopes; upper calcareous sandstone is platy to thin bedded and forms ledges; 43 to 67 m (140-220 ft) thick.

Trmt **Timpoweap Member** – Light gray-brown limestone, dolomite, sandstone, cherty breccia, and siltstone; thin to thick bedded; some sandstone beds are pebbly; upper half is more resistant and forms a cliff over a ledgy lower part; locally a thin section of tan and brown siltstone (Black Dragon Member?) underlies the unit; contact with Kaibab Formation below is an unconformity; 6 to 15 m (20-50 ft) thick at exposures on Buckskin Mountain in the southeast part of the quadrangle; well data indicate the Timpoweap may be as much as 45 m (150 ft) thick in western part of the quadrangle.

unconformity

PERMIAN ROCKS

Pk **Kaibab Formation** (lower Permian) – Cherty gray limestone and dolomitic limestone and calcareous, commonly cherty sandstone; divisible into two members (not mapped separately), upper Harrisburg Member and lower Fossil Mountain Member; Harrisburg rocks are ledge-and slope-forming and unfossiliferous; Fossil Mountain rocks are massive, cliff forming, and fossiliferous containing mostly brachiopods, crinoid columnals, and bryozoa; thickness of the Kaibab ranges from 45 to 90 m (150-295 ft) in outcrops in the southeast corner of the quadrangle, of which 5 to 25 m (15-80 ft) is Harrisburg Member; it may be 45 to 155 m (150-500 ft) thick in the quadrangle subsurface and thickens to the west.

Pt **Toroweap Formation** (includes possible thin **Coconino Sandstone)** (lower Permian) – Limestone, dolomite, anhydrite, gypsum, and sandstone. Upper part (Woods Ranch Member) is mostly slope-forming, yellow-gray and red-brown, very fine- to fine-grained calcareous sandstone, with discontinuous gypsum, travertine, and intraformational conglomerate, and is about 46 m (150 ft) thick; middle part (Brady Canyon Member) is yellow-gray, cherty, fossiliferous, cliff-forming limestone and subordinate sandstone, and is about 30 m (100 ft) thick; lower part (Coconino Sandstone) is pale-yellow, fine-grained, cliff-forming, quartz sandstone about 20 m (65 ft) thick. Map unit is 96 to 102 m (315-335 ft) thick in Buckskin Gulch in southeast corner of quadrangle.

Ph **Hermit Formation** – Red-brown, silty sandstone, mudstone, and shale; forms slope; only upper 17 m (55 ft) exposed in the southeast corner of the quadrangle in Buckskin Gulch; wells indicate the formation is 32 to 190 m (105-625 ft) thick in the subsurface.

MAP SYMBOLS

- Contact – Dashed where approximately located
- Fault – Dashed where approximately located; dotted where concealed; bar and ball on down-thrown side

[This map shows many solid and dashed faults bounding surficial deposits in places where the fault and the surficial deposit contact are in approximately the same location; these faults are shown this way on the original source maps; this does not imply that fault movement cut or displaced the surficial deposit]

- Anticline – Showing axial trace; arrow on trace shows direction of plunge; dotted where concealed
- Syncline – Showing axial trace; arrow on trace shows direction of plunge; dotted where concealed
- Monocline – Line placed on axial trace of upper hinge; dotted where concealed
- 2400 / 1800 Structural contour – Contours in meters; *red* - drawn on top of Navajo Sandstone (western, southern, and eastern part of map in areas of Jurassic and older outcrops); *purple* - drawn on top of Jurassic Entrada or Carmel Formation (north-central part of map in area of Cretaceous and younger outcrops); dashed where projected above ground
- Cinder cone
- Oil or gas exploration drill hole – Plugged and abandoned
- Sand, gravel, or road-fill quarry
- Abandoned mine
- A — A' Line of cross section

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Figure 3 GEOLOGIC MAP - DESCRIPTION OF UNITS

East Fork Virgin River - Cove Reservoir Watershed Plan - EIS

near Orderville, Kane County, Utah

East Fork Virgin River - Alternatives Screening Matrix

10/14/2021

None | Low | Medium | High | Further Study Needed

			Constructability Concerns								Special Environmental Concerns					
Alternative	**Meets Purpose and Need**	**On-Channel Reservoir**	**Removal of Homes/Buldings for Construction**	**Irrigated Land Loss**	**Geotechnical Challenges**	**Sedimentation Load**	**Required Dam Height**	**Earthwork Quantity**	**Diversion Changes / Energy Requirements**	**Road Realignment Impacts**	**Perennial Stream Impacts**	**Intermittent Stream Impacts**	**Wetland Impacts**	**Cultural Resource Impacts**	**Riparian Area Impacts**	**Sensitive Fish Species Impacts**
Lower Swapp Reservoir	Yes	No	0	0 ac		115 ac-ft @ 50yrs	97 ft	1159198	Pump & pipeline needed							
Stout Creek Upper Reservoir	Yes	Yes	0	0 ac		950 ac-ft @ 50yrs	152 ft	1553511	Pump & pipeline needed							
Stout Creek Lower Reservoir	Yes	Yes	Possibly 1 Outbuilding	0 ac		1150 ac-ft @ 50yrs	158 ft	1548485	Pump & pipeline needed							
Lydia's Canyon Upper Reservoir	Yes	Yes	0	15 ac		600 ac-ft @ 50yrs	185 ft	2430834	Pump & pipeline needed				0 ac			
Lydia's Canyon Lower Reservoir	Yes	Yes	9	88 ac		750 ac-ft @ 50yrs	162 ft	1979492	Pump & pipeline needed							
Dry Wash Reservoir	Yes	No	1	20 ac	Faults	340 ac-ft @ 50yrs	139 ft	1085076	Pump & pipeline needed				0 ac			
Cove Reservoir (Full)	Yes	No	0	0 ac		235 ac-ft @ 50yrs	86 ft	1192320	Existing pipeline plus gravity feed				0 ac			
Muddy Creek Upper Reservoir	Yes	Yes	0	0 ac		1300 ac-ft @ 50yrs	115 ft	1293213	Pump back to users							
Muddy Creek Lower Reservoir	Yes	Yes	Possibly 2 Outbuildings	180 ac	Gypsum	1,300+ ac-ft @ 50yrs	85 ft	924873	Pump back to users				0 ac			
Conservation (No-Build)	No	N/A														
Cove Reservoir (Small)	Yes	No	0	0 ac		235 ac-ft @ 50yrs	67	897,590	Existing pipeline plus gravity feed							

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MEMO DRAFT

Date: July 22, 2024

To: KCWCD East Fork Virgin River Watershed Plan – Project Team

From: Brent Gardner

Re: 3,000 vs. 6,000-Acre Foot Reservoir Analysis

Items:

As requested, I am providing the information that has been provided in the past in the form of a memo to the project team. We have developed the following information in relation to the construction of a 3,000 acre foot (AF) reservoir verses a 6,000 AF reservoir:

1) Earthwork quantities for the construction of the dam are reduced by approximately 40% with the lower dam height but foundation preparation requirements were not reduced substantially. In addition, the excavation required for the smaller reservoir spillway was over 100% higher. There was an overall reduction in cost of approximately $6,732,796.

2) The 6,000 AF reservoir had a cost of $31,511,514 or $5,252 per AF in 2023 dollars. The 3,000 AF reservoir cost was $24,778,718 or $8,260 per AF.

3) Having a larger reservoir increases the surface area available for recreation from approximately 122 acres to 187 acres or an increase of about 50%.

4) A larger reservoir also provides for additional storage at a higher elevation to reduce evaporation losses and provide for drought relief when needed. According to Utah State University Research Report 145 approximately 43 inches of lake evaporation occurs in the St. George area annually and 27 inches in the Orderville area near the Cove Reservoir site or a reduction of approximately 60%.

5) With maximum demands placed on the reservoir a yield of 2,148 AF could be met during each of the 54 years of record with a 6,000 AF capacity reservoir. A 3,000 AF reservoir only yielded 1,453 AF of water during the same period of record. The larger reservoir yielded 48% more water with an increase of 27% in cost.

6) The smaller reservoir did not provide an adequate water supply during 17 of the 54 years of record to the Kane County irrigators. The larger reservoir did not meet the irrigation demands during one year of the 54 years of record. The following average annual yields would be provided to the KCWCD and the WCWCD with the differing sizes of reservoirs:

Cove Reservoir Size	KCWCD	WCWCD
3,000 AF	784 AF	1,092 AF
6,000 AF	867 AF	1,340 AF

It should be noted that the WCWCD anticipates an overall yield to their system of 700 AF from the Cove Reservoir as the Division of Water Resources (DOWR) water model shows that a portion of the high water available at the Cove Reservoir diversion is also available at the Quail Creek Diversion dam during the same period to fill the Quail Lake and Sand Hollow Reservoirs. However, there is reduced evaporation losses storing the water at a higher elevation.

End of Memo

Standard Best Management Practices and Standard Operating Procedures

As part of standard operating procedures, standard best management practices (BMPs) would be implemented throughout the project in order to reduce potential adverse environmental impacts. Most of the impacts are short-term and generally occur during the construction period. Project design and implementation of site-specific or selectively recommended BMPs would minimize the effect of the project where the potential for long-term, adverse impacts may occur. These BMPs were taken from the Draft Cove Reservoir Plan of Development (POD) (Appendix E, Plan of Development for Cove Reservoir).

Standard BMPs
1. All construction vehicle movement outside of the ROW would be restricted to pre-designated access roads, contractor-acquired access roads, or public roads.
2. The limits of construction activities would be predetermined, with activity restricted to and confined within those limits. No paint or permanent discoloring agents would be applied to rocks or vegetation to indicate survey or construction activity limits. The ROW boundary would be flagged in environmentally sensitive areas, described in the POD, to alert construction personnel that those areas would be avoided.
3. In construction areas where re-contouring is not required, vegetation would be left in place wherever possible to avoid excessive root damage and allow for resprouting.
4. In construction areas where ground disturbance is significant or where recontouring is required, surface restoration would occur as required by the landowner or land management agency. The method of restoration typically would consist of returning disturbed areas to their natural contour (to the extent practical) and reseeding or revegetating with native plants. Seed viability would be tested and seed mixes would be certified to contain no noxious weeds.
5. Prior to construction, all construction personnel would be instructed on the protection of cultural, paleontological, and ecological resources. To assist in this effort, the construction contract would address (a) federal and state laws regarding antiquities, fossils, and plants and wildlife, including collection and removal; and (b) the importance of these resources and the purpose and necessity of protecting them.
6. An initial intensive cultural resource inventory survey would be conducted prior to construction. Impact avoidance and mitigation measures developed in consultation with appropriate land management and regulatory agencies and other interested parties would be implemented subsequent to the completion of the National Environmental Policy Act (NEPA) compliance document.
7. Any cultural and/or paleontological resource discovered during construction by the Kane County Water Conservancy District (KCWCD) or any person working on their behalf on public or federal land would be reported immediately to the authorized officer. The KCWCD would suspend operations in the area until an evaluation is completed to prevent the loss of cultural or scientific values.
8. All construction and maintenance activities would be conducted in a manner that would minimize disturbance to vegetation, drainage channels, and intermittent and perennial stream banks. In addition, dust-control measures would be utilized as necessary during construction in sensitive areas. Any used existing roads would be left in a condition equal to or better than their condition prior to construction.
9. All requirements of those entities having jurisdiction over air quality matters would be adhered to and any necessary permits for construction activities would be obtained. Open burning of construction trash (cleared trees, etc.) would not be allowed on Bureau of Land Management- (BLM) or U.S. Forest Service- (USFS) administered lands.
10. Fences and gates, if damaged or destroyed by construction activities, would be repaired or replaced to their original pre-disturbed condition as required by the landowner or the land management agency. Temporary gates would be installed only with the permission of the landowner or the land management agency.
11. Totally enclosed containment would be provided for all hazardous materials (if needed) and trash. All construction waste including trash, litter, garbage, other solid waste, petroleum products, and other potentially hazardous materials would be removed to a disposal facility authorized to accept such materials.
12. Third-party environmental contractors would be used throughout the construction effort, from clearing through rehabilitation.
13. The KCWCD would trim trees, in preference to cutting trees, and would cut trees, in preference to bulldozing them.
14. Construction holes left open overnight would be covered to prevent livestock or wildlife from harm.

Standard BMPs
15. The contractor would clean off-road equipment (power or high-pressure cleaning) of all mud, dirt, and plant parts prior to moving equipment onto public land.

Additional Stipulations

The following additional stipulations would be implemented throughout the construction and operation of the project and would be included as part of the standard operating procedures.

Stipulations – Standard Operating Procedures
1. KCWCD would construct, operate, and maintain the facilities, improvements, and structures within this ROW in strict conformity with the POD, as it is approved. Any relocation, additional construction, or use that is not in accord with the approved POD would not be initiated without the prior written approval of the authorized officer. A copy of the complete ROW grant or acknowledgment, including all stipulations and approved POD, would be made available on the ROW area during construction, operation, and maintenance to the authorized officer. Noncompliance with the above shall be grounds for an immediate temporary suspension of activities if it constitutes a threat to public health and safety or a material threat to the environment.
2. This POD describes in detail the construction, operation, maintenance of the ROW and its associated improvements and/or facilities. An approved POD may be referred to for interpretation of the ROW grant.
3. KCWCD would contact the authorized officer at least 10 days prior to the anticipated start of construction and/or any surface-disturbing activities. The authorized officer may require and schedule a preconstruction conference with the KCWCD prior to commencement of construction and/or surface disturbing activities on the ROW. The KCWCD, its contractor(s), or agents involved with the construction and/or surface disturbing activities on the ROW should attend this conference to review the stipulations of the grant and the POD.
4. KCWCD would designate a representative(s) who would have the authority to act upon and implement instructions from the authorized officer within a reasonable time when construction or other surface disturbing activities are underway.
5. KCWCD would protect all survey monuments found within the ROW. Survey monuments include but are not limited to General Land Office and BLM Cadastral Survey Corners, reference corners, witness points, U.S. Coastal and Geological Survey benchmarks and triangulation stations, military control monuments, and recognizable civil (both public and private) survey monuments. In the event of obliteration or disturbance of any of the above, the KCWCD would immediately report the incident, in writing, to the authorized officer and the respective installing authority, if known. Where General Land Office or BLM ROW monuments or references are obliterated during operations, KCWCD shall secure the services of a registered land surveyor or a BLM cadastral surveyor to restore the disturbed monuments and references using surveying procedures found in the *Manual of Surveying Instructions for the Survey of the Public Lands of the United States*, latest edition. KCWCD shall record such survey in the appropriate county and send a copy to the authorized officer. If the BLM cadastral surveyors or other federal surveyors are used to restore the disturbed survey monument, KCWCD would be responsible for the survey cost.
6. The KCWCD or the successor in interest shall comply with Title VI of the Civil Rights Act of 1964 (42 U.S.C. 2000d et. seq.) and the regulations of the Secretary of Interior issued pursuant hereto.
7. KCWCD would mark the exterior boundaries of the ROW with a stake and/or lath. The intervals may be varied at the time of staking at the discretion of the authorized officer. The tops of the stakes and/or laths would be painted and the laths flagged in a distinctive color as determined by the holder. The survey station numbers would be marked on the boundary stakes and/or laths at the entrance to and exit from public land. Holder would maintain all boundary stakes and/or laths in place until final cleanup and restoration are completed and approved by the authorized officer. The stakes and/or laths would then be removed at the direction of the authorized officer.
8. KCWCD would conduct all activities associated with the construction, operation, and maintenance of the ROW within the authorized limits of the ROW and approved POD.
9. KCWCD would survey and clearly mark the centerline and/or exterior limits of the ROW, as determined by the authorized officer.

Stipulations – Standard Operating Procedures
10. All design, material, and construction, operation, maintenance, and termination practices would be in accordance with safe and proven engineering practices.
11. KCWCD would inform the authorized officer within 48 hours of any accidents on federal lands that require reporting to the Department of Transportation as required by 49 CFR Part 195.
12. During conditions of extreme fire danger, operations may be suspended or limited in certain areas.
13. KCWCD would be liable for damage or injury to the United States to the extent provided by 43 CFR Sec. 2803.1-4. KCWCD would be held to a standard of strict liability for damage or injury to the United States resulting from fire or soil movement (including landslides and slumps as well as wind- and water-caused movement of particles) caused or substantially aggravated by any of the following within the ROW or permit area: • Activities of the holder including but not limited to construction, operation and maintenance of the facility. • Activities of other parties acting under color of authority from the KCWCD, including but not limited to: o land clearing; o earth-disturbing and earth-moving work; and o blasting.
14. Within 30 days of completion, KCWCD would submit to the authorized officer, as-built drawings and a certification of construction verifying that the facility has been constructed (and tested) in accordance with the design, plans, specifications, and applicable laws and regulations.
15. Construction sites would be maintained in a sanitary condition at all times. Waste materials at those sites would be disposed of promptly at an appropriate waste disposal site. "Waste" means all discarded matter including but not limited to human waste, debris, garbage, refuse, oil drums, petroleum products, ashes, and equipment.
16. Prior to preconstruction activities on the subject parcel, KCWCD would identify all noxious weeds present. A list of the weeds would be provided to the authorized officer. A determination would be made by the authorized officer of any noxious weeds that may require flagging for treatment. KCWCD shall treat the noxious weeds as required by the authorized officer.
17. KCWCD would clean off-road equipment (power or high-pressure cleaning) of all mud, dirt, and plant parts prior to moving equipment onto public land authorized under this lease.
18. Gravel and/or fill material to be placed in relatively weed-free areas must come from weed-free sources. Prior to obtaining gravel and/or fill material, the authorized officer would inspect the source for weeds and determine adequacy of site.
19. KCWCD would identify a road maintenance program, which would include monitoring for noxious weeds. If KCWCD identifies any noxious weeds, KCWCD would notify the authorized officer immediately. A treatment program would be identified and KCWCD would be responsible for weed abatement.

Best Management Practices

As part of standard operating procedures, standard BMPs would be implemented throughout the project in order to reduce potential adverse environmental impacts. Most of the impacts are short term and generally occur during the construction period. Project design and implementation of site-specific or selectively recommended BMPs would minimize the effect of the project where the potential for long-term, adverse impacts may occur.

STANDARD BMPs
1. All construction vehicle movement outside of the right-of-way would be restricted to pre-designated access, contractor acquired access, or public roads.
2. The limits of construction activities would be predetermined, with activity restricted to and confined within those limits. No paint or permanent discoloring agents would be applied to rocks or vegetation to indicate survey or construction activity limits. The right-of-way boundary would be flagged in environmentally sensitive areas described in the plan of development to alert construction personnel that those areas would be avoided.
3. In construction areas where re-contouring is not required, vegetation would be left in place wherever possible to avoid excessive root damage and allow for re-sprouting.
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STANDARD BMPs
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14. Construction holes left open overnight would be covered to prevent livestock or wildlife from harm.
15. The contractor would clean off-road equipment (power or high-pressure cleaning) of all mud, dirt, and plant parts prior to moving equipment onto public land.

ADDITIONAL STIPULATIONS

The following additional stipulations would be implemented throughout the construction and operation of the project and would be included as part of the standard operating procedures.

STIPULATIONS – STANDARD OPERATING PROCEDURES
1. KCWCD would construct, operate, and maintain the facilities, improvements, and structures within this ROW in strict conformity with the plan of development as it is approved. Any relocation, additional construction, or use that is not in accord with the approved plan of development would not be initiated without the prior written approval of the authorized officer. A copy of the complete ROW grant or acknowledgment, including all stipulations and approved plan of development, would be made available on the ROW area during construction, operation, and maintenance to the authorized officer. Noncompliance with the above shall be grounds for an immediate temporary suspension of activities if it constitutes a threat to public health and safety or a material threat to the environment.
2. This plan of development describes in detail the construction, operation, maintenance of the ROW and its associated improvements and/or facilities. An approved plan of development may be referred to for interpretation of the right-of-way grant.
3. KCWCD would contact the authorized officer at least 10 days prior to the anticipated start of construction and/or any surface-disturbing activities. The authorized officer may require and

STIPULATIONS – STANDARD OPERATING PROCEDURES
schedule a preconstruction conference with the KCWCD prior to commencement of construction and/or surface-disturbing activities on the ROW. The KCWCD, its contractor(s), or agents involved with the construction and/or surface-disturbing activities on the ROW should attend this conference to review the stipulations of the grant and the plan(s) of development.
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STIPULATIONS – STANDARD OPERATING PROCEDURES
United States resulting from fire or soil movement (including landslides and slumps as well as wind and water-caused movement of particles) caused or substantially aggravated by any of the following within the ROW or permit area: • Activities of the holder including but not limited to construction, operation and maintenance of the facility. • Activities of other parties acting under color of authority from the KCWCD, including but not limited to: - land clearing - earth-disturbing and earth-moving work - blasting
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Cove Reservoir
SITES Analysis

Kane County, Utah

RB&G ENGINEERING, INC.
1435 West 820 North
Provo, Utah 84601
801-374-5771 Provo
801-521-5771 Salt Lake City
801-374-5773 Fax

MEMORANDUM

To: Brent Gardner, P.E.

From: Brandon Horrocks, P.E.

Date: November 13, 2019

This memorandum describes auxiliary spillway stability and integrity analyses performed for the proposed Cove Dam, located in Kane County, Utah. The purpose of these analyses was to evaluate if the planned auxiliary spillway to be excavated into the native materials near the left abutment of the dam will meet NRCS stability and integrity design requirements. It is anticipated that this memorandum will be included in Appendix D of the project Environmental Assessment, and that the studies and documents referenced herein, such as the hydrological analyses, 2004 Cove Dam Feasibility Study, and preliminary design drawings will also be included in Appendix D, and the reader will have access to these documents for reference.

Flood routing and spillway evaluation analyses were performed for the calculated Stability Design Hydrograph (SDH) and Freeboard Hydrograph (FBH). The reservoir inflow hydrographs were provided to us by Alpha Engineering. The calculated SDH and FBH provided to us have peak reservoir inflows of 1,516 and 3,524 cfs, respectively. Routing analyses performed indicated that the SDH can be routed through the proposed Cove Reservoir and principal spillway without use of the auxiliary spillway; therefore, no erosion within the auxiliary spillway would occur as a result of the stability design storm, and the NRCS stability design requirements would be satisfied. An integrity design erosion analysis for the auxiliary spillway while passing the FBH was performed using the NRCS SITES computer program (version 2015.1.8). The calculated peak flow through the auxiliary spillway while routing the FBH through the reservoir is 378 cfs. NRCS requires that the spillway be designed to not breach during passage of the FBH.

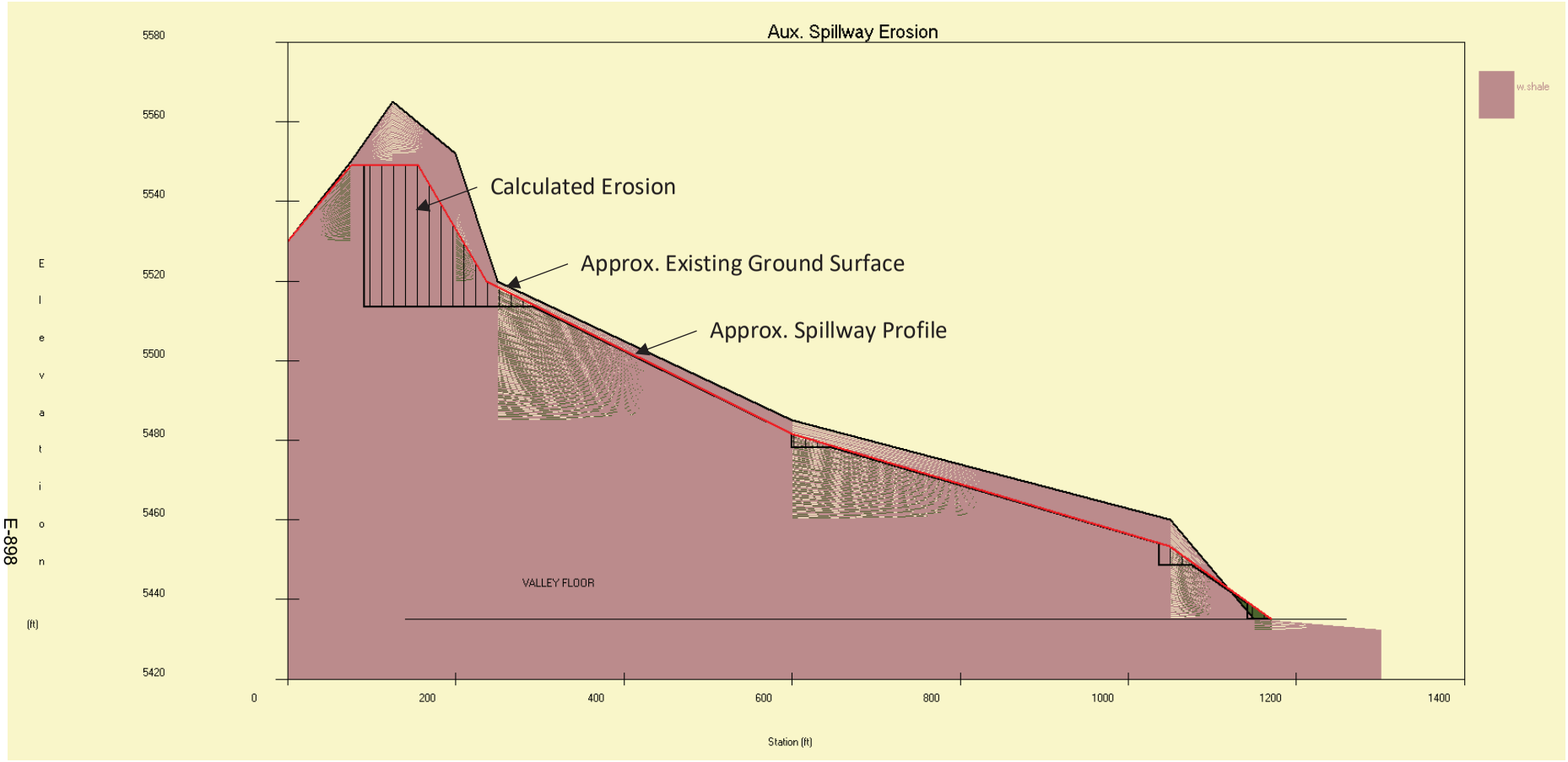
The boring completed on the left abutment nearest the proposed auxiliary spillway during the 2004 feasibility study (DH04-5) encountered weathered shale at the ground surface. Based upon

a review of erosion parameters for weathered shale included in the SITES program Help menu, a head cut index of 0.2 and representative diameter of 1 inch was used to model the weathered shale materials.

The existing ground surface and proposed spillway profile along the planned auxiliary spillway alignment were inputted into the SITES model. The existing topography along the planned spillway is as steep as about 1.5H:1V (Horizontal:Vertical). The planned spillway profile will require excavation into the native subsurface materials, resulting in spillway flowline grades as steep as about 3H:1V.

The results of the SITES analysis are illustrated on the attached output graphic, and it will be noted that the estimated erosion as a result of the FBH does not result in a spillway breach. The results of the analysis indicate that NRCS auxiliary spillway integrity requirements are satisfied.

We appreciate the opportunity to provide this service to you. Please feel free to contact us if you have any questions.

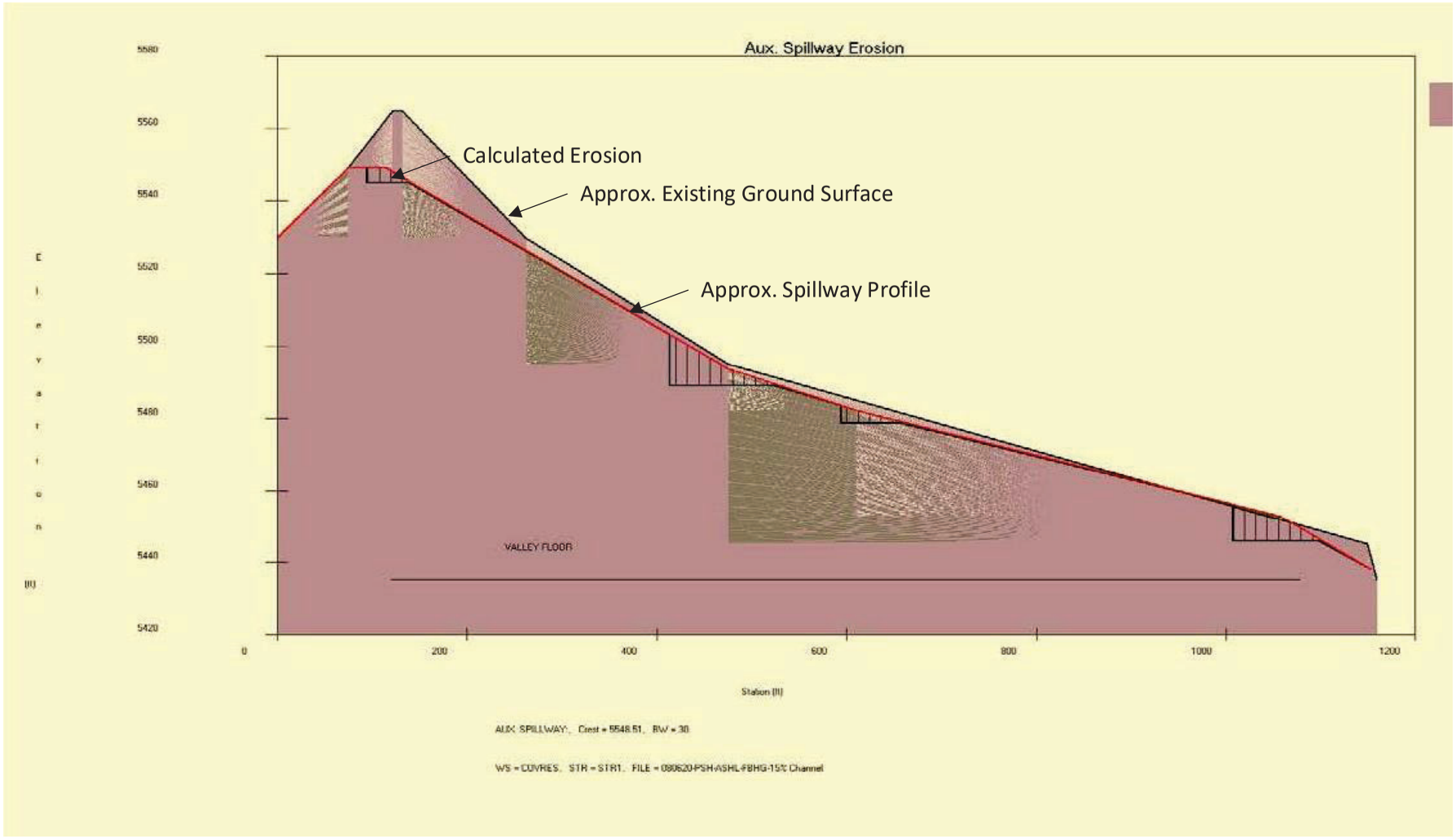


E-898

RB&G ENGINEERING, INC.

SITES OUTPUT

Cove Reservoir
Kane County, Utah



RB&G ENGINEERING, INC.

SITES OUTPUT

Cove Reservoir
Kane County, Utah

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SITES XEQ 08/28/2020   WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
     VER 2005.1.8              (USER MANUAL - DATED DECEMBER 2005)
     TIME 16:21:21

************************* 80-80 LIST OF INPUT Data ***************************

SITES     01/01/2005COVRES    COV RES                        4.74      C3
SAVMOV    0    101
SAVMOV    101  1                                                      1
STRUCTURE STR1      Cove Res
                    5470                                     0.18
                    5480                                     62.26
                    5490                                     303.40
                    5500                                     738.03
                    5510                                     1400.09
                    5520                                     2323.02
                    5530                                     3541.97
                    5540                                     5073.81
                    5545.5                                   6055.03
                    5550                                     6934.92
                    5552                                     7347.18
                    5552.5                                   7450.25
ENDTABLE
HYD       1                 Principal Spillway
                    1
                    0         11        14        15        15
                    15        15        15        15        15
                    15        16        16        16        16
                    16        16        16        16        16
                    16        17        17        17        17
                    17        17        17        17        17
                    17        18        18        18        18
                    18        18        18        18        19
                    19        19        19        19        19
                    20        20        20        20        20
                    20        21        21        21        21
                    21        21        22        22        22
                    22        23        23        23        23
                    24        24        24        24        25
                    25        25        26        26        26
                    27        27        27        28        28
                    29        29        29        30        30
                    31        31        32        33        33
                    34        35        35        36        37
                    38        39        40        41        42
                    43        45        46        48        49
                    51        53        56        58        61
                    65        69        74        80        87
                    96        109       127       157       219
                    850       479       259       172       132
                    111       98        88        81        75
                    70        65        62        59        56
                    54        51        50        48        46
                    45        43        42        41        40
                    39        38        37        36        35
                    35        34        33        33        32
                    32        31        30        30        29
                    29        29        28        28        27
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                    27        27        26        26        26
                    25        25        25        24        24
                    24        24        23        23        23
                    23        22        22        22        22
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                    21        20        20        20        20
                    20        20        19        19        19
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                    18        18        18        18        18
                    18        17        17        17        17
                    17        17        17        17        17
                    17        16        16        16        16
                    16        16        16        16        16
                    16        15        15        15        15
                    15        15        15        15        15
                    15        4         1
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HYD       3                 Auxiliary Spillway (Local)
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                    6         39        194       687       1365
                    2027      2180      1955      1683      1441
                    1248      1107      1001      924       874
                    833       748       589       423       283
                    180       112       73        47        28
                    16        9         5         3         1
                    1         0
ENDTABLE
HYD       5                 Freeboard (General)
                    1.2
                    0         0         4         35        84
                    195       425       1352      3365      3296
                    2008      1331      1060      912       792
                    742       664       624       613       611
                    547       262       90        24        5
                    1         0
ENDTABLE
WSDATA    2C CR             4.74
PDIRECT                               9.40      16.00
POOLDATA  ELEV              5545.5              5552      5435      SC
PSINLET             1       3.75
PSDATA    1         1000      30                0.012     5450
ASSPRFL   41
          0         5530      75        5549.2  115       5549.2
          475       5493.8    610       5482.3  1057      5453
          1153      5438
ENDTABLE
ASSURFACE 41        1170      1
          0         1170      .025      0         1
ENDTABLE
ASDATA    41                            2                             1
BTMWIDTH  FEET      30
ASMATERIAL
          1         50        1         75        115       .25
ENDTABLE
ASCOORD    1        W.Shale   N
          0         5530      75        5549.3    122       5565
          132       5565      262       5530      475       5495
          1150      5445      1155      5440      1160      5435
```

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 ENDTABLE
 GRAPHICS  I
 GO,DESIGN LCPIO     TYPE2     24
 SAVMOV    2    101  1                   STR1
 ENDJOB

 ********************************************************************************

 ***** MESSAGE - DEFAULT TOPSOIL FILL MATERIAL PARAMETERS USED.

 ***** MESSAGE - AUXILIARY SPILLWAY CREST ELEVATION IS SET TO  5549.20
                 FROM THE ASSPRFL RECORDS.

 ***** MESSAGE - VALUES FROM ASSURFACE, REACH  1 IMPLY NO VEGETAL COVER WITH
                 "n" OF 0.025.


1SITES ----------------------------------------------------------------------
 XEQ 08/28/2020                    COV RES                        WSID= COVRES
 VER 2005.1.8                        Cove Res                       SUBW= CR
 TIME 16:21:21           SITE = STR1             PASS=    1     PART=   1


 **********************    MATERIAL PROPERTIES    ****************************
                            DRY                    PERCENT       DETACH.      REP.
      MATERIAL       PI    DENSITY        Kh        CLAY         RATE      DIAMETER
                           lbs/CuFt                            (Ft/H)/(lb/SqFt)  inches
     W.Shale        50.      115.      0.25        75.0          --        1.00000
     TS_FILL         0.      100.      0.05         0.0          --        0.05000
     GEN_FILL       50.      115.      0.25        75.0          --        1.00000

 ****************************    BASIC Data    ********************************
 HUMID- SUBHUMID CLIMATE AREA                    DESIGN CLASS  C

 INFLOW HYDROGRAPH(S) ENTERED

 PRECIP. - Q-PS,1-DAY    Q-PS,10-DAY       P-SD          P-FB
               0.00          0.00          9.40         16.00

 WSDATA -       CN          DA-SM          TC/L           -/H          QRF
               0.00          4.74          0.00          0.00         0.00

 SITEDATA- PERM POOL     CREST PS        FP SED       VALLEY FL        378?
               0.00       5545.50          0.00        5435.00          NO

           BASEFLOW      INITIAL EL     EXTRA VOL      SITE TYPE
               0.00          0.00          0.00         DESIGN

 PSDATA -  NO. COND        COND L         DIA/W           -/H
               1.00       1000.00         30.00          0.00

              PS N            KE         WEIR L         TW EL
             0.012          1.00          3.75        5450.00

            2ND STG         ORF H          ORF L      START AUX.
               0.00          0.00          0.00          0.00

 ASCRESTS -   AUX.1         AUX.2         AUX.3         AUX.4         AUX.5
```

5549.20	0.00	0.00	0.00	0.00

AUX.Data - REF.NO.	RETARD. Ci	TIE STATION	INLET LENGTH
41	0.00	115.00	0

AUX.Data - INLET N	SIDE SLOPE	EXIT N	EXIT SLOPE	ACTUAL AUX?
0.025	2.00	0.025	0.154	NO

BTM WIDTH -	BW1	BW2	BW3	BW4	BW5
ft	30.00	0.00	0.00	0.00	0.00

AUXILIARY SPILLWAY RATING DEVELOPED USING WSPVRT.

1********** DETAILED LIST OF BASIC Data **********

WEIR COEF. FOR ORIFICES.....	3.10	RATIO OF Ia TO S (CH.10,NEH4).	0.20
WEIR COEF. FOR DROP INLET.....	3.10	TIME INCS TO PEAK OF UNIT HYD.	10.
DISCHARGE COEF. FOR ORIFICES.....	0.60	NO. POINTS FOR DESIGN HYD. ...	5000
HOOD, WEIR INLET COEF.	0.60	DRAWDOWN TIME LIMIT - DAYS....	10.0
HOOD, PIPE ENTRANCE COEF.	0.60	DRAWDOWN RATIO STORAGE LIMIT..	0.15
HOOD, SLUG FLOW COEF.	0.00	OTHER DRAWDOWN RATIOS APPLY ?.	NO
PS ACCURACY OF FULL FLOW CALC.,FT	0.01	WSP ALLOWABLE FSS VEL. CHANGE.	0.05
FILLET SIZE FOR BOX CONDUITS.....	6.00	WSP FSS CALC. PRECISION, FT..	0.005
GRAVITATIONAL CONSTANT.....	32.16	AUX. SPILLWAY MIN. CAP. COEF.	237.0
MIN. NHCP378 PS PIPE AREA SQFT..	0.545	AUX. SPILLWAY MIN. CAP. EXP.	0.493
MIN. TR60 DEPTH AUX. TO TOP DAM..	3.00	MIN. AUX. BW IN BW SOLUTION,FT	20.0
MIN. NHCP378 DEPTH AUX.TO TOP DAM	2.00	PRECISION OF BW SOLUTION.....	1.0
MIN. NHCP378 DEPTH PS - AUX.CREST	1.00	OLD TR60 CRITERIA USED	NO
MIN. NHCP378 DEPTH DESIGN Q - TOD	1.00	OLD NHCP378 CRITERIA USED	NO

EMBANKMENT TEMPLATE: TOP WIDTH = (calc.), MAX. CROWN = 0.667 ft,

SIDE SLOPE RATIOS		WAVE BERM WIDTH	MULTIPLE STABILITY BERMS U&D/S WIDTHS	DELTA H	SEPARATE STABILITY BERMS WIDTHS, ft		HEIGHTS, ft	
U/S	D/S	ft	ft	ft	U/S	D/S	U/S	D/S
2.50	2.50	10.0	0.0	0.00	0.00	0.00	0.00	0.00

DIMENSIONLESS UNIT HYDROGRAPH
STANDARD DIMENSIONLESS UNIT HYDROGRAPH
PEAK FACTOR = 484.0 | TIME INC. =0.020 | NO. INC. TO PEAK = 10.
VOLUME FACTOR = 48.3429

0.0000	0.0300	0.1000	0.1900	0.3100
0.4700	0.6600	0.8200	0.9300	0.9900
1.0000	0.9900	0.9300	0.8600	0.7800
0.6800	0.5600	0.4600	0.3900	0.3300
0.2800	0.2410	0.2070	0.1740	0.1470
0.1260	0.1070	0.0910	0.0770	0.0660
0.0550	0.0470	0.0400	0.0340	0.0290
0.0250	0.0210	0.0180	0.0150	0.0130
0.0110	0.0090	0.0080	0.0070	0.0060
0.0050	0.0040	0.0030	0.0020	0.0010
0.0000				

EXISTING NATURAL SURFACE AT AUXILIARY SPILLWAY SITE - X,Y COORDINATES:

0.	5530.00
75.	5549.30
122.	5565.00
132.	5565.00
262.	5530.00
475.	5495.00
1150.	5445.00
1155.	5440.00
1160.	5435.00

1NRCS DESIGN STORM RAINFALL DISTRIBUTION (CHAPTER 21, NEH4 & TR-60).

0.000	0.008	0.016	0.025	0.033
0.043	0.052	0.063	0.074	0.086
0.099	0.112	0.126	0.142	0.160
0.180	0.205	0.255	0.345	0.437
0.530	0.603	0.633	0.660	0.684
0.705	0.724	0.742	0.759	0.775
0.790	0.804	0.818	0.831	0.844
0.856	0.868	0.879	0.890	0.900
0.910	0.920	0.930	0.939	0.948
0.957	0.966	0.975	0.983	0.992
1.000				

24 HOUR TYPE II RAINFALL DISTRIBUTION
IDENTIFICATION NAME IS TYPE2 GIVEN DURATION = 24.0 HRS

0.000	0.001	0.002	0.003	0.004
0.005	0.006	0.007	0.008	0.009
0.010	0.012	0.013	0.014	0.015
0.016	0.017	0.018	0.020	0.021
0.022	0.023	0.024	0.026	0.027
0.028	0.029	0.031	0.032	0.033
0.034	0.036	0.037	0.038	0.040
0.041	0.042	0.044	0.045	0.047
0.048	0.049	0.051	0.052	0.054
0.055	0.057	0.058	0.060	0.061
0.063	0.065	0.066	0.068	0.070
0.071	0.073	0.075	0.076	0.078
0.080	0.082	0.084	0.085	0.087
0.089	0.091	0.093	0.095	0.097
0.099	0.101	0.103	0.105	0.107
0.109	0.111	0.113	0.116	0.118
0.120	0.122	0.125	0.127	0.130
0.132	0.135	0.138	0.141	0.144
0.147	0.150	0.153	0.157	0.160
0.163	0.166	0.170	0.173	0.177
0.181	0.185	0.189	0.194	0.199
0.204	0.209	0.215	0.221	0.228
0.235	0.243	0.251	0.261	0.271
0.283	0.307	0.354	0.431	0.568
0.663	0.682	0.699	0.713	0.725
0.735	0.743	0.751	0.759	0.766
0.772	0.778	0.784	0.789	0.794
0.799	0.804	0.808	0.812	0.816
0.820	0.824	0.827	0.831	0.834
0.838	0.841	0.844	0.847	0.850

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      0.854      0.856      0.859      0.862      0.865
      0.868      0.870      0.873      0.875      0.878
      0.880      0.882      0.885      0.887      0.889
      0.891      0.893      0.895      0.898      0.900
      0.902      0.904      0.906      0.908      0.910
      0.912      0.914      0.915      0.917      0.919
      0.921      0.923      0.925      0.926      0.928
      0.930      0.931      0.933      0.935      0.936
      0.938      0.939      0.941      0.942      0.944
      0.945      0.947      0.948      0.949      0.951
      0.952      0.953      0.955      0.956      0.957
      0.958      0.960      0.961      0.962      0.964
      0.965      0.966      0.967      0.968      0.970
      0.971      0.972      0.973      0.975      0.976
      0.977      0.978      0.979      0.981      0.982
      0.983      0.984      0.985      0.986      0.988
      0.989      0.990      0.991      0.992      0.993
      0.994      0.996      0.997      0.998      0.999
      1.000

1SITES ------------------------------------------------------------------------
 XEQ 08/28/2020                    COV RES                          WSID= COVRES
 VER 2005.1.8                       Cove Res                          SUBW= CR
 TIME 16:21:21           SITE = STR1              PASS=    1     PART=   2

MESSAGE ---- Climatic Index changed from 0.0 to 1.0 for this run.

 CREST PS       5545.50 FT    6055.0 ACFT      0.00 AC     126.3 CFS

 SED ACCUM      5545.50 FT    6055.0 ACFT      0.00 AC     126.3 CFS

 START ELEV     5545.50 FT    6055.0 ACFT      0.00 AC       0.0 CFS

 INFLOW HYDROGRAPH PROVIDED IN LOCATION  1,  PEAK=    850.00 CFS, AT 120.00 HRS.
 TITLE = Principal Spillway

 HYD       PO              4.74Cove Res                                COVRES  1
           0             1.0000                                      STR1    2
                           0.03       0.03       0.10       0.18       0.26   PO D  3
                           0.34       0.41       0.49       0.57       0.65   PO D  4
                           0.73       0.81       0.89       0.97       1.05   PO D  5
                           1.13       1.22       1.30       1.38       1.45   PO D  6
                           1.53       1.61       1.70       1.78       1.86   PO D  7
                           1.95       2.03       2.11       2.19       2.27   PO D  8
                           2.35       2.43       2.51       2.60       2.68   PO D  9
                           2.77       2.85       2.93       3.01       3.10   PO D 10
                           3.18       3.27       3.35       3.44       3.52   PO D 11
                           3.61       3.70       3.79       3.87       3.96   PO D 12
                           4.05       4.14       4.23       4.32       4.41   PO D 13
                           4.50       4.59       4.68       4.77       4.87   PO D 14
                           4.96       5.05       5.15       5.25       5.34   PO D 15
                           5.44       5.54       5.64       5.74       5.84   PO D 16
                           5.95       6.05       6.16       6.26       6.37   PO D 17
                           6.48       6.59       6.70       6.82       6.93   PO D 18
                           7.05       7.17       7.28       7.40       7.53   PO D 19
                           7.65       7.78       7.91       8.04       8.17   PO D 20
                           8.31       8.45       8.60       8.74       8.89   PO D 21
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9.05	9.21	9.37	9.54	9.71	PO D 22
9.89	10.08	10.27	10.47	10.67	PO D 23
10.89	11.11	11.34	11.59	11.85	PO D 24
12.13	12.43	12.75	13.09	13.47	PO D 25
13.90	14.38	14.94	15.63	17.26	PO D 26
22.38	28.72	32.09	33.90	35.07	PO D 27
35.92	36.60	37.15	37.62	38.02	PO D 28
38.36	38.65	38.90	39.11	39.29	PO D 29
39.45	39.58	39.68	39.78	39.85	PO D 30
39.90	39.94	39.97	39.98	39.99	PO D 31
39.98	39.97	39.94	39.91	39.87	PO D 32
39.82	39.77	39.70	39.64	39.57	PO D 33
39.49	39.41	39.33	39.23	39.14	PO D 34
39.04	38.94	38.84	38.73	38.62	PO D 35
38.50	38.39	38.27	38.15	38.03	PO D 36
37.91	37.78	37.65	37.52	37.39	PO D 37
37.26	37.13	36.99	36.85	36.72	PO D 38
36.58	36.44	36.30	36.16	36.02	PO D 39
35.88	35.74	35.59	35.45	35.30	PO D 40
35.16	35.02	34.87	34.72	34.58	PO D 41
34.43	34.29	34.14	33.99	33.85	PO D 42
33.70	33.55	33.41	33.27	33.12	PO D 43
32.97	32.82	32.68	32.53	32.39	PO D 44
32.25	32.10	31.95	31.80	31.66	PO D 45
31.51	31.37	31.23	31.09	30.95	PO D 46
30.81	30.67	30.52	30.38	30.24	PO D 47
30.10	29.96	29.82	29.68	29.55	PO D 48
29.41	29.28	29.14	29.00	28.86	PO D 49
28.72	28.58	28.45	28.32	28.19	PO D 50
28.06	27.87	27.62	27.36	27.10	PO D 51
26.84	26.58	26.33	26.08	25.83	PO D 52
25.59	25.35	25.10	24.87	24.63	PO D 53
24.40	24.17	23.94	23.71	23.49	PO D 54
23.26	23.04	22.83	22.61	22.40	PO D 55
22.18	21.98	21.77	21.56	21.36	PO D 56
21.16	20.96	20.76	20.57	20.37	PO D 57
20.18	19.99	19.80	19.62	19.43	PO D 58
19.25	19.07	18.89	18.72	18.54	PO D 59
18.37	18.20	18.03	17.86	17.69	PO D 60
17.53	17.36	17.20	17.04	16.88	PO D 61
16.73	16.57	16.42	16.26	16.11	PO D 62
15.96	15.82	15.69	15.61	15.53	PO D 63
15.45	15.37	15.29	15.22	15.14	PO D 64
15.06	14.99	14.91	14.83	14.76	PO D 65
14.69	14.61	14.54	14.46	14.39	PO D 66
14.32	14.25	14.17	14.10	14.03	PO D 67
13.96	13.89	13.82	13.75	13.68	PO D 68
13.61	13.55	13.48	13.41	13.34	PO D 69
13.28	13.21	13.14	13.08	13.01	PO D 70
12.95	12.88	12.82	12.75	12.69	PO D 71
12.63	12.56	12.50	12.44	12.38	PO D 72
12.32	12.25	12.19	12.13	12.07	PO D 73
12.01	11.95	11.89	11.83	11.78	PO D 74
11.72	11.66	11.60	11.54	11.49	PO D 75
11.43	11.37	11.32	11.26	11.21	PO D 76
11.15	11.10	11.04	10.99	10.93	PO D 77
10.88	10.83	10.77	10.72	10.67	PO D 78
10.61	10.56	10.51	10.46	10.41	PO D 79
10.36	10.31	10.26	10.21	10.16	PO D 80

10.11	10.06	10.01	9.96	9.91	PO D 81
9.86	9.81	9.77	9.72	9.67	PO D 82
9.62	9.58	9.53	9.48	9.44	PO D 83
9.39	9.35	9.30	9.26	9.21	PO D 84
9.17	9.12	9.08	9.04	8.99	PO D 85
8.95	8.91	8.86	8.82	8.78	PO D 86
8.74	8.69	8.65	8.61	8.57	PO D 87
8.53	8.49	8.45	8.41	8.37	PO D 88
8.33	8.29	8.25	8.21	8.17	PO D 89
8.13	8.09	8.05	8.02	7.98	PO D 90
7.94	7.90	7.87	7.83	7.79	PO D 91
7.75	7.72	7.68	7.64	7.61	PO D 92
7.57	7.54	7.50	7.47	7.43	PO D 93
7.40	7.36	7.33	7.29	7.26	PO D 94
7.23	7.19	7.16	7.12	7.09	PO D 95
7.06	7.03	6.99	6.96	6.93	PO D 96
6.90	6.86	6.83	6.80	6.77	PO D 97
6.74	6.71	6.68	6.65	6.61	PO D 98
6.58	6.55	6.52	6.49	6.46	PO D 99
6.43	6.41	6.38	6.35	6.32	PO D100
6.29	6.26	6.23	6.20	6.18	PO D101
6.15	6.12	6.09	6.06	6.04	PO D102
6.01	5.98	5.96	5.93	5.90	PO D103
5.88	5.85	5.82	5.80	5.77	PO D104
5.74	5.72	5.69	5.67	5.64	PO D105
5.62	5.59	5.57	5.54	5.52	PO D106
5.49	5.47	5.45	5.42	5.40	PO D107
5.37	5.35	5.33	5.30	5.28	PO D108
5.26	5.23	5.21	5.19	5.16	PO D109
5.14	5.12	5.10	5.08	5.05	PO D110
5.03	5.01	4.99	4.97	4.94	PO D111
4.92	4.90	4.88	4.86	4.84	PO D112
4.82	4.80	4.78	4.76	4.74	PO D113
4.72	4.70	4.68	4.66	4.64	PO D114
4.62	4.60	4.58	4.56	4.54	PO D115
4.52	4.50	4.48	4.46	4.44	PO D116
4.43	4.41	4.39	4.37	4.35	PO D117
4.33	4.32	4.30	4.28	4.26	PO D118
4.24	4.23	4.21	4.19	4.17	PO D119
4.16	4.14	4.12	4.11	4.09	PO D120
4.07	4.06	4.04	4.02	4.01	PO D121
3.99	3.97	3.96	3.94	3.93	PO D122
3.91	3.89	3.88	3.86	3.85	PO D123
3.83	3.82	3.80	3.79	3.77	PO D124
3.76	3.74	3.73	3.71	3.70	PO D125
3.68	3.67	3.65	3.64	3.62	PO D126
3.61	3.60	3.58	3.57	3.55	PO D127
3.54	3.53	3.51	3.50	3.49	PO D128
3.47	3.46	3.45	3.43	3.42	PO D129
3.41	3.39	3.38	3.37	3.35	PO D130
3.34	3.33	3.32	3.30	3.29	PO D131
3.28	3.27	3.25	3.24	3.23	PO D132
3.22	3.21	3.19	3.18	3.17	PO D133
3.16	3.15	3.14	3.12	3.11	PO D134
3.10	3.09	3.08	3.07	3.06	PO D135
3.04	3.03	3.02	3.01	3.00	PO D136
2.99	2.98	2.97	2.96	2.95	PO D137
2.94	2.93	2.92	2.90	2.89	PO D138
2.88	2.87	2.86	2.85	2.84	PO D139

2.83	2.82	2.81	2.80	2.79	PO D140
2.78	2.78	2.77	2.76	2.75	PO D141
2.74	2.73	2.72	2.71	2.70	PO D142
2.69	2.68	2.67	2.66	2.65	PO D143
2.65	2.64	2.63	2.62	2.61	PO D144
2.60	2.59	2.58	2.58	2.57	PO D145
2.56	2.55	2.54	2.53	2.52	PO D146
2.52	2.51	2.50	2.49	2.48	PO D147
2.48	2.47	2.46	2.45	2.44	PO D148
2.44	2.43	2.42	2.41	2.41	PO D149
2.40	2.39	2.38	2.38	2.37	PO D150
2.36	2.35	2.35	2.34	2.33	PO D151
2.32	2.32	2.31	2.30	2.30	PO D152
2.29	2.28	2.27	2.27	2.26	PO D153
2.25	2.25	2.24	2.23	2.23	PO D154
2.22	2.21	2.21	2.20	2.19	PO D155
2.19	2.18	2.17	2.17	2.16	PO D156
2.16	2.15	2.14	2.14	2.13	PO D157
2.12	2.12	2.11	2.11	2.10	PO D158
2.09	2.09	2.08	2.08	2.07	PO D159
2.07	2.06	2.05	2.05	2.04	PO D160
2.04	2.03	2.03	2.02	2.01	PO D161
2.01	2.00	2.00	1.99	1.99	PO D162
1.98	1.98	1.97	1.97	1.96	PO D163
1.96	1.95	1.95	1.94	1.94	PO D164
1.93	1.92	1.92	1.91	1.91	PO D165
1.91	1.90	1.90	1.89	1.89	PO D166
1.88	1.88	1.87	1.87	1.86	PO D167
1.86	1.85	1.85	1.84	1.84	PO D168
1.83	1.83	1.83	1.82	1.82	PO D169
1.81	1.81	1.80	1.80	1.79	PO D170
1.79	1.79	1.78	1.78	1.77	PO D171
1.77	1.76	1.76	1.76	1.75	PO D172
1.75	1.74	1.74	1.74	1.73	PO D173
1.73	1.72	1.72	1.72	1.71	PO D174
1.71	1.70	1.70	1.70	1.69	PO D175
1.69	1.69	1.68	1.68	1.67	PO D176
1.67	1.67	1.66	1.66	1.66	PO D177
1.65	1.65	1.65	1.64	1.64	PO D178
1.64	1.63	1.63	1.63	1.62	PO D179
1.62	1.62	1.61	1.61	1.61	PO D180
1.60	1.60	1.60	1.59	1.59	PO D181
1.59	1.58	1.58	1.58	1.57	PO D182
1.57	1.57	1.56	1.56	1.56	PO D183
1.56	1.55	1.55	1.55	1.54	PO D184
1.54	1.54	1.53	1.53	1.53	PO D185
1.53	1.52	1.52	1.52	1.51	PO D186
1.51	1.51	1.51	1.50	1.50	PO D187
1.50	1.50	1.49	1.49	1.49	PO D188
1.48	1.48	1.48	1.48	1.47	PO D189
1.47	1.47	1.47	1.46	1.46	PO D190
1.46	1.46	1.45	1.45	1.45	PO D191
1.45	1.44	1.44	1.44	1.44	PO D192
1.43	1.43	1.43	1.43	1.43	PO D193
1.42	1.42	1.42	1.42	1.41	PO D194
1.41	1.41	1.41	1.41	1.40	PO D195
1.40	1.40	1.40	1.39	1.39	PO D196
1.39	1.39	1.39	1.38	1.38	PO D197
1.38	1.38	1.38	1.37	1.37	PO D198

1.37	1.37	1.37	1.36	1.36	PO D199
1.36	1.36	1.36	1.35	1.35	PO D200
1.35	1.35	1.35	1.34	1.34	PO D201
1.34	1.34	1.34	1.33	1.33	PO D202
1.33	1.33	1.33	1.33	1.32	PO D203
1.32	1.32	1.32	1.32	1.32	PO D204
1.31	1.31	1.31	1.31	1.31	PO D205
1.31	1.30	1.30	1.30	1.30	PO D206
1.30	1.30	1.29	1.29	1.29	PO D207
1.29	1.29	1.29	1.28	1.28	PO D208
1.28	1.28	1.28	1.28	1.28	PO D209
1.27	1.27	1.27	1.27	1.27	PO D210
1.27	1.27	1.26	1.26	1.26	PO D211
1.26	1.26	1.26	1.26	1.25	PO D212
1.25	1.25	1.25	1.25	1.25	PO D213
1.25	1.24	1.24	1.24	1.24	PO D214
1.24	1.24	1.24	1.24	1.23	PO D215
1.23	1.23	1.23	1.23	1.23	PO D216
1.23	1.23	1.22	1.22	1.22	PO D217
1.22	1.22	1.22	1.22	1.22	PO D218
1.21	1.21	1.21	1.21	1.21	PO D219
1.21	1.21	1.21	1.21	1.20	PO D220
1.20	1.20	1.20	1.20	1.20	PO D221
1.20	1.20	1.20	1.19	1.19	PO D222
1.19	1.19	1.19	1.19	1.19	PO D223
1.19	1.19	1.19	1.18	1.18	PO D224
1.18	1.18	1.18	1.18	1.18	PO D225
1.18	1.18	1.18	1.17	1.17	PO D226
1.17	1.17	1.17	1.17	1.17	PO D227
1.17	1.17	1.17	1.17	1.16	PO D228
1.16	1.16	1.16	1.16	1.16	PO D229
1.16	1.16	1.16	1.16	1.16	PO D230
1.15	1.15	1.15	1.15	1.15	PO D231
1.15	1.15	1.15	1.15	1.15	PO D232
1.15	1.15	1.15	1.14	1.14	PO D233
1.14	1.14	1.14	1.14	1.14	PO D234
1.14	1.14	1.14	1.14	1.14	PO D235
1.14	1.13	1.13	1.13	1.13	PO D236
1.13	1.13	1.13	1.13	1.13	PO D237
1.13	1.13	1.13	1.13	1.13	PO D238
1.12	1.12	1.12	1.12	1.12	PO D239
1.12	1.12	1.12	1.12	1.12	PO D240
1.12	1.12	1.12	1.12	1.12	PO D241
1.11	1.11	1.11	1.11	1.11	PO D242
1.11	1.11	1.11	1.11	1.11	PO D243
1.11	1.11	1.11	1.11	1.11	PO D244
1.11	1.11	1.10	1.10	1.10	PO D245
1.10	1.10	1.10	1.10	1.10	PO D246
1.10	1.10	1.10	1.10	1.10	PO D247
1.10	1.10	1.10	1.10	1.10	PO D248
1.10	1.09	1.09	1.09	1.09	PO D249
1.09	1.09	1.09	1.09	1.09	PO D250
1.09	1.09	1.09	1.09	1.09	PO D251
1.09	1.09	1.09	1.09	1.09	PO D252
1.09	1.08	1.08	1.08	1.08	PO D253
1.08	1.08	1.08	1.08	1.08	PO D254
1.08	1.08	1.08	1.08	1.08	PO D255
1.08	1.08	1.08	1.08	1.08	PO D256
1.08	1.08	1.08	1.08	1.07	PO D257

1.07	1.07	1.07	1.07	1.07	PO D258
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1.07	1.07	1.07	1.07	1.07	PO D261
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1.07	1.06	1.06	1.06	1.06	PO D263
1.06	1.06	1.06	1.06	1.06	PO D264
1.06	1.06	1.06	1.06	1.06	PO D265
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1.06	1.06	1.06	1.06	1.06	PO D267
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1.05	1.05	1.05	1.05	1.05	PO D274
1.05	1.05	1.05	1.05	1.05	PO D275
1.05	1.05	1.05	1.04	1.04	PO D276
1.04	1.04	1.04	1.04	1.04	PO D277
1.04	1.04	1.04	1.04	1.04	PO D278
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1.04	1.04	1.04	1.04	1.04	PO D280
1.04	1.04	1.04	1.04	1.04	PO D281
1.04	1.04	1.04	1.04	1.04	PO D282
1.04	1.04	1.04	1.04	1.04	PO D283
1.04	1.04	1.04	1.04	1.04	PO D284
1.04	1.04	1.04	1.04	1.04	PO D285
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1.00	1.00	1.00	1.00	1.00	PO D417
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1.00	1.00	1.00	1.00	1.00	PO D420
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1.00	1.00	1.00	1.00	1.00	PO D422
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1.00	1.00	1.00	1.00	1.00	PO D425
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1.00	1.00	1.00	1.00	1.00	PO D427
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1.00	1.00	1.00	1.00	1.00	PO D433
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1.00	1.00	1.00	1.00	1.00	PO D462
1.00	1.00	1.00	1.00	1.00	PO D463
1.00	1.00	1.00	1.00	1.00	PO D464
1.00	1.00	1.00	1.00	1.00	PO D465
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1.00	1.00	1.00	1.00	1.00	PO D467
1.00	1.00	1.00	1.00	1.00	PO D468
1.00	1.00	1.00	1.00	1.00	PO D469
1.00	1.00	1.00	1.00	1.00	PO D470
1.00	1.00	1.00	1.00	1.00	PO D471
1.00	1.00	1.00	1.00	1.00	PO D472
1.00	1.00	1.00	1.00	1.00	PO D473
1.00	1.00	1.00	1.00	1.00	PO D474
1.00	1.00	1.00	1.00	1.00	PO D475
1.00	1.00	1.00	1.00	1.00	PO D476
1.00	1.00	1.00	1.00	1.00	PO D477
1.00	1.00	1.00	1.00	1.00	PO D478
1.00	1.00	1.00	1.00	1.00	PO D479
1.00	1.00	1.00	1.00	1.00	PO D480
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1.00	1.00	1.00	1.00	1.00	PO D482
1.00	1.00	1.00	1.00	1.00	PO D483
1.00	1.00	1.00	1.00	1.00	PO D484
1.00	1.00	1.00	1.00	1.00	PO D485
1.00	1.00	1.00	1.00	1.00	PO D486
1.00	1.00	1.00	1.00	1.00	PO D487
1.00	1.00	1.00	1.00	1.00	PO D488

ENDTABLE P 1,T 1489

1SITES ----------

XEQ 08/28/2020 COV RES WSID= COVRES

CREST PS 5545.50 FT 6055.0 ACFT 0.00 AC 126.3 CFS

SED ACCUM 5545.50 FT 6055.0 ACFT 0.00 AC 126.3 CFS

START ELEV 5545.50 FT 6055.0 ACFT 0.00 AC 0.0 CFS

NRCS-PSH RAINFALL 1-DAY = 0.00 IN 10-DAY = 0.00 IN DA = 4.74 SM
RUNOFF 1-DAY = 0.00 IN 10-DAY = 0.00 IN

CLIMATIC INDEX = 1.00 CN 10-DAY = 0. CN 1-DAY = 0.

PEAK = 850.0 CFS, AT 120.0 HRS.

ROUTED RESULT - HYD TYPE EMAX VOL-MAX AMAX QMAX
NRCS-PSH 5547.76 FT 6496.1 ACFT 0.00 AC 40.0 CFS

PS STORAGE 441.0 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

DRAWDOWN (DDT) TEST 5545.84 FT 6121.2 ACFT 4.35 CFS
CONTROL IS 0.150 DETENTION STORAGE

TIME LIMIT REACHED = 10.00 DAYS. FLOW WAS 9.73 CFS, ELEV = 5546.26
(ELEVATION TO START ROUTING SDH AND/OR FBH HAS BEEN RAISED.)

TIME TO DDT TEST DISCHARGE IS 15.79 DAYS - DRAWDOWN STOPPED.

***** NOTE - CREST OF AUX. RAISED TO HOLD 148.03 ACFT NOT EVACUATED IN
DRAWDOWN TIME LIMIT. TOTAL STORAGE REQUIRED = 6644.08 ACFT,
NEW ELEVATION OF AUXILIARY SPILLWAY CREST = 5548.51 FT.

PLOT OF PRINCIPAL SPILLWAY HYDROGRAPH, 1 INCH= 200. CFS

Time	Qin	Qout	Elev	Vol	Area	ExtVel	0. I 200. I 400. I 600. I 800 I
0.00	0.0	0.0	5545.5	6055.5	0.0		.
1.00	11.0	0.0	5545.5	6055.5	0.0		.I
2.00	14.0	0.1	5545.5	6056.5	0.0		.I
3.00	15.0	0.2	5545.5	6057.7	0.0		.I
4.00	15.0	0.3	5545.5	6058.9	0.0		.I
5.00	15.0	0.3	5545.5	6060.1	0.0		.I
6.00	15.0	0.4	5545.5	6061.3	0.0		.I
7.00	15.0	0.5	5545.5	6062.5	0.0		.I
8.00	15.0	0.6	5545.5	6063.7	0.0		.I
9.00	15.0	0.7	5545.6	6064.9	0.0		.I
10.00	15.0	0.7	5545.6	6066.1	0.0		.I
11.00	16.0	0.8	5545.6	6067.3	0.0		.I
12.00	16.0	0.9	5545.6	6068.6	0.0		.I
13.00	16.0	1.0	5545.6	6069.8	0.0		.I
14.00	16.0	1.1	5545.6	6071.1	0.0		.I
15.00	16.0	1.1	5545.6	6072.3	0.0		.I
16.00	16.0	1.2	5545.6	6073.5	0.0		.I
17.00	16.0	1.3	5545.6	6074.7	0.0		.I
18.00	16.0	1.4	5545.6	6076.0	0.0		.I
19.00	16.0	1.5	5545.6	6077.2	0.0		.I

20.00	16.0	1.5	5545.6	6078.4	0.0	.I
21.00	17.0	1.6	5545.6	6079.6	0.0	.I
22.00	17.0	1.7	5545.6	6080.9	0.0	.I
23.00	17.0	1.8	5545.6	6082.1	0.0	.I
24.00	17.0	1.9	5545.6	6083.4	0.0	.I
25.00	17.0	1.9	5545.7	6084.6	0.0	.I
26.00	17.0	2.0	5545.7	6085.9	0.0	.I
27.00	17.0	2.1	5545.7	6087.1	0.0	.I
28.00	17.0	2.2	5545.7	6088.3	0.0	.I
29.00	17.0	2.3	5545.7	6089.5	0.0	.I
30.00	17.0	2.3	5545.7	6090.8	0.0	.I
31.00	18.0	2.4	5545.7	6092.0	0.0	.I
32.00	18.0	2.5	5545.7	6093.3	0.0	.I
33.00	18.0	2.6	5545.7	6094.6	0.0	.I
34.00	18.0	2.7	5545.7	6095.8	0.0	.I
35.00	18.0	2.8	5545.7	6097.1	0.0	.I
36.00	18.0	2.8	5545.7	6098.4	0.0	.I
37.00	18.0	2.9	5545.7	6099.6	0.0	.I
38.00	18.0	3.0	5545.7	6100.8	0.0	.I
39.00	19.0	3.1	5545.7	6102.1	0.0	.I
40.00	19.0	3.2	5545.7	6103.4	0.0	.I
41.00	19.0	3.3	5545.8	6104.7	0.0	.I
42.00	19.0	3.4	5545.8	6106.0	0.0	.I
43.00	19.0	3.4	5545.8	6107.3	0.0	.I
44.00	19.0	3.5	5545.8	6108.6	0.0	.I
45.00	20.0	3.6	5545.8	6109.9	0.0	.I
46.00	20.0	3.7	5545.8	6111.3	0.0	.I
47.00	20.0	3.8	5545.8	6112.6	0.0	.I
48.00	20.0	3.9	5545.8	6114.0	0.0	.I
49.00	20.0	4.0	5545.8	6115.3	0.0	.I
50.00	20.0	4.0	5545.8	6116.6	0.0	.I
51.00	21.0	4.1	5545.8	6118.0	0.0	.I
52.00	21.0	4.2	5545.8	6119.4	0.0	.I
53.00	21.0	4.3	5545.8	6120.7	0.0	.I
54.00	21.0	4.4	5545.8	6122.1	0.0	.I
55.00	21.0	4.5	5545.9	6123.5	0.0	.I
56.00	21.0	4.6	5545.9	6124.8	0.0	.I
57.00	22.0	4.7	5545.9	6126.2	0.0	.I
58.00	22.0	4.8	5545.9	6127.7	0.0	.I
59.00	22.0	4.9	5545.9	6129.1	0.0	.I
60.00	22.0	5.0	5545.9	6130.5	0.0	.I
61.00	23.0	5.1	5545.9	6131.9	0.0	.I
62.00	23.0	5.2	5545.9	6133.4	0.0	.I
63.00	23.0	5.2	5545.9	6134.9	0.0	.I
64.00	23.0	5.3	5545.9	6136.4	0.0	.I
65.00	24.0	5.4	5545.9	6137.8	0.0	.I
66.00	24.0	5.5	5545.9	6139.4	0.0	.I
67.00	24.0	5.6	5545.9	6140.9	0.0	.I
68.00	24.0	5.7	5545.9	6142.4	0.0	.I
69.00	25.0	5.8	5546.0	6144.0	0.0	.I
70.00	25.0	5.9	5546.0	6145.5	0.0	.I
71.00	25.0	6.1	5546.0	6147.1	0.0	.I
72.00	26.0	6.2	5546.0	6148.7	0.0	.I
73.00	26.0	6.3	5546.0	6150.3	0.0	.I
74.00	26.0	6.4	5546.0	6152.0	0.0	.I
75.00	27.0	6.5	5546.0	6153.6	0.0	.I
76.00	27.0	6.6	5546.0	6155.3	0.0	.I
77.00	27.0	6.7	5546.0	6157.0	0.0	.I
78.00	28.0	6.8	5546.0	6158.7	0.0	.I

79.00	28.0	6.9	5546.0	6160.5	0.0	.I
80.00	29.0	7.0	5546.0	6162.2	0.0	.I
81.00	29.0	7.2	5546.1	6164.1	0.0	.I
82.00	29.0	7.3	5546.1	6165.9	0.0	.I
83.00	30.0	7.4	5546.1	6167.7	0.0	. I
84.00	30.0	7.5	5546.1	6169.5	0.0	. I
85.00	31.0	7.7	5546.1	6171.4	0.0	. I
86.00	31.0	7.8	5546.1	6173.4	0.0	. I
87.00	32.0	7.9	5546.1	6175.3	0.0	. I
88.00	33.0	8.0	5546.1	6177.3	0.0	. I
89.00	33.0	8.2	5546.1	6179.4	0.0	. I
90.00	34.0	8.3	5546.1	6181.5	0.0	. I
91.00	35.0	8.5	5546.2	6183.6	0.0	. I
92.00	35.0	8.6	5546.2	6185.8	0.0	. I
93.00	36.0	8.7	5546.2	6188.1	0.0	. I
94.00	37.0	8.9	5546.2	6190.3	0.0	. I
95.00	38.0	9.0	5546.2	6192.7	0.0	. I
96.00	39.0	9.2	5546.2	6195.1	0.0	. I
97.00	40.0	9.4	5546.2	6197.6	0.0	. I
98.00	41.0	9.5	5546.2	6200.2	0.0	. I
99.00	42.0	9.7	5546.3	6202.8	0.0	. I
100.00	43.0	9.9	5546.3	6205.5	0.0	. I
101.00	45.0	10.1	5546.3	6208.3	0.0	.PI
102.00	46.0	10.3	5546.3	6211.3	0.0	.PI
103.00	48.0	10.5	5546.3	6214.3	0.0	.PI
104.00	49.0	10.7	5546.3	6217.4	0.0	.PI
105.00	51.0	10.9	5546.3	6220.7	0.0	.P I
106.00	53.0	11.1	5546.4	6224.0	0.0	.P I
107.00	56.0	11.3	5546.4	6227.6	0.0	.P I
108.00	58.0	11.6	5546.4	6231.4	0.0	.P I
109.00	61.0	11.9	5546.4	6235.3	0.0	.P I
110.00	65.0	12.1	5546.4	6239.5	0.0	.P I
111.00	69.0	12.4	5546.5	6244.1	0.0	.P I
112.00	74.0	12.7	5546.5	6248.9	0.0	.P I
113.00	80.0	13.1	5546.5	6254.2	0.0	.P I
114.00	87.0	13.5	5546.5	6260.0	0.0	.P I
115.00	96.0	13.9	5546.6	6266.5	0.0	.P I
116.00	109.0	14.4	5546.6	6273.8	0.0	.P I
117.00	127.0	14.9	5546.7	6282.3	0.0	.P I
118.00	157.0	15.6	5546.7	6292.8	0.0	.P I
119.00	219.0	17.3	5546.8	6307.0	0.0	.P I
120.00	850.0	22.4	5547.0	6349.5	0.0	.P
121.00	479.0	28.7	5547.3	6402.3	0.0	.P I
122.00	259.0	32.1	5547.4	6430.3	0.0	. P I
123.00	172.0	33.9	5547.5	6445.4	0.0	. P I
124.00	132.0	35.1	5547.5	6455.1	0.0	. P I
125.00	111.0	35.9	5547.6	6462.2	0.0	. P I
126.00	98.0	36.6	5547.6	6467.8	0.0	. P I
127.00	88.0	37.2	5547.6	6472.5	0.0	. P I
128.00	81.0	37.6	5547.7	6476.4	0.0	. P I
129.00	75.0	38.0	5547.7	6479.7	0.0	. P I
130.00	70.0	38.4	5547.7	6482.5	0.0	. P I
131.00	65.0	38.7	5547.7	6484.9	0.0	. PI
132.00	62.0	38.9	5547.7	6487.0	0.0	. PI
133.00	59.0	39.1	5547.7	6488.7	0.0	. PI
134.00	56.0	39.3	5547.7	6490.2	0.0	. PI
135.00	54.0	39.4	5547.7	6491.5	0.0	. PI
136.00	51.0	39.6	5547.7	6492.6	0.0	. PI
137.00	50.0	39.7	5547.7	6493.5	0.0	. PI

138.00	48.0	39.8	5547.7	6494.3	0.0	. P
139.00	46.0	39.8	5547.7	6494.9	0.0	. P
140.00	45.0	39.9	5547.8	6495.3	0.0	. P
141.00	43.0	39.9	5547.8	6495.7	0.0	. P
142.00	42.0	40.0	5547.8	6495.9	0.0	. P
143.00	41.0	40.0	5547.8	6496.0	0.0	. P
144.00	40.0	40.0	5547.8	6496.1	0.0	. X
145.00	39.0	40.0	5547.8	6496.0	0.0	. P
146.00	38.0	40.0	5547.8	6495.9	0.0	. P
147.00	37.0	39.9	5547.8	6495.7	0.0	. P
148.00	36.0	39.9	5547.8	6495.4	0.0	. P
149.00	35.0	39.9	5547.8	6495.0	0.0	. P
150.00	35.0	39.8	5547.7	6494.6	0.0	. P
151.00	34.0	39.8	5547.7	6494.2	0.0	. P
152.00	33.0	39.7	5547.7	6493.7	0.0	. P
153.00	33.0	39.6	5547.7	6493.1	0.0	. P
154.00	32.0	39.6	5547.7	6492.6	0.0	. P
155.00	32.0	39.5	5547.7	6491.9	0.0	. P
156.00	31.0	39.4	5547.7	6491.3	0.0	. P
157.00	30.0	39.3	5547.7	6490.5	0.0	. P
158.00	30.0	39.2	5547.7	6489.8	0.0	. P
159.00	29.0	39.1	5547.7	6489.0	0.0	.IP
160.00	29.0	39.0	5547.7	6488.1	0.0	.IP
161.00	29.0	38.9	5547.7	6487.3	0.0	.IP
162.00	28.0	38.8	5547.7	6486.5	0.0	.IP
163.00	28.0	38.7	5547.7	6485.6	0.0	.IP
164.00	27.0	38.6	5547.7	6484.6	0.0	.IP
165.00	27.0	38.5	5547.7	6483.7	0.0	.IP
166.00	27.0	38.4	5547.7	6482.7	0.0	.IP
167.00	26.0	38.3	5547.7	6481.8	0.0	.IP
168.00	26.0	38.1	5547.7	6480.8	0.0	.IP
169.00	26.0	38.0	5547.7	6479.8	0.0	.IP
170.00	25.0	37.9	5547.7	6478.7	0.0	.IP
171.00	25.0	37.8	5547.7	6477.7	0.0	.IP
172.00	25.0	37.7	5547.7	6476.6	0.0	.IP
173.00	24.0	37.5	5547.7	6475.5	0.0	.IP
174.00	24.0	37.4	5547.6	6474.4	0.0	.IP
175.00	24.0	37.3	5547.6	6473.3	0.0	.IP
176.00	24.0	37.1	5547.6	6472.2	0.0	.IP
177.00	23.0	37.0	5547.6	6471.1	0.0	.IP
178.00	23.0	36.9	5547.6	6470.0	0.0	.IP
179.00	23.0	36.7	5547.6	6468.8	0.0	.IP
180.00	23.0	36.6	5547.6	6467.7	0.0	.IP
181.00	22.0	36.4	5547.6	6466.5	0.0	.IP
182.00	22.0	36.3	5547.6	6465.3	0.0	.IP
183.00	22.0	36.2	5547.6	6464.2	0.0	.IP
184.00	22.0	36.0	5547.6	6463.0	0.0	.IP
185.00	22.0	35.9	5547.6	6461.8	0.0	.IP
186.00	21.0	35.7	5547.6	6460.7	0.0	.IP
187.00	21.0	35.6	5547.6	6459.5	0.0	.IP
188.00	21.0	35.4	5547.6	6458.3	0.0	.IP
189.00	21.0	35.3	5547.6	6457.1	0.0	.IP
190.00	21.0	35.2	5547.6	6455.9	0.0	.IP
191.00	20.0	35.0	5547.5	6454.7	0.0	.IP
192.00	20.0	34.9	5547.5	6453.4	0.0	.IP
193.00	20.0	34.7	5547.5	6452.2	0.0	.IP
194.00	20.0	34.6	5547.5	6451.0	0.0	.IP
195.00	20.0	34.4	5547.5	6449.8	0.0	.IP
196.00	20.0	34.3	5547.5	6448.6	0.0	.IP

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197.00  19.0  34.1 5547.5  6447.4   0.0          .IP
198.00  19.0  34.0 5547.5  6446.2   0.0          .IP
199.00  19.0  33.8 5547.5  6444.9   0.0          .IP
200.00  19.0  33.7 5547.5  6443.7   0.0          .IP
201.00  19.0  33.6 5547.5  6442.5   0.0          .IP
202.00  19.0  33.4 5547.5  6441.3   0.0          .IP
203.00  19.0  33.3 5547.5  6440.1   0.0          .IP
204.00  18.0  33.1 5547.5  6438.9   0.0          .IP
205.00  18.0  33.0 5547.5  6437.7   0.0          .IP
206.00  18.0  32.8 5547.5  6436.4   0.0          .IP
207.00  18.0  32.7 5547.4  6435.2   0.0          .IP
208.00  18.0  32.5 5547.4  6434.0   0.0          .IP
209.00  18.0  32.4 5547.4  6432.8   0.0          .IP
210.00  18.0  32.2 5547.4  6431.6   0.0          .IP
211.00  17.0  32.1 5547.4  6430.4   0.0          .IP
212.00  17.0  32.0 5547.4  6429.2   0.0          .IP
213.00  17.0  31.8 5547.4  6427.9   0.0          .IP
214.00  17.0  31.7 5547.4  6426.7   0.0          .IP
215.00  17.0  31.5 5547.4  6425.5   0.0          .IP
216.00  17.0  31.4 5547.4  6424.3   0.0          .IP
217.00  17.0  31.2 5547.4  6423.1   0.0          .IP
218.00  17.0  31.1 5547.4  6422.0   0.0          .IP
219.00  17.0  30.9 5547.4  6420.8   0.0          .IP
220.00  17.0  30.8 5547.4  6419.7   0.0          .IP
221.00  16.0  30.7 5547.4  6418.5   0.0          .IP
222.00  16.0  30.5 5547.4  6417.3   0.0          .IP
223.00  16.0  30.4 5547.3  6416.1   0.0          .IP
224.00  16.0  30.2 5547.3  6414.9   0.0          .IP
225.00  16.0  30.1 5547.3  6413.7   0.0          .IP
226.00  16.0  30.0 5547.3  6412.6   0.0          .P
227.00  16.0  29.8 5547.3  6411.4   0.0          .P
228.00  16.0  29.7 5547.3  6410.3   0.0          .P
229.00  16.0  29.5 5547.3  6409.2   0.0          .P
230.00  16.0  29.4 5547.3  6408.1   0.0          .P
231.00  15.0  29.3 5547.3  6406.9   0.0          .P
232.00  15.0  29.1 5547.3  6405.7   0.0          .P
233.00  15.0  29.0 5547.3  6404.6   0.0          .P
234.00  15.0  28.9 5547.3  6403.4   0.0          .P
235.00  15.0  28.7 5547.3  6402.3   0.0          .P
236.00  15.0  28.6 5547.3  6401.2   0.0          .P
237.00  15.0  28.5 5547.3  6400.0   0.0          .P
238.00  15.0  28.3 5547.3  6398.9   0.0          .P
239.00  15.0  28.2 5547.3  6397.8   0.0          .P
 Time    Qin  Qout   Elev    Vol   Area  ExtVel  I          I          I          I          I
                                                 0.       200.       400.       600.       800
        END NRCS-PSH   PLOT


**********************************************************************************
RATING TABLE DEVELOPED, SITE = STR1 :
 BY PROGRAM FOR PS AND AUX. SPILLWAYS
 AUX. RATING USED WSPVRT METHOD.


RATING TABLE NUMBER  1
       ELEV.    Q-TOTAL    Q-PS     Q-AUX.    VOLUME     AREA
       FEET       CFS       CFS       CFS      AC-FT     ACRE
  1  5545.50      0.00      0.00      0.00   6055.03      0.00
  2  5546.72     15.71     15.71      0.00   6294.00      0.00
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   3  5547.94     44.43     44.43      0.00   6532.97      0.00
   4  5549.17     81.62     81.62      0.00   6771.95      0.00
                                                FULL CONDUIT FLOW, ELEV = 5550.39 FT
   5  5550.39    125.65    125.65      0.00   7015.04      0.00
   6  5550.65    125.84    125.84      0.00   7069.39      0.00
   7  5550.92    126.01    126.01      0.00   7123.74      0.00
   8  5551.18    126.17    126.17      0.00   7178.09      0.00
   9  5551.44    126.34    126.34      0.00   7232.44      0.00
  10  5551.71    126.50    126.50      0.00   7286.79      0.00
  11  5551.97    126.67    126.67      0.00   7341.14      0.00
  12  5552.23    126.83    126.83      0.00   7395.49      0.00
  13  5552.50    126.99    126.99      0.00   7449.85      0.00

 INFLOW HYDROGRAPH PROVIDED IN LOCATION  3,  PEAK=   2180.00 CFS, AT   3.30 HRS.
 TITLE = Auxiliary Spillway (Local)


 INFLOW HYDROGRAPH PROVIDED IN LOCATION  5,  PEAK=   3365.00 CFS, AT   9.60 HRS.
 TITLE = Freeboard (General)



1SITES ------------------------------------------------------------------------
 XEQ 08/28/2020                    COV RES                          WSID= COVRES
 VER 2005.1.8                       Cove Res                          SUBW= CR
 TIME 16:21:21           SITE = STR1              PASS=    1     PART=   4


 AUX. CREST     5548.51 FT    6644.1 ACFT      0.00 AC      61.7 CFS

      PS STORAGE    589.1 ACFT,  BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

 START ELEV     5546.26 FT    6203.0 ACFT      0.00 AC       9.7 CFS

 ***** WARNING - AUXILIARY CREST LOWER THAN LOW POINT IN SITE.

 NRCS-SDH   INFLOW HYDROGRAPH INPUT, DA =    4.74 SQUARE MILES

      PEAK =      2180.0 CFS, AT    3.3 HRS.

 NRCS-FBH   INFLOW HYDROGRAPH INPUT, DA =    4.74 SQUARE MILES

      PEAK =      3365.0 CFS, AT    9.6 HRS.

 ***** WARNING - MAXIMUM AUX. SURFACE PROFILE ELEVATION ( 5549.20) AND AUXILIARY
                 CREST ( 5548.51) ELEVATION Do NOT MATCH.  MAXIMUM AUX. SURFACE
                 PROFILE ELEVATION USED IN WSPVRT PROCEDURE.


 ***** MESSAGE - INPUT(5549.14) TO INTERPOLATION ROUTINE IS BELOW
                 ARRAY LIMIT(5549.20).


 ********************************************************************************
 RATING TABLE DEVELOPED, SITE = STR1 :
  BY PROGRAM FOR PS AND AUX. SPILLWAYS
  AUX. RATING USED WSPVRT METHOD.
```

RATING TABLE NUMBER 2

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE	
1	5545.50	0.00	0.00	0.00	6055.03	0.00	
2	5545.83	2.25	2.25	0.00	6120.52	0.00	
3	5546.17	6.37	6.37	0.00	6186.02	0.00	
4	5546.50	11.71	11.71	0.00	6251.52	0.00	
5	5546.84	18.03	18.03	0.00	6317.01	0.00	
6	5547.17	25.20	25.20	0.00	6382.51	0.00	
7	5547.51	33.12	33.12	0.00	6448.00	0.00	
8	5547.84	41.74	41.74	0.00	6513.50	0.00	
9	5548.18	50.99	50.99	0.00	6578.99	0.00	
10	5548.51	60.85	60.85	0.00	6644.49	0.00	
11	5549.14	80.67	80.67	0.00	6766.41	0.00	
12	5549.76	128.97	102.35	26.63	6888.71	0.00	
					FULL CONDUIT FLOW, ELEV = 5550.39 FT		
13	5550.39	227.03	125.67	101.36	7015.14	0.00	
14	5550.49	242.46	125.75	116.71	7036.88	0.00	
15	5550.60	260.89	125.81	135.07	7058.62	0.00	
16	5550.79	295.79	125.93	169.86	7097.77	0.00	
17	5551.02	338.51	126.08	212.44	7145.68	0.00	
18	5551.44	429.26	126.34	302.92	7232.64	0.00	
19	5551.97	558.86	126.67	432.19	7341.44	0.00	
20	5552.50	706.93	126.99	579.94	7450.25	0.00	

****

SUMMARY OF AUXILIARY SPILLWAY SURFACE CONDITIONS USED IN COMPUTATIONS BY REACH

REACH	FROM STA (ft)	TO STA (ft)	SLOPE (%)	RETARDANCE CURVE INDEX@	VEGETAL COVER FACTOR	MAINT. CODE +	ROOTING DEPTH (ft)	REACH LOCATION *
1	0.	75.	-25.6	0.025	**	**	**	INLET
2	75.	115.	0.0	0.025	**	**	**	CREST
3	115.	475.	15.4	0.025	0.00	1		EXIT !
4	475.	610.	8.5	0.025	0.00	1		EXIT
5	610.	1057.	6.6	0.025	0.00	1		EXIT
6	1057.	1153.	15.6	0.025	0.00	1		EXIT

@ The program interprets retardance curve index entries of less than 1 as Manning's n values.
+ The minimum maintenance code value of 2 is used in INTEGRITY computations (the program changes values of 1 to 2 during computation).
* Upper case indicates a reach of constructed spillway channel.
** The program does not use vegetal cover factor, maintenance code, and rooting depth for inlet and crest reaches in computations.
! Reach 3 used in computing exit channel velocities.

****

```
HYD       AO              4.74Cove Res                                    COVRES  1
          0             0.3000                                            STR1    2
                          7.76      7.76      7.79      8.01      8.88   AO D  3
                         10.93     14.81     20.04     25.63     31.00   AO D  4
                         35.80     40.07     43.92     47.45     50.65   AO D  5
                         53.79     56.77     59.50     61.84     63.63   AO D  6
                         64.79     65.46     65.79     65.90     65.87   AO D  7
                         65.76     65.58     65.37     65.13     64.89   AO D  8
                         64.63     64.38     64.12     63.87     63.62   AO D  9
                         63.36     63.11     62.86     62.62     62.37   AO D 10
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62.12     61.87     61.63     61.39     61.14   AO D 11
60.90     60.67     60.45     60.23     60.01   AO D 12
59.79     59.57     59.35     59.14     58.92   AO D 13
58.70     58.49     58.27     58.06     57.85   AO D 14
57.64     57.43     57.22     57.01     56.80   AO D 15
56.59     56.38     56.18     55.97     55.77   AO D 16
55.56     55.36     55.16     54.96     54.76   AO D 17
54.56     54.36     54.16     53.96     53.76   AO D 18
53.57     53.37     53.17     52.98     52.79   AO D 19
52.59     52.40     52.21     52.02     51.83   AO D 20
51.64     51.45     51.26     51.08     50.90   AO D 21
50.72     50.55     50.38     50.20     50.03   AO D 22
49.86     49.69     49.52     49.35     49.18   AO D 23
49.01     48.84     48.68     48.51     48.34   AO D 24
48.18     48.01     47.85     47.68     47.52   AO D 25
47.36     47.20     47.03     46.87     46.71   AO D 26
46.55     46.39     46.23     46.08     45.92   AO D 27
45.76     45.60     45.45     45.29     45.14   AO D 28
44.98     44.83     44.68     44.52     44.37   AO D 29
44.22     44.07     43.92     43.77     43.62   AO D 30
43.47     43.32     43.17     43.03     42.88   AO D 31
42.73     42.59     42.44     42.30     42.15   AO D 32
42.01     41.86     41.72     41.59     41.46   AO D 33
41.33     41.19     41.06     40.93     40.80   AO D 34
40.67     40.54     40.41     40.29     40.16   AO D 35
40.03     39.90     39.78     39.65     39.53   AO D 36
39.40     39.27     39.15     39.03     38.90   AO D 37
38.78     38.66     38.53     38.41     38.29   AO D 38
38.17     38.05     37.93     37.81     37.69   AO D 39
37.57     37.45     37.33     37.21     37.09   AO D 40
36.97     36.86     36.74     36.62     36.51   AO D 41
36.39     36.28     36.16     36.05     35.93   AO D 42
35.82     35.71     35.59     35.48     35.37   AO D 43
35.26     35.15     35.03     34.92     34.81   AO D 44
34.70     34.59     34.48     34.37     34.27   AO D 45
34.16     34.05     33.94     33.83     33.73   AO D 46
33.62     33.51     33.41     33.30     33.20   AO D 47
33.10     33.00     32.90     32.81     32.71   AO D 48
32.62     32.52     32.43     32.33     32.24   AO D 49
32.15     32.05     31.96     31.87     31.78   AO D 50
31.68     31.59     31.50     31.41     31.32   AO D 51
31.23     31.14     31.05     30.96     30.87   AO D 52
30.78     30.69     30.60     30.51     30.42   AO D 53
30.33     30.25     30.16     30.07     29.98   AO D 54
29.90     29.81     29.72     29.64     29.55   AO D 55
29.47     29.38     29.30     29.21     29.13   AO D 56
29.04     28.96     28.87     28.79     28.71   AO D 57
28.62     28.54     28.46     28.38     28.30   AO D 58
28.21     28.13     28.05     27.97     27.89   AO D 59
27.81     27.73     27.65     27.57     27.49   AO D 60
27.41     27.33     27.25     27.17     27.09   AO D 61
27.02     26.94     26.86     26.78     26.71   AO D 62
26.63     26.55     26.48     26.40     26.32   AO D 63
26.25     26.17     26.10     26.02     25.95   AO D 64
25.87     25.80     25.72     25.65     25.57   AO D 65
25.50     25.43     25.35     25.28     25.21   AO D 66
ENDTABLE                                        P 1,T 2 67
```

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-SDH	30.0	5548.67	6675.5	0.0	0.16	31.0

PEAK - CFS	Q-PS	Q-AUX.	Q-TOT.
DISCHARGE =	65.7	0.2	65.9

AUXILIARY	CRITICAL DEPTH FT	CRITICAL VELOCITY FT/SEC	CRITICAL SLOPE-Sc FT/FT	25% OF Q Sc FT/FT
SPILLWAY ---	0.01	0.57	0.039	0.054

AUXILIARY SPILLWAY DURATION FLOW = 8.7 HOURS

***** MESSAGE - MAX. DISCHARGE OF 0. CFS IS BELOW CREST AUXILIARY SPILLWAY. NO STABILITY STRESS COMPUTED.

PLOT NRCS-SDH 1 IN = 500. CFS

Time	Qin	Qout	Elev	Vol	Area	ExtVel	0. 500. 1000. 1500. 2000
1.50	0	8	5546.3	6203.0	0.0	0.00	.
1.80	6	8	5546.3	6203.0	0.0	0.00	.
2.10	39	8	5546.3	6203.4	0.0	0.00	.I
2.40	194	8	5546.3	6206.1	0.0	0.00	. I
2.70	687	9	5546.3	6216.8	0.0	0.00	. I
3.00	1365	11	5546.5	6242.0	0.0	0.00	. I
3.30	2027	15	5546.7	6283.7	0.0	0.00	.
3.60	2180	20	5546.9	6335.4	0.0	0.00	.
3.90	1955	26	5547.2	6386.1	0.0	0.00	.P I
4.20	1683	31	5547.4	6430.5	0.0	0.00	.P I
4.50	1441	36	5547.6	6468.4	0.0	0.00	.P I
4.80	1248	40	5547.8	6500.8	0.0	0.00	.P I
5.10	1107	44	5547.9	6528.9	0.0	0.00	.P I
5.40	1001	47	5548.1	6553.9	0.0	0.00	.P I
5.70	924	51	5548.2	6576.6	0.0	0.00	.P I
6.00	874	54	5548.3	6597.6	0.0	0.00	.P I
6.30	833	57	5548.4	6617.4	0.0	0.00	.P I
6.60	748	60	5548.5	6635.5	0.0	0.00	.P I
6.90	589	62	5548.5	6650.6	0.0	0.00	.A I
7.20	423	64	5548.6	6661.6	0.0	0.00	.A I
7.50	283	65	5548.6	6668.8	0.0	0.00	.A I
7.80	180	65	5548.7	6672.9	0.0	0.00	.A I
8.10	112	66	5548.7	6674.9	0.0	0.00	.AI
8.40	73	66	5548.7	6675.5	0.0	0.00	.X
8.70	47	66	5548.7	6675.4	0.0	0.00	.A
9.00	28	66	5548.7	6674.7	0.0	0.00	.A
9.30	16	66	5548.7	6673.6	0.0	0.00	.A
9.60	9	65	5548.7	6672.3	0.0	0.00	.A
9.90	5	65	5548.6	6670.8	0.0	0.00	.A
10.20	3	65	5548.6	6669.3	0.0	0.00	.A
10.50	1	65	5548.6	6667.8	0.0	0.00	.A
10.80	1	64	5548.6	6666.2	0.0	0.00	.A
11.10	0	64	5548.6	6664.6	0.0	0.00	.A

11.40	0	64	5548.6	6663.1	0.0	0.00	.A
11.70	0	64	5548.6	6661.5	0.0	0.00	.A
12.00	0	63	5548.6	6660.0	0.0	0.00	.A
12.30	0	63	5548.6	6658.4	0.0	0.00	.A
12.60	0	63	5548.6	6656.9	0.0	0.00	.A
12.90	0	63	5548.6	6655.4	0.0	0.00	.A
13.20	0	62	5548.6	6653.8	0.0	0.00	.A
13.50	0	62	5548.6	6652.3	0.0	0.00	.A
13.80	0	62	5548.5	6650.8	0.0	0.00	.A
14.10	0	62	5548.5	6649.3	0.0	0.00	.A
14.40	0	61	5548.5	6647.8	0.0	0.00	.A
14.70	0	61	5548.5	6646.3	0.0	0.00	.A
15.00	0	61	5548.5	6644.8	0.0	0.00	.A
15.30	0	61	5548.5	6643.3	0.0	0.00	.P
15.60	0	60	5548.5	6641.9	0.0	0.00	.P
15.90	0	60	5548.5	6640.4	0.0	0.00	.P
16.20	0	60	5548.5	6638.9	0.0	0.00	.P
16.50	0	60	5548.5	6637.5	0.0	0.00	.P
16.80	0	60	5548.5	6636.0	0.0	0.00	.P
17.10	0	59	5548.5	6634.5	0.0	0.00	.P
17.40	0	59	5548.5	6633.1	0.0	0.00	.P
17.70	0	59	5548.4	6631.7	0.0	0.00	.P
18.00	0	59	5548.4	6630.2	0.0	0.00	.P
18.30	0	58	5548.4	6628.8	0.0	0.00	.P
18.60	0	58	5548.4	6627.4	0.0	0.00	.P
18.90	0	58	5548.4	6626.0	0.0	0.00	.P
19.20	0	58	5548.4	6624.6	0.0	0.00	.P
19.50	0	58	5548.4	6623.1	0.0	0.00	.P
19.80	0	57	5548.4	6621.7	0.0	0.00	.P
20.10	0	57	5548.4	6620.3	0.0	0.00	.P
20.40	0	57	5548.4	6619.0	0.0	0.00	.P
20.70	0	57	5548.4	6617.6	0.0	0.00	.P
21.00	0	57	5548.4	6616.2	0.0	0.00	.P
21.30	0	56	5548.4	6614.8	0.0	0.00	.P
21.60	0	56	5548.4	6613.4	0.0	0.00	.P
21.90	0	56	5548.3	6612.1	0.0	0.00	.P
22.20	0	56	5548.3	6610.7	0.0	0.00	.P
22.50	0	56	5548.3	6609.4	0.0	0.00	.P
22.80	0	55	5548.3	6608.0	0.0	0.00	.P
23.10	0	55	5548.3	6606.7	0.0	0.00	.P
23.40	0	55	5548.3	6605.3	0.0	0.00	.P
23.70	0	55	5548.3	6604.0	0.0	0.00	.P
24.00	0	55	5548.3	6602.7	0.0	0.00	.P
24.30	0	54	5548.3	6601.3	0.0	0.00	.P
24.60	0	54	5548.3	6600.0	0.0	0.00	.P
24.90	0	54	5548.3	6598.7	0.0	0.00	.P
25.20	0	54	5548.3	6597.4	0.0	0.00	.P
25.50	0	54	5548.3	6596.1	0.0	0.00	.P
25.80	0	53	5548.3	6594.8	0.0	0.00	.P
26.10	0	53	5548.3	6593.5	0.0	0.00	.P
26.40	0	53	5548.2	6592.2	0.0	0.00	.P
26.70	0	53	5548.2	6590.9	0.0	0.00	.P
27.00	0	53	5548.2	6589.6	0.0	0.00	.P
27.30	0	52	5548.2	6588.4	0.0	0.00	.P
27.60	0	52	5548.2	6587.1	0.0	0.00	.P
27.90	0	52	5548.2	6585.8	0.0	0.00	.P
28.20	0	52	5548.2	6584.5	0.0	0.00	.P
28.50	0	52	5548.2	6583.3	0.0	0.00	.P
28.80	0	51	5548.2	6582.0	0.0	0.00	.P

29.10	0	51	5548.2	6580.8	0.0	0.00	.P
29.40	0	51	5548.2	6579.5	0.0	0.00	.P
29.70	0	51	5548.2	6578.3	0.0	0.00	.P
30.00	0	51	5548.2	6577.1	0.0	0.00	.P
30.30	0	51	5548.2	6575.8	0.0	0.00	.P
30.60	0	50	5548.2	6574.6	0.0	0.00	.P
30.90	0	50	5548.2	6573.4	0.0	0.00	.P
31.20	0	50	5548.1	6572.2	0.0	0.00	.P
31.50	0	50	5548.1	6571.0	0.0	0.00	.P
31.80	0	50	5548.1	6569.8	0.0	0.00	.P
32.10	0	50	5548.1	6568.5	0.0	0.00	.P
32.40	0	49	5548.1	6567.3	0.0	0.00	.P
32.70	0	49	5548.1	6566.1	0.0	0.00	.P
33.00	0	49	5548.1	6565.0	0.0	0.00	.P
33.30	0	49	5548.1	6563.8	0.0	0.00	.P
33.60	0	49	5548.1	6562.6	0.0	0.00	.P
33.90	0	49	5548.1	6561.4	0.0	0.00	.P
34.20	0	48	5548.1	6560.2	0.0	0.00	.P
34.50	0	48	5548.1	6559.1	0.0	0.00	.P
34.80	0	48	5548.1	6557.9	0.0	0.00	.P
35.10	0	48	5548.1	6556.7	0.0	0.00	.P
35.40	0	48	5548.1	6555.6	0.0	0.00	.P
35.70	0	48	5548.1	6554.4	0.0	0.00	.P
36.00	0	47	5548.0	6553.3	0.0	0.00	.P
36.30	0	47	5548.0	6552.1	0.0	0.00	.P
36.60	0	47	5548.0	6551.0	0.0	0.00	.P
36.90	0	47	5548.0	6549.8	0.0	0.00	.P
37.20	0	47	5548.0	6548.7	0.0	0.00	.P
37.50	0	47	5548.0	6547.6	0.0	0.00	.P
37.80	0	46	5548.0	6546.4	0.0	0.00	.P
38.10	0	46	5548.0	6545.3	0.0	0.00	.P
38.40	0	46	5548.0	6544.2	0.0	0.00	.P
38.70	0	46	5548.0	6543.1	0.0	0.00	.P
39.00	0	46	5548.0	6542.0	0.0	0.00	.P
39.30	0	46	5548.0	6540.9	0.0	0.00	.P
39.60	0	45	5548.0	6539.8	0.0	0.00	.P
39.90	0	45	5548.0	6538.7	0.0	0.00	.P
40.20	0	45	5548.0	6537.6	0.0	0.00	.P
40.50	0	45	5548.0	6536.5	0.0	0.00	.P
40.80	0	45	5548.0	6535.4	0.0	0.00	.P
41.10	0	45	5548.0	6534.3	0.0	0.00	.P
41.40	0	45	5547.9	6533.2	0.0	0.00	.P
41.70	0	44	5547.9	6532.1	0.0	0.00	.P
42.00	0	44	5547.9	6531.1	0.0	0.00	.P
42.30	0	44	5547.9	6530.0	0.0	0.00	.P
42.60	0	44	5547.9	6528.9	0.0	0.00	.P
42.90	0	44	5547.9	6527.9	0.0	0.00	.P
43.20	0	44	5547.9	6526.8	0.0	0.00	.P
43.50	0	43	5547.9	6525.7	0.0	0.00	.P
43.80	0	43	5547.9	6524.7	0.0	0.00	.P
44.10	0	43	5547.9	6523.6	0.0	0.00	.P
44.40	0	43	5547.9	6522.6	0.0	0.00	.P
44.70	0	43	5547.9	6521.6	0.0	0.00	.P
45.00	0	43	5547.9	6520.5	0.0	0.00	.P
45.30	0	43	5547.9	6519.5	0.0	0.00	.P
45.60	0	42	5547.9	6518.5	0.0	0.00	.P
45.90	0	42	5547.9	6517.4	0.0	0.00	.P
46.20	0	42	5547.9	6516.4	0.0	0.00	.P
46.50	0	42	5547.9	6515.4	0.0	0.00	.P

46.80	0	42	5547.8	6514.4	0.0	0.00	.P
47.10	0	42	5547.8	6513.4	0.0	0.00	.P
47.40	0	42	5547.8	6512.4	0.0	0.00	.P
47.70	0	41	5547.8	6511.4	0.0	0.00	.P
48.00	0	41	5547.8	6510.4	0.0	0.00	.P
48.30	0	41	5547.8	6509.4	0.0	0.00	.P
48.60	0	41	5547.8	6508.4	0.0	0.00	.P
48.90	0	41	5547.8	6507.4	0.0	0.00	.P
49.20	0	41	5547.8	6506.4	0.0	0.00	.P
49.50	0	41	5547.8	6505.4	0.0	0.00	.P
49.80	0	41	5547.8	6504.4	0.0	0.00	.P
50.10	0	40	5547.8	6503.4	0.0	0.00	.P
50.40	0	40	5547.8	6502.5	0.0	0.00	.P
50.70	0	40	5547.8	6501.5	0.0	0.00	.P
51.00	0	40	5547.8	6500.5	0.0	0.00	.P
51.30	0	40	5547.8	6499.6	0.0	0.00	.P
51.60	0	40	5547.8	6498.6	0.0	0.00	.P
51.90	0	40	5547.8	6497.6	0.0	0.00	.P
52.20	0	40	5547.8	6496.7	0.0	0.00	.P
52.50	0	39	5547.8	6495.7	0.0	0.00	.P
52.80	0	39	5547.7	6494.8	0.0	0.00	.P
53.10	0	39	5547.7	6493.8	0.0	0.00	.P
53.40	0	39	5547.7	6492.9	0.0	0.00	.P
53.70	0	39	5547.7	6491.9	0.0	0.00	.P
54.00	0	39	5547.7	6491.0	0.0	0.00	.P
54.30	0	39	5547.7	6490.1	0.0	0.00	.P
54.60	0	39	5547.7	6489.1	0.0	0.00	.P
54.90	0	38	5547.7	6488.2	0.0	0.00	.P
55.20	0	38	5547.7	6487.3	0.0	0.00	.P
55.50	0	38	5547.7	6486.4	0.0	0.00	.P
55.80	0	38	5547.7	6485.4	0.0	0.00	.P
56.10	0	38	5547.7	6484.5	0.0	0.00	.P
56.40	0	38	5547.7	6483.6	0.0	0.00	.P
56.70	0	38	5547.7	6482.7	0.0	0.00	.P
57.00	0	38	5547.7	6481.8	0.0	0.00	.P
57.30	0	37	5547.7	6480.9	0.0	0.00	.P
57.60	0	37	5547.7	6480.0	0.0	0.00	.P
57.90	0	37	5547.7	6479.1	0.0	0.00	.P
58.20	0	37	5547.7	6478.2	0.0	0.00	.P
58.50	0	37	5547.7	6477.3	0.0	0.00	.P
58.80	0	37	5547.7	6476.4	0.0	0.00	.P
59.10	0	37	5547.7	6475.5	0.0	0.00	.P
59.40	0	37	5547.6	6474.6	0.0	0.00	.P
59.70	0	37	5547.6	6473.7	0.0	0.00	.P
60.00	0	36	5547.6	6472.9	0.0	0.00	.P
60.30	0	36	5547.6	6472.0	0.0	0.00	.P
60.60	0	36	5547.6	6471.1	0.0	0.00	.P
60.90	0	36	5547.6	6470.2	0.0	0.00	.P
61.20	0	36	5547.6	6469.4	0.0	0.00	.P
61.50	0	36	5547.6	6468.5	0.0	0.00	.P
61.80	0	36	5547.6	6467.7	0.0	0.00	.P
62.10	0	36	5547.6	6466.8	0.0	0.00	.P
62.40	0	35	5547.6	6465.9	0.0	0.00	.P
62.70	0	35	5547.6	6465.1	0.0	0.00	.P
63.00	0	35	5547.6	6464.2	0.0	0.00	.P
63.30	0	35	5547.6	6463.4	0.0	0.00	.P
63.60	0	35	5547.6	6462.5	0.0	0.00	.P
63.90	0	35	5547.6	6461.7	0.0	0.00	.P
64.20	0	35	5547.6	6460.9	0.0	0.00	.P

64.50	0	35	5547.6	6460.0	0.0	0.00	.P
64.80	0	35	5547.6	6459.2	0.0	0.00	.P
65.10	0	34	5547.6	6458.4	0.0	0.00	.P
65.40	0	34	5547.6	6457.5	0.0	0.00	.P
65.70	0	34	5547.6	6456.7	0.0	0.00	.P
66.00	0	34	5547.5	6455.9	0.0	0.00	.P
66.30	0	34	5547.5	6455.1	0.0	0.00	.P
66.60	0	34	5547.5	6454.2	0.0	0.00	.P
66.90	0	34	5547.5	6453.4	0.0	0.00	.P
67.20	0	34	5547.5	6452.6	0.0	0.00	.P
67.50	0	34	5547.5	6451.8	0.0	0.00	.P
67.80	0	34	5547.5	6451.0	0.0	0.00	.P
68.10	0	33	5547.5	6450.2	0.0	0.00	.P
68.40	0	33	5547.5	6449.4	0.0	0.00	.P
68.70	0	33	5547.5	6448.6	0.0	0.00	.P
69.00	0	33	5547.5	6447.8	0.0	0.00	.P
69.30	0	33	5547.5	6447.0	0.0	0.00	.P
69.60	0	33	5547.5	6446.2	0.0	0.00	.P
69.90	0	33	5547.5	6445.4	0.0	0.00	.P
70.20	0	33	5547.5	6444.6	0.0	0.00	.P
70.50	0	33	5547.5	6443.8	0.0	0.00	.P
70.80	0	33	5547.5	6443.1	0.0	0.00	.P
71.10	0	32	5547.5	6442.3	0.0	0.00	.P
71.40	0	32	5547.5	6441.5	0.0	0.00	.P
71.70	0	32	5547.5	6440.7	0.0	0.00	.P
72.00	0	32	5547.5	6439.9	0.0	0.00	.P
72.30	0	32	5547.5	6439.2	0.0	0.00	.P
72.60	0	32	5547.5	6438.4	0.0	0.00	.P
72.90	0	32	5547.5	6437.6	0.0	0.00	.P
73.20	0	32	5547.5	6436.9	0.0	0.00	.P
73.50	0	32	5547.4	6436.1	0.0	0.00	.P
73.80	0	32	5547.4	6435.4	0.0	0.00	.P
74.10	0	31	5547.4	6434.6	0.0	0.00	.P
74.40	0	31	5547.4	6433.8	0.0	0.00	.P
74.70	0	31	5547.4	6433.1	0.0	0.00	.P
75.00	0	31	5547.4	6432.3	0.0	0.00	.P
75.30	0	31	5547.4	6431.6	0.0	0.00	.P
75.60	0	31	5547.4	6430.8	0.0	0.00	.P
75.90	0	31	5547.4	6430.1	0.0	0.00	.P
76.20	0	31	5547.4	6429.4	0.0	0.00	.P
76.50	0	31	5547.4	6428.6	0.0	0.00	.P
76.80	0	31	5547.4	6427.9	0.0	0.00	.P
77.10	0	31	5547.4	6427.1	0.0	0.00	.P
77.40	0	31	5547.4	6426.4	0.0	0.00	.P
77.70	0	30	5547.4	6425.7	0.0	0.00	.P
78.00	0	30	5547.4	6425.0	0.0	0.00	.P
78.30	0	30	5547.4	6424.2	0.0	0.00	.P
78.60	0	30	5547.4	6423.5	0.0	0.00	.P
78.90	0	30	5547.4	6422.8	0.0	0.00	.P
79.20	0	30	5547.4	6422.1	0.0	0.00	.P
79.50	0	30	5547.4	6421.3	0.0	0.00	.P
79.80	0	30	5547.4	6420.6	0.0	0.00	.P
80.10	0	30	5547.4	6419.9	0.0	0.00	.P
80.40	0	30	5547.4	6419.2	0.0	0.00	.P
80.70	0	30	5547.4	6418.5	0.0	0.00	.P
81.00	0	29	5547.4	6417.8	0.0	0.00	.P
81.30	0	29	5547.4	6417.1	0.0	0.00	.P
81.60	0	29	5547.3	6416.4	0.0	0.00	.P
81.90	0	29	5547.3	6415.7	0.0	0.00	.P

82.20	0	29	5547.3	6415.0	0.0	0.00	.P
82.50	0	29	5547.3	6414.3	0.0	0.00	.P
82.80	0	29	5547.3	6413.6	0.0	0.00	.P
83.10	0	29	5547.3	6412.9	0.0	0.00	.P
83.40	0	29	5547.3	6412.2	0.0	0.00	.P
83.70	0	29	5547.3	6411.5	0.0	0.00	.P
84.00	0	29	5547.3	6410.8	0.0	0.00	.P
84.30	0	29	5547.3	6410.2	0.0	0.00	.P
84.60	0	28	5547.3	6409.5	0.0	0.00	.P
84.90	0	28	5547.3	6408.8	0.0	0.00	.P
85.20	0	28	5547.3	6408.1	0.0	0.00	.P
85.50	0	28	5547.3	6407.4	0.0	0.00	.P
85.80	0	28	5547.3	6406.8	0.0	0.00	.P
86.10	0	28	5547.3	6406.1	0.0	0.00	.P
86.40	0	28	5547.3	6405.4	0.0	0.00	.P
86.70	0	28	5547.3	6404.8	0.0	0.00	.P
87.00	0	28	5547.3	6404.1	0.0	0.00	.P
87.30	0	28	5547.3	6403.4	0.0	0.00	.P
87.60	0	28	5547.3	6402.8	0.0	0.00	.P
87.90	0	28	5547.3	6402.1	0.0	0.00	.P
88.20	0	27	5547.3	6401.4	0.0	0.00	.P
88.50	0	27	5547.3	6400.8	0.0	0.00	.P
88.80	0	27	5547.3	6400.1	0.0	0.00	.P
89.10	0	27	5547.3	6399.5	0.0	0.00	.P
89.40	0	27	5547.3	6398.8	0.0	0.00	.P
89.70	0	27	5547.3	6398.2	0.0	0.00	.P
90.00	0	27	5547.3	6397.5	0.0	0.00	.P
90.30	0	27	5547.2	6396.9	0.0	0.00	.P
90.60	0	27	5547.2	6396.3	0.0	0.00	.P
90.90	0	27	5547.2	6395.6	0.0	0.00	.P
91.20	0	27	5547.2	6395.0	0.0	0.00	.P
91.50	0	27	5547.2	6394.3	0.0	0.00	.P
91.80	0	27	5547.2	6393.7	0.0	0.00	.P
92.10	0	26	5547.2	6393.1	0.0	0.00	.P
92.40	0	26	5547.2	6392.4	0.0	0.00	.P
92.70	0	26	5547.2	6391.8	0.0	0.00	.P
93.00	0	26	5547.2	6391.2	0.0	0.00	.P
93.30	0	26	5547.2	6390.6	0.0	0.00	.P
93.60	0	26	5547.2	6389.9	0.0	0.00	.P
93.90	0	26	5547.2	6389.3	0.0	0.00	.P
94.20	0	26	5547.2	6388.7	0.0	0.00	.P
94.50	0	26	5547.2	6388.1	0.0	0.00	.P
94.80	0	26	5547.2	6387.5	0.0	0.00	.P
95.10	0	26	5547.2	6386.9	0.0	0.00	.P
95.40	0	26	5547.2	6386.2	0.0	0.00	.P
95.70	0	26	5547.2	6385.6	0.0	0.00	.P
96.00	0	26	5547.2	6385.0	0.0	0.00	.P
96.30	0	25	5547.2	6384.4	0.0	0.00	.P
96.60	0	25	5547.2	6383.8	0.0	0.00	.P
96.90	0	25	5547.2	6383.2	0.0	0.00	.P
97.20	0	25	5547.2	6382.6	0.0	0.00	.P

Time	Qin	Qout	Elev	Vol	Area	ExtVel	I	I	I	I	I
							0.	500.	1000.	1500.	2000

END NRCS-SDH PLOT

HYD	FO	4.74	Cove Res							COVRES	1
	0	1.2000								STR1	2
		7.74	7.74	7.84	8.25	9.31	FO	D			3
		11.73	20.36	49.54	130.06	325.02	FO	D			4

```
                    458.59    540.79    594.66    627.20    644.87   FO D  5
                    652.22    651.18    647.05    642.62    634.58   FO D  6
                    605.49    552.09    496.87    443.06    398.14   FO D  7
                    359.06    325.87    298.36    273.18    250.64   FO D  8
                    232.38    215.72    199.82    185.09    171.45   FO D  9
                    158.83    147.14    136.31    127.58    122.72   FO D 10
                    118.04    113.55    109.22    105.07    101.07   FO D 11
                     97.22     93.53     89.97     86.56     83.27   FO D 12
                     80.44     79.17     77.92     76.69     75.48   FO D 13
                     74.28     73.11     71.96     70.82     69.71   FO D 14
                     68.61     67.53     66.46     65.41     64.38   FO D 15
                     63.37     62.37     61.39     60.46     59.58   FO D 16
                     58.71     57.85     57.01     56.18     55.36   FO D 17
                     54.56     53.77     52.98     52.21     51.46   FO D 18
                     50.73     50.03     49.35     48.68     48.01   FO D 19
                     47.36     46.72     46.08     45.45     44.83   FO D 20
                     44.22     43.62     43.03     42.44     41.87   FO D 21
                     41.33     40.81     40.29     39.78     39.28   FO D 22
                     38.78     38.29     37.81     37.33     36.86   FO D 23
                     36.40     35.94     35.48     35.04     34.60   FO D 24
                     34.16     33.73     33.31     32.91     32.53   FO D 25
                     32.15     31.78     31.41     31.05     30.69   FO D 26
                     30.33     29.98     29.64     29.30     28.96   FO D 27
                     28.63     28.30     27.97     27.65     27.33   FO D 28
                     27.02     26.71     26.40     26.10     25.80   FO D 29
                     25.50     25.21     24.95     24.69     24.43   FO D 30
                     24.18     23.93     23.68     23.44     23.20   FO D 31
                     22.96     22.72     22.48     22.25     22.02   FO D 32
                     21.80     21.57     21.35     21.13     20.91   FO D 33
                     20.70     20.49     20.27     20.07     19.86   FO D 34
                     19.66     19.46     19.26     19.06     18.86   FO D 35
                     18.67     18.48     18.29     18.11     17.93   FO D 36
                     17.77     17.61     17.45     17.30     17.14   FO D 37
                     16.99     16.84     16.69     16.54     16.39   FO D 38
                     16.24     16.10     15.95     15.81     15.67   FO D 39
                     15.53     15.39     15.25     15.12     14.98   FO D 40
                     14.85     14.72     14.59     14.46     14.33   FO D 41
                     14.20     14.08     13.95     13.83     13.71   FO D 42
                     13.59     13.47     13.35     13.23     13.11   FO D 43
                     13.00     12.89     12.77     12.66     12.55   FO D 44
                     12.44     12.33     12.22     12.12     12.01   FO D 45
                     11.90     11.80     11.70     11.61     11.53   FO D 46
                     11.44     11.36     11.28     11.19     11.11   FO D 47
                     11.03     10.95     10.87     10.79     10.71   FO D 48
                     10.63     10.56     10.48     10.40     10.33   FO D 49
                     10.25     10.18     10.10     10.03      9.96   FO D 50
                      9.89      9.81      9.74      9.67      9.60   FO D 51
                      9.53      9.46      9.40      9.33      9.26   FO D 52
 ENDTABLE                                                          P 1,T 2 53


1SITES ------------------------------------------------------------------------
 XEQ 08/28/2020                    COV RES                        WSID= COVRES
 VER 2005.1.8                        Cove Res                       SUBW= CR
 TIME 16:21:21          SITE = STR1              PASS=    1     PART=   6


 ROUTED       BTM WIDTH  MAX ELEV   VOL-MAX  AREA-MAX   AUX.-HP   VOL-AUX.
 RESULTS          FT        FT        ACFT      AC         FT       ACFT
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NRCS-FBH 30.0 5552.31 7410.0 0.0 3.79 765.6

PEAK - CFS Q-PS Q-AUX. Q-TOT.
DISCHARGE = 126.9 525.3 652.2

AUXILIARY SPILLWAY ---	CRITICAL DEPTH FT	CRITICAL VELOCITY FT/SEC	CRITICAL SLOPE-Sc FT/FT	25% OF Q Sc FT/FT
	2.02	7.63	0.008	0.010

INTEGRITY ANALYSIS - REACH SURFACE PERFORMANCE SUMMARY
(The auxiliary spillway began flow at time = 9.6 hours
and peaked at time = 20.4 hours.)

REACH 3: FROM STATION 115. TO 475. ON 15.4% SLOPE.
Non-vegetated conditions implied: flow concentration
assumed with minimal flow: Time = 12.0 hours.

REACH 4: FROM STATION 475. TO 610. ON 8.5% SLOPE.
Non-vegetated conditions implied: flow concentration
assumed with minimal flow: Time = 12.0 hours.

REACH 5: FROM STATION 610. TO 1057. ON 6.6% SLOPE.
Non-vegetated conditions implied: flow concentration
assumed with minimal flow: Time = 12.0 hours.

REACH 6: FROM STATION 1057. TO 1153. ON 15.6% SLOPE.
Non-vegetated conditions implied: flow concentration
assumed with minimal flow: Time = 12.0 hours.

INTEGRITY ANALYSIS - HEADCUT EROSION DAMAGE SUMMARY

The most upstream headcut began at station 115.
and progressed upstream to station 94.
The final height of the headcut was 4.3 ft.

The headcut having the maximum final overfall height began
at station 475. and progressed upstream to station 414.
The final height of the headcut was 14.1 ft.

THE HYDROGRAPH WAS NOT ADJUSTED FOR THE EFFECTS OF EROSION.

AUXILIARY SPILLWAY ---	DURATION FLOW HRS	ATTACK OE/B ACFT/FT	DIST. FROM MOST U/S HEADCUT TO U/S EDGE AUX. CREST, FT
	73.2	28.0	19.

EXIT CHANNEL FLOW SUPERCRITICAL: MAX VELOCITY= 19.8 FT/SEC
EXIT SLOPE = 0.154 FT/FT
FLOW DEPTH = 0.8 FT

PLOT NRCS-FBH 1 IN = 500. CFS

Time	Qin	Qout	Elev	Vol	Area	ExtVel	0. I	500. I	1000. I	1500. I	2000 I

2.40	0	8	5546.3	6203.0	0.0	0.00	.
3.60	4	8	5546.3	6203.0	0.0	0.00	.
4.80	35	8	5546.3	6204.0	0.0	0.00	.I
6.00	84	8	5546.3	6209.1	0.0	0.00	. I
7.20	195	9	5546.4	6222.1	0.0	0.00	. I
8.40	425	12	5546.5	6251.8	0.0	0.00	. I
9.60	1352	20	5546.9	6338.3	0.0	0.00	. I
10.80	3365	50	5548.1	6568.7	0.0	0.00	.P
12.00	3296	130	5549.8	6890.1	0.0	6.33	. A
13.20	2008	325	5550.9	7130.6	0.0	13.72	. A I
14.40	1331	459	5551.6	7257.3	0.0	16.69	. A I
15.60	1060	541	5551.9	7326.3	0.0	18.14	. A I
16.80	912	595	5552.1	7367.8	0.0	19.00	. A I
18.00	792	627	5552.2	7391.7	0.0	19.48	. A I
19.20	742	645	5552.3	7404.6	0.0	19.73	. A I
20.40	664	652	5552.3	7410.0	0.0	19.84	. X
21.60	624	651	5552.3	7409.3	0.0	19.82	. IA
22.80	613	647	5552.3	7406.2	0.0	19.77	. IA
24.00	611	643	5552.3	7403.0	0.0	19.70	. IA
25.20	547	635	5552.2	7397.1	0.0	19.59	. I A
26.40	262	605	5552.1	7375.7	0.0	19.16	. I A
27.60	90	552	5551.9	7335.8	0.0	18.33	. I A
28.80	24	497	5551.7	7289.4	0.0	17.39	. A
30.00	5	443	5551.5	7244.2	0.0	16.39	. A
31.20	1	398	5551.3	7202.8	0.0	15.47	. A
32.40	0	359	5551.1	7165.4	0.0	14.58	. A
33.60	0	326	5551.0	7131.5	0.0	13.75	. A
34.80	0	298	5550.8	7100.6	0.0	12.99	. A
36.00	0	273	5550.7	7072.4	0.0	12.22	. A
37.20	0	251	5550.5	7046.5	0.0	11.46	. A
38.40	0	232	5550.4	7022.7	0.0	10.78	. A
39.60	0	216	5550.3	7000.6	0.0	10.21	. A
40.80	0	200	5550.2	6980.1	0.0	9.67	. A
42.00	0	185	5550.1	6961.1	0.0	9.12	. A
43.20	0	171	5550.0	6943.5	0.0	8.55	. A
44.40	0	159	5550.0	6927.2	0.0	7.97	. A
45.60	0	147	5549.9	6912.1	0.0	7.38	. A
46.80	0	136	5549.8	6898.2	0.0	6.74	. A
48.00	0	128	5549.7	6885.2	0.0	6.18	. A
49.20	0	123	5549.7	6872.9	0.0	5.93	. A
50.40	0	118	5549.6	6861.0	0.0	5.67	. A
51.60	0	114	5549.6	6849.7	0.0	5.39	. A
52.80	0	109	5549.5	6838.7	0.0	5.11	. A
54.00	0	105	5549.5	6828.2	0.0	4.80	. A
55.20	0	101	5549.4	6818.1	0.0	4.48	. A
56.40	0	97	5549.4	6808.3	0.0	4.12	. A
57.60	0	94	5549.3	6799.0	0.0	3.73	. A
58.80	0	90	5549.3	6790.0	0.0	3.28	. A
60.00	0	87	5549.2	6781.3	0.0	2.74	. A
61.20	0	83	5549.2	6773.0	0.0	1.98	. A
62.40	0	80	5549.1	6765.0	0.0	0.00	. A
63.60	0	79	5549.1	6757.2	0.0	0.00	. A
64.80	0	78	5549.1	6749.5	0.0	0.00	. A
66.00	0	77	5549.0	6741.9	0.0	0.00	. A
67.20	0	75	5549.0	6734.4	0.0	0.00	. A
68.40	0	74	5548.9	6727.1	0.0	0.00	.A
69.60	0	73	5548.9	6719.9	0.0	0.00	.A
70.80	0	72	5548.9	6712.8	0.0	0.00	.A
72.00	0	71	5548.8	6705.8	0.0	0.00	.A

```
 73.20     0    70 5548.8  6699.0   0.0   0.00   .A
 74.40     0    69 5548.8  6692.2   0.0   0.00   .A
 75.60     0    68 5548.7  6685.6   0.0   0.00   .A
 76.80     0    66 5548.7  6679.0   0.0   0.00   .A
 78.00     0    65 5548.7  6672.6   0.0   0.00   .A
 79.20     0    64 5548.6  6666.2   0.0   0.00   .A
 Time    Qin  Qout   Elev    Vol   Area  ExtVel  I         I         I         I         I
                                                 0.      500.     1000.     1500.     2000
        END NRCS-FBH   PLOT
 ------------------------------------------------------------------------------

 Inflow Hyd 1 PSH-Peak =         39.99 CFS  at  143.00 hrs.,  Location Point

 Inflow Hyd 1 SDH-Peak =         65.90 CFS  at    8.10 hrs.,  Location Point

 Inflow Hyd 1 FBH-Peak =        652.22 CFS  at   19.20 hrs.,  Location Point
HYDOUT   1     STR1

1SITES....JOB NO.  1 COMPLETE.
 ------------------------------------------------------------------------------

 COVRES        COV RES

       0 SUBWATERSHED(S) ANALYZED.

       1 STRUCTURE(S) ANALYZED.

       3 HYDROGRAPHS ROUTED AT LOWEST SITE.

       0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

 ******************************************************************************



 SITES.....COMPUTATIONS COMPLETE

                                SUMMARY TABLE  1          SITES VERSION 2005.1.8
                               ----------------               DATED 01/01/2005


 WATERSHED ID                          RUN DATE                          RUN TIME
 ------------                          --------                          --------
 COVRES                              08/28/2020                          16:21:21

 >>>   SITE   SUBWS   SUBWS DA   CURVE    TC   TOTAL DA   TYPE    STRUC    <<<
         ID     ID     (SQ MI)    NO.    (HRS)  (SQ MI)  DESIGN   CLASS
         -----  ----   --------   -----  ----   -------  -----   -----
         STR1    CR        4.74      0.  0.00      4.74    TR60     C

 PASS  DIA./  AUX.CREST  BTM.  MAX.    MAX.    EMB.  INTEGR.*  EXIT*    TYPE
  NO.  WIDTH    ELEV    WIDTH   HP     ELEV    VOL.   DIST.     VEL.     HYD
      (IN/FT)   (FT)     (FT)  (FT)    (FT)    (CY)   (FT)   (FT/SEC)
 ---- -----  -------  ------  ----  -------  -------  -----  ------  ---------
    1  30.0   5548.5    30.0   3.8   5552.3       0.    19.    19.8  NRCS-FBH
```

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 *  INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED
    HYDROGRAPH SHOWN UNDER TYPE HYD.



 SITES.......SUMMARY TABLE 1 COMPLETED.


                    NRCS  SITES    VERSION 2005.1.8  ,01/01/2005
                             COVRES   FILES

INPUT  = H:\DAMS\Cove.200401-025\TASK 1 - Cove Reservoir EA Project\SITES\Aug 2020\SITES\08
OUTPUT = H:\DAMS\Cove.200401-025\TASK 1 - Cove Reservoir EA Project\SITES\Aug 2020\SITES\08
         DATED 08/28/2020 16:21:21

        FILE GEN.   = H:\DAMS\Cove.200401-025\TASK 1 - Cove Reservoir EA Project\SITES\Aug

                          GRAPHICS FILES GENERATED

OPTION "L"  = H:\DAMS\Cove.200401-025\TASK 1 - Cove Reservoir EA Project\SITES\Aug 2020\SIT

OPTION "P"  = H:\DAMS\Cove.200401-025\TASK 1 - Cove Reservoir EA Project\SITES\Aug 2020\SIT

OPTION "E"  = H:\DAMS\Cove.200401-025\TASK 1 - Cove Reservoir EA Project\SITES\Aug 2020\SIT

AUX.GRAPHICS = H:\DAMS\Cove.200401-025\TASK 1 - Cove Reservoir EA Project\SITES\Aug 2020\SI
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Sediment

The site is located in the East Fork of the Virgin River Watershed at 37.273° N 112.660° W. The reservoir will serve as a multi-purpose structure including providing storage for irrigation, recreation, and drought.

The reservoir will have a storage capacity of 6,032 acre-feet and an average depth 40 feet. The drainage area covers 4.7 square miles (3034 acres). The reservoir site is in an alluvial valley that has been cut into Cretaceous and Tertiary sedimentary rocks consisting mostly of sandstone and shale. Residual soils are silt and sandy clay. The terrain adjacent to the basin valley has steep slopes. Ridges are capped with thin deposits of pebble gravel and cobbles of grey and red quartzite, grey to black chert, and grey limestone in a matrix of sand with silt. Vegetation in the drainage is sparse, consisting of brush and small trees. Using the National Engineering Handbook (NEH) land cover designation, the majority of the drainage basin is comprised of Woods, Fair; with portions of Desert Shrub, Poor. The drainage areas are capable of producing flash flood conditions and large sediment volumes during intense rainfalls. The reservoir is expected to contain all of the sediment and therefore, the trap efficiency is assumed to be 100 percent for the reservoir.

An initial estimate of sediment yield has been performed using two methods included in the Bureau of Reclamation Erosion and Sedimentation Manual (November 2006) and the Estimated Sediment Yield Rates for the State of Utah Map (U.S.D.A SCS, 1973). These methods are described below.

Sediment Yield as a Function of Drainage Area

Empirical sediment yield equations have been developed strictly as a function of drainage area based on reservoir sediment survey data. Strand and Pemberton (1982) developed the following equation for the semiarid climate of the Southwestern United States:

$$Q = 1.84A_d^{-0.24}$$

Where Q = sediment yield in ac-ft/mi^2/yr
A_d = drainage area in mi^2

For the reservoir drainage area of 4.7 mi^2, a sediment accumulation 6 acre-feet per year or 600 acre-feet over a 100- year period is computed.

Sediment Yield Classification Procedure

The Pacific Southwest Inter-Agency Committee developed a sediment yield classification procedure that estimates sediment yield as a function of nine individual drainage basin characteristics. Each characteristic is given a subjective numerical rating based on

observation and experience and the sum of these ratings determines the basin classification and the annual sediment yield per unit area. Tables showing this procedure are included on the following page. The sum of the basin characteristics ratings is 70, resulting in a classification number of 3, with annual sediment yield (ac-ft/mi^2) ranging from 0.5 to 1.0. For the drainage basin area of 4.7 mi^2, using the upper end of the range results in an annual yield of 4.7 ac-ft and a sediment yield of 470 acre-feet over a 100-year life span.

Estimated Sediment Yield Rate Map

An estimated sediment yield rate map for the State of Utah was prepared by the U.S.D.A. Soil Conservation Service in 1973. This map is a general area map with cautions that it is not to be used for specific sites since large variations may occur in the delineated areas. A copy of the map with the Cove Reservoir area enlarged is attached. This area in in a Yield Class 4 which indicates yield rates ranging from 0.2 to 0.5 ac-ft./sq mi^2/year. Using the upper end of the range, results in an estimate of 2.35 ac-ft per year for the 4.7 sq mi^2 drainage area and 235 acre-feet over a 100-year life span.

These initial estimate methods are considered to provide upper end values of the sediment volume which will accumulate over the 100-year life of the structure. Ranging from 235 to 600 acre-feet, these values represent 10% or less of the reservoir storage volume and more refined analyses are not deemed necessary for planning purposes.

Table 2.9. List of drainage basin characteristics and possible range of numerical ratings (modified from Pacific Southwest Interagency Committee, Water Management Subcommittee, 1968)

Drainage basin characteristics	Sediment yield levels		
	High rating	Moderate rating	Low rating
Surface geology	10: marine shales and related mudstones and siltstones	5: rocks of medium hardness moderately weathered and fractured	0: massive hard formations
Soils	10: fine textured and easily dispersed or single grain salts and fine sands	5: medium textured, occasional rock fragments, or caliche crusted layers	0: frequent rock fragments, aggregated clays, or high organic content
Climate	10: frequent intense convective storms	5: infrequent convective storms, moderate intensity	0: humid climate with low intensity rainfall, arid climate with low intensity rainfall, or arid climate with rare convective storms
Runoff	10: high flows or volume per unit area	5: moderate flows or runoff volume per unit area	0: low flows or volume per unit area or rare runoff events
Topography	20: steep slopes (in excess of 30%), high relief, little or no flood plain development	10: moderate slopes (about 20%), moderate flood plain development	0: gentle slopes (less than 5%), extensive flood plain development
Ground cover	10: ground cover less than 20%, no rock or organic litter in surface soil	0: ground cover less than 40%, noticeable organic litter in surface soil	-10: area completely covered by vegetation, rock fragments, organic litter with little opportunity for rainfall to erode soil
Land use	10: more than 50% cultivated, sparse vegetation, and no rock in surface soil	0: less than 25% cultivated, less than 50% intensively grazed	-10: no cultivation, no recent logging, and only low intensity grazing, if any
Upland erosion	25: rill, gully, or landslide erosion over more than 50% of the area	10: rill, gully, or landslide erosion over about 25% of area	0: no apparent signs of erosion
Channel erosion	25: continuous or frequent bank erosion, or active headcuts and degradation in tributary channels	10: occasional channel erosion of bed or banks	0: wide shallow channels with mild gradients, channels in massive rock, large boulders, or dense vegetation or artificially protected channels

TOTAL = 70

Table 2.10. Drainage basin sediment yield classification (Randle, 1996)

Drainage basin classification number	Total rating	Annual sediment yield (ac-ft/mi^2)
1	> 100	> 3
2	75 to 100	1.0 to 3.0
3	50 to 75	0.5 to 1.0
4	25 to 50	0.2 to 0.5
5	0 to 25	<0.2

- EXPLANATION -

Yield Class	Yield Rate 1/ (Ac.Ft/Sq.Mi/Yr.)	Total Area (Sq.Mi.)
1	> 3.0	____
2	1.0-3.0	____
3	0.5-1.0	____
4	0.2-0.5	____
5	0.1-0.2	____
6	< 0.1	____

▼ 0.45 AVERAGE ANNUAL SUSPENDED SEDIMENT YIELDS DETERMINED FROM SEDIMENT TRANSPORT RECORDS. RATES ARE IN Ac.Ft/Sq.Mi/Yr.

80 - 20 ECT. (PERCENT OF SHEET AND RILL EROSION - PERCENT OF CHANNEL AND GULLY EROSION.

Subregion Number	Subregions
4	SNAKE
1A	BEAR LAKE
1B	GREAT SALT LAKE
2A	SEVIER LAKE
2B	GREEN RIVER
2C	SAN JUAN - COLORADO
3	UPPER MAIN STEM
	LOWER MAIN STEM

1/ DO NOT USE THESE RATES TO DETERMINE SEDIMENT YIELDS AT SPECIFIC SITES. LARGE VARIATIONS IN SEDIMENT RATES MAY OCCUR WITHIN THE DELINEATED AREAS.

Cove Reservoir

SOURCES OF INFORMATION

1. GREAT BASIN, UPPER COLORADO AND LOWER COLORADO REGIONS, COMPREHENSIVE FRAMEWORK STUDY, APPENDICES VIII, WATERSHED MANAGEMENT, JUNE 1971, PACIFIC SOUTHWEST INTER-AGENCY COMMITTEE/WATER RESOURCES COUNCIL.
2. UTAH STATE SOILS MAP AND SOILS DESCRIPTIONS.
3. RESERVOIR SURVEYS BY SCS & USBR
4. SUSPENDED LOAD MEASUREMENTS BY USGS, USBR & SCS.
5. WATERSHED STUDIES BY SCS.
6. GENERAL KNOWLEDGE OF THE STATE FROM REGULAR SCS PROGRAM WORK.

ESTIMATED SEDIMENT YIELD RATES FOR THE STATE OF UTAH

EROSION & SEDIMENTATION -70
WESTERN U.S. WATER PLAN
AUGUST 1973
(SUBJECT TO REVISION)
prepared by
U.S.D.A., Soil Conservation Service
Geologist, Bob L. Bridges

10 5 0 5 10 15
scale in miles

Cove Dam Feasibility Study



Near Orderville, Kane County, Utah

June 2004

RB&G ENGINEERING, INC.

RB&G
ENGINEERING, INC.

June 16, 2004

Kane County Water Conservancy District
76 North Main Street
Kanab, UT 84741

Attn: Mike Noel

Subject: Cove Dam
Feasibility Study

Gentlemen:

A Feasibility Study has been completed for the proposed Cove Dam near Orderville, Kane County, Utah. The investigation has been conducted in accordance with a proposal submitted to your organization for the work, and the results of the study are summarized in the report transmitted herewith.

We appreciate the opportunity of providing this service for you. If there are any questions relating to the information contained herein, please call.

Sincerely,

RB&G ENGINEERING, INC.

Bradford E. Price, P.E.

bep/jag

1435 WEST 820 NORTH, PROVO, UTAH 84601-1343
PROVO 801-374-5771 SALT LAKE CITY 801-521-5771 FAX 801-374-5773

Feasibility Study

Cove Dam

near Orderville
Kane County, Utah

June 14, 2004

RB&G ENGINEERING, INC.

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COVE DAM

Kane County Water Conservancy District

Feasibility Study – Executive Summary

This report summarizes the results of a feasibility study performed for the proposed Cove Reservoir to be located about 1 mile southwest of Orderville, Utah. The purpose of the reservoir is to provide off-stream storage for the district to aid in water distribution for municipal and agricultural purposes. Water will be delivered to the off-stream reservoir via pipeline.

Surficial deposits in the study area consist of Quaternary alluvial deposits overlying the Tropic Shale Formation. This formation consists predominantly of dark gray shale with some gray sandstone. At the site, the formation also contains thin layers of grayish-white bentonite and minor to very minor gypsum lenses, stringers, and fracture infill. Bedrock in the upper 25 to 50 feet of the abutments is highly fractured and will require a grout curtain to reduce seepage through the abutments.

Based upon the results of field and laboratory testing, it is our opinion that a homogeneous clay earthfill embankment with an internal filter and drainage system will be the most efficient type of structure for this site. It is anticipated that clay fill can be obtained from required excavations and the reservoir basin. Filter, drain, riprap bedding, and riprap material must be imported from off-site sources. Sources have been identified within a 5 mile radius of the site.

A maximum dam height of between 100 and 110 feet is available at the site. Assuming 10 feet of freeboard, this results in an available capacity of between 6800 and 8800 acre feet. Our opinion of probable cost for a 100 foot high dam 10.7 million dollars, increasing to 14.5 million dollars for a 110 foot high structure. This results in a cost per acre foot of $1,578 for the 100 foot high structure and $1,644 for the 110 foot high structure. These values do not include the cost of land or piping to bring water to the reservoir.

COVE DAM

Kane County Water Conservancy District

Feasibility Study

I. INTRODUCTION

1. PROJECT DESCRIPTION

The proposed Cove Dam and Reservoir is located about 1 mile southwest of Orderville, Utah at the approximate location shown on the vicinity map in Figure 1. The reservoir site is situated in a natural off-stream drainage basin and will be enclosed by a single dam near the mouth of the basin. The drainage basin is located ½ mile west of the East Fork Virgin River. A new diversion structure and pipeline will route water into the reservoir. A site plan of the reservoir is shown in Figure 2. The purpose of the project is to provide water storage for Kane County Water Conservancy District to aid in water distribution for municipal and agricultural purposes.

2. PURPOSE AND SCOPE

The purpose and scope of this study was to (1) perform sufficient surface and subsurface investigations at the reservoir site to determine the feasibility of construction of the dam and reservoir, (2) perform sufficient field and laboratory investigations to identify borrow sources for the dam embankment, (3) evaluate dam type options, (4) provide recommendations relative to the best option for this site, and (5) provide preliminary cost estimates for the selected sections and appurtenant structures required to meet the safety, storage, and operation requirements of the owner.

Consideration has been given to potential borrow sources for earthfill, rockfill, and roller compacted concrete type structures. Borrow sources for impervious (clay/silt) type material, granular (sand/gravel) type material, and rock for use as riprap were identified within the basin or in the surrounding area. The work has been performed in accordance with the proposal and is discussed under the following headings:

- Geologic Investigations
- Field and Laboratory Testing Procedures
- Foundation Investigation
- Borrow Investigation
- Feasibility Analysis and Conclusions

3. PREVIOUS STUDIES

The following studies were reviewed for this report:

"Memorandum", State of Utah - Division of Water Resources; Engineering Geology Section; Oct. 6, 1997; Author: Ben Everitt, Engineering Geologist

"Proposed Cove Canyon Dam and Reservoir Near Orderville, Utah; Reconnaissance-Level Evaluation", June 1996; Franson-Noble & Associates, Inc.

II. GEOLOGIC INVESTIGATIONS

1. REGIONAL GEOLOGY

The Orderville area is located within the Grand Staircase section of the Colorado Plateau Physiographic Province. The Grand Staircase contains a series of terraces and cliffs, which rise northward from the Grand Canyon to the south to the High Plateaus to the north. The Hurricane Fault bounds the area to the west, the Kiabab Monocline bounds the area to the east (Stokes, 1987).

The Grand Staircase section is typified by a series of alternating step-like cliffs and flat areas. The upward steps in the staircase include the Vermillion Cliffs, White Cliffs, Gray Cliffs, and Pink Cliffs. The cliffs consist of more competent material while the lowlands between them consist of generally softer more erodible deposits (Stokes, 1987).

The age of the deposits exposed above the Grand Canyon range from the Triassic age, 245 million years ago near the Vermillion Cliffs, to the younger Tertiary deposits of the Pink Cliffs to the north, deposited 15 million years ago. A large portion of the sediments in this section were derived from continental deposits

The Orderville area is located within the less tectonically active Colorado Plateau Province. Bedrock in the Orderville area shows evidence of some ancient normal faulting as well as younger Quaternary faults. This general region has been less disrupted by compressional forces from the Sevier Orogeny, which was more prominent across the northwestern side of the state.

The area is located within the western edge of the Intermountain Seismic Belt (ISB). The ISB is a zone of seismic activity which trends from northern Arizona up through northern Montana in the U.S.A.

The study area is located east of the general transition zone between the Basin and Range Province and the Colorado Plateau Province. The area is located on the western edge of the potentially active Sevier Fault. The Sevier Fault is the eastern most major extensional fault in southern Utah.

2. SITE GEOLOGY

Figure 3 is a portion of a geologic map of Kane County showing the location of the study area. As shown on the map, surficial deposits in the study area consist of Quaternary alluvial deposits overlying bedrock. Bedrock throughout the reservoir basin and proposed dam abutments consists of the Cretaceous age Tropic Shale Formation (Doelling, etal, 1989, Doelling, 1999). No competent outcrops of Tropic Shale were observed at the site from which strike and dip could be measured. Based on information from drill holes, and topographic and structural geology maps, bedrock in the area appears to dip 2 to 3° down toward the northeast (Doelling, etal, 1989). The strike of the bedrock taken from a structural geologic map is about North 30° West. Interpretations taken from topographic and geologic maps show the strike to be about North 60° West.

The following descriptions of the surficial and rock units in the study area are taken from "The Geology of Kane County, Utah, Geology, Mineral Resources and Geologic Hazards, by Hellmut H. Doelling and Fritzhugh D. Davis"... published in 1987 and Interim geologic map of the Kanab 30'X60" Quadrangle..., Open-File Report 366,1999. Deposits are listed from youngest to oldest, with personal comments relative to the study area in italics.

Quaternary

Qa Alluvium - sand and silty clay with lenses of sandy silt and gravel sediments consist of unconsolidated clay, silt, sand and gravel, deposited in stream bed and flood-plains. *(During this investigation sand and gravel deposits appeared very limited and discontinuous. Deposits may be considered for embankment material).*

Qag Alluvial gravel - poor to well sorted gravel and sand with some silt and clay interbeds.(*Exposures are predominate terrace deposits along the east side of the East Fork of the Virgin River which trends southeast along the east side of the highway. Sand and gravel may be considered for granular borrow source*).

Cretaceous

Ks Straight Cliffs Formation - Yellow-gray very fine to fine grained , med to thick bedded, cliff forming, calcareous sandstone with interbedded less resistant sandstone, shale and mudstone. (*This unit is exposed north and northwest of the site. The unit is well exposed due to faulting on the north side of Orderville. The formation is exposed as a yellow cliff forming cap rock above the Tropic Shale. Competent material may be suitable for rip rap but appears to have many interbedded weak layers*).

Kt Tropic Shale Formation- Dark gray, drab marine shale with some gray sandstone. (*This unit forms the bedrock for the dam abutments and reservoir basin. At this site the formation also contains several grayish-white bentonite layers which are exposed along the south (right) side of the reservoir basin, septarian nodules/concretions are also common locally. Some minor gypsum lenses, stringers and fracture infilling were noted during this study*).

Kd Dakota Formation - Interbedded sandy shale, carbonaceous shale, sandstone, conglomerate and coal.

Jurassic

Jc Carmel formation - sandstone, siltstone, limestone, shaly limestone and gypsum. Divided into members.

Jcw Winsor and Wiggler Wash Members - Reddish or yellow slope forming silty sandstone.

Jcp Paria River Member - Gypsum, reddish siltstone and sandstone, with some limestone at top. *(south of site seen as a white gypsum cliff along highway*).

Jcc Crystal Creek Member - Brown banded sandstone. *(South of site this unit exposes a small fault zone in a road cut off of highway).*

Jck Co-op Creek Member - Thin to medium bedded light gray limestone and tan limestone shale. (*Unit forms ledges south of sewer lagoon, off of highway and was used as rip rap for lagoon. This unit is also exposed just east of the highway on the east side of the Sevier fault on the northeast end of Orderville. This may be a source of rip rap*).

3. SEISMIC CONSIDERATIONS

A detailed seismic evaluation for the site has not been completed as part of the Feasibility Study. However, the Utah Dam Safety Map for the *No Fault Specific* seismic event with a 5,000 year return interval indicates that the extreme event could generate a Peak Ground Acceleration (PGA) of about 0.29g. A preliminary seismic evaluation finds that the nearest seismic source is the southern section of the Sevier (Toroweap) Fault, located about 1.9 miles (3 km) east of the site. This fault is Quaternary in age (Late Pleistocene 10-130 k years ago) with no documented Holocene movement. No recurrence interval information is currently available for this fault, however an estimated slip rate of 0.2-1mm/yr has been given by others (Anderson and Christenson, 1989; Hecker, 1993; Black and others, 2003). This section of the fault is about 55 miles (88 km) long and may be capable of generating a Maximum Credible Earthquake (MCE) with a magnitude of about 7.2 to 7.4. Due to the close proximity of the fault, a 7.2 to7.4 earthquake could generate Peak Horizontal Ground Acceleration (PGA) values of between 0.62g to 0.65g.

4. GEOLOGIC HAZARDS

Geologic hazards which should be considered at this site include seismic, slope stability, and potential embankment and foundation hazards. These hazards are discussed below as follows:

Seismic

As mentioned previously, ground shaking during a moderate to large seismic event near the site is a potential hazard. While the activity rate of the Sevier Fault is not fully understood, evidence suggests that it has the potential to generate a large magnitude earthquake. Since the site is located a couple of miles west of the fault surface, fault rupture during a seismic event is unlikely. Hazards include tectonic subsidence and deformation. Tectonic deformation should be addressed during the design of the dam.

Liquefaction

Current and previous studies have identified some scattered alluvial sand and gravel deposits in the basin which may have a potential for liquefaction. Information to date indicates that the deposits are relatively localized and discontinuous. It is possible that loose sand deposits exist beneath the dam footprint, which will require mitigation. Sufficient investigation should be performed during final design to determine if mitigation measures are required.

Non-seismic Slope Failure

A review of the site did not find any evidence of rock fall, debris flow or landslide deposits. The stability of abutment slopes under saturated sudden draw down conditions should be addressed during design of the dam.

Foundation and Embankment Hazards

Several geologic hazard maps indicated that the Tropic Shale Formation and the alluvial material in the basin has a potential for swelling and shrinking with changes in moisture content (bentonite layers have very high potential) (Doelling etal, 1989; Mulvey, 1992). It

should be noted that during site visits between April and June (2004), relatively large polygonal desiccation cracks were observed within the alluvial material covering the basin and abutments. These cracks were observed to be up to 1 inch wide and 1 foot deep. In many places the cracks were difficult to see due to the popcorn texture of the soil at the surface.

Doelling's map also mentions that the Tropic Shale has a high sulfate content which may react with concrete (Doelling etal, 1989). For this project, site specific testing should be conducted to verify the sulfate content in the area. Gypsum is moderately soluble and may dissolve over time when exposed to water. Dissolution of the gypsum may gradually create voids within the foundation of the reservoir. During this preliminary investigation relatively little visible gypsum was observed in the test borings or test pits. Additional testing should be performed to determine the percent of soluble salts in the embankment and foundation materials. Test pits within the basin also encountered some collapsible soils. Testing results are discussed later in this report.

Based on observations at the site the bedrock contact beneath alluvium in the basin may be somewhat undulating. Three small knolls are located within the center of the basin in an east-west direction. Test Pit 04-5 was excavated in the eastern knoll and encountered bedrock at a depth of about 4.5 feet. It is assumed that the other knolls also have shallow bedrock. These exposures indicate that bedrock may also be located at varying depths beneath the foundation of the dam. Depending on the final design of the dam, variations in the depth of bedrock could have an effect on differential settlement of the structure. Additional investigations will be needed to better define the bedrock contact beneath the dam.

III. FIELD AND LABORATORY TESTING PROCEDURES

The borings were drilled using a CME 55 rotary drill rig with a tri-cone rock bit and NW casing to advance the boring and water as the drilling fluid through the over-burden. Continuous coring was performed in bedrock using an NQ size wireline system. In addition, test pits were excavated with a 310 SE John Deere backhoe. Sampling of over-burden in the borings was performed at about five-foot intervals, while sampling in the test pits was performed at approximately three-foot intervals or at each significant change of material type. Both disturbed and undisturbed samples were obtained during the field investigations. Disturbed samples from the borings were obtained by driving a 2-inch split spoon sampling tube through a distance of 18 inches using a 140-pound weight dropped from a distance of 30 inches. The number of blows to drive the sampling spoon through each 6 inches of penetration is shown on the boring logs. The sum of the last two blow counts, which represents the number of blows to drive the sampling spoon through 12 inches, is defined as the standard penetration value. The standard penetration value, corrected for overburden and hammer energy, provides a good indication of the in-place density of sandy material; however, it only provides an indication of the relative stiffness of the cohesive material, since the penetration resistance of materials of this type is a function of the moisture content.

Undisturbed samples in the borings were obtained by pushing a thin-walled sampling tube into the subsurface material using the hydraulic pressure on the drill rig. Undisturbed samples in the test pits were recovered by cutting block samples or by pushing consolidation rings into undisturbed benches

excavated into the side walls of the test pit. The location at which the undisturbed samples were obtained is shown on the boring and test pit logs.

Miniature vane shear tests, which provide an indication of the undrained shearing strength of cohesive materials, were performed on samples of the clay soil during the field investigations. The results of these tests are shown on the boring logs as the torvane value in tons per square foot (tsf).

Each sample obtained in the field was classified in the laboratory according to the Unified Soil Classification System. The symbol designating the soil type according to this system, is presented on the boring or test pit log. A description of the Unified Soil Classification System is presented in the appendix, and the meaning of the various symbols, shown on the log sheet, can be obtained from this figure.

Laboratory tests performed during this investigation to define the characteristics of the subsurface material throughout the proposed site and at the identified granular and rock borrow sources included in-place dry unit weight, natural moisture content, moisture-density (proctor) tests, Atterberg Limits, mechanical analyses, direct shear tests, laboratory permeability tests, dispersive clay tests, slaking tests, specific gravity tests, and consolidation tests. Testing was performed following procedures outlined in the American Society for Testing and Materials (ASTM) standards.

IV. FOUNDATION INVESTIGATION

Prior to beginning the subsurface investigation, a site reconnaissance was made to determine the optimal alignment for the dam. Topographically, the ridges at the southern end of the valley appear to provide the most efficient alignment for the dam enclosure. It was apparent that the ridges are relatively narrow and, to provide adequate abutment support, it was our opinion that the alignment shown on Figures 2 and 4 should be used for the embankment.

The characteristics of the subsurface material at the site were evaluated by drilling five borings to depths ranging from 39 to 101 feet and excavating two test pits to depths of about twelve feet. The drill hole and test pit locations are shown in Figure 4. The logs for the borings and test pits are presented in Test Hole Log section of this report. All five drill holes were completed within or very near the footprint of the proposed dam.

Both the drill holes and the test pits were used in evaluating the characteristics of the overburden material at this site. Bedrock core was recovered from four of the borings to assess the competency and condition of the foundation bedrock. Photographs of the core from the drill holes are included in the Test Hole Log section of this report.

Three holes were drilled within the footprint of the dam and one hole was drilled on each of the abutments at the locations shown in Figure 4. The test holes are also shown on the profile presented in Figure 5.

DH 04-1, 04-2 and 04-4 were drilled vertical and DH 04-3 and DH 04-5 were drilled at an angle of 60 degrees from horizontal. The percent recovery and Rock Quality Designation (RQD), along with the results of field permeability tests are shown on the logs and in profile view on Figure 5.

While the drill logs indicate the angles and direction the hole was drilled, the core is not classified as being "Oriented"; hence, the actual direction of bedding and fractures seen in the core can not always be determined. Terms on the drill logs such as vertical fractures and angles of bedding, refer to how they appear relative to the cored sample and not to actual vertical and horizontal at the surface.

Test Pit 04-1 was completed between the right abutment and the maximum section beneath the upstream shell portion of an earthfill type structure at approximately elevation 5463 feet. Test Pit 04-7 was completed on the centerline alignment at the maximum section of the proposed structure midway between DH 04-4 and DH 04-2 at elevation 5458 feet.

1. SOIL PROFILE

It will be observed from DH 04-1, 04-2 and 04-4 that the depth of soil overburden on the valley floor varies at these particular locations from 20 to 47 feet. Deeper channels may also be present which were not encountered by these borings. It should also be noted that TP 04-5 excavated on the small knoll at the upstream toe near the maximum section encountered heavily weathered shale bedrock at a depth of only four feet.

The soil overburden sampled from the drill holes and test pits consists predominantly of lean clay with interbedded layers and lenses of fat clay, sandy silt, and silty sand with pockets of gravel. The overburden is a combination of weathered material from the underlying Tropic Shale formation and alluvial material washed down from the surrounding slopes. The silt and clay deposits were heterogeneously layered with some sections of the test pits showing distinct layers several inches in thickness and other sections of the test pits showing thin closely spaced lenses less than an inch in thickness. When combined, these layers generally exhibit the characteristics of lean clay with medium plasticity and good workability. The silt and clay deposits were visually observed to have a low to moderate mineral content. A close examination of the sidewall of these test pits showed that the interbedded layers of silty sand were generally fine grained and from one to six inches in thickness. Gravel particles tended to be sandstone or shale in origin with sub-angular to sub-rounded edges. Generally the pockets of gravel were fine grained with a size range of ¼ to 1 inch. The gravel layers which made up these scattered deposits were observed to be from one to three feet in thickness. A few cobbles and boulders were encountered with maximum particle size of about 12 inches. A pin-hole type structure was readily evident in the silt and clay type deposits in the test pits. The moisture content of the samples varied from dry to very dry.

Standard Penetration Test (SPT) values ranged from 6 to 55 indicating the material is in a firm to hard condition. Thirteen disturbed samples were recovered and seven undisturbed samples were recovered from the bore holes. Some of the undisturbed samples recovered were not extracted intact due the very dry condition of the soil.

The overburden on the abutments was removed during construction of the access roads for DH 04-3 and DH 04-5. Drilling began directly in the weathered bedrock. It is estimated from the access road cut that the depth of overburden prior to its removal was between 1 and 3 feet.

2. BEDROCK PROFILE

The quality of the bedrock is characterized by the percent of core recovered, along with the rock quality designation (RQD). The RQD is the percent of material within a cored interval that is twice as long as the cored diameter (segment at least 4 inches long). The core generally consisted of gray mudstone (Tropic Shale Formation) with occasional bentonite layers. It will be noted from the boring logs and Figure 5 that the percent recovery and RQD ranged from 63 to 100% in DH 04-1 and DH 04-2 located on the valley floor.

In DH 04-3 on the right abutment, the bedrock in the upper 25 feet was highly weathered and fractured, with the percent recovery ranging from 78 to 100 and the RQD varying from 18 to 65. Below 25 feet, the percent recovery ranged from 69 to 100 and the RQD varied from 42 to 100 with the layer between 32 and 38 feet having 0 RQD. Minor gypsum coating was observed on some joints in the upper 70 feet. Bentonite layers, approximately 1.5 feet thick, were encountered at 25, 75 and 95 feet.

In DH 04-5 on the left abutment, the bedrock in the upper 40 feet was highly fractured, with the percent recovery ranging from 0 to 96 and an RQD of 0. Below 40 feet, the bedrock was relatively competent with the percent recovery ranging from 80 to 100 and the RQD varying from 60 to 100. A few random gypsum stringers were observed in the core between 28 and 46 feet. Bentonite layers ranging in thickness from 0.5 to 2 feet were encountered at 71, 77 and 89 feet.

3. GROUNDWATER

Ground water was not encountered in the test pits. Temporary monitoring wells consisting one inch PVC pipe were installed in each of the drill holes completed in April/May 2004. Each of the wells was bailed out upon completion of drilling. On June 3, 2004 the wells were bailed out again and ground water levels were recorded. The results are shown on the following table:

Water Table Readings - Recorded June 3, 2004

Drill Hole	Orientation	Depth		Elevation		Water Table	
		Angle	Vertical	Top	Bottom	Depth	Elevation
04-1	Vertical	-	90	5454	5364	46.8'	5407.2
04-2	Vertical	-	39	5458	5419	17.0'	5441.0
04-3	60° Dip	100.5	87	5546	5445.5	71.0'	5484.5
04-4	Vertical	-	41	5458	Caved at 29'	Dry @ 29'	-
04-5	60° Dip	101	87.5	5542.5	5441.5	36.0'	5511.3

The groundwater level at each bore hole is also shown on the Geologic Profile in Figure 5 and it will be observed that the gradient is toward the center of the basin.

4. PERMEABILITY

Permeability tests were conducted in both the soil overburden and the foundation bedrock. The test results are shown on the boring logs and the profile view in Figure 5. Permeability calculations are included in the appendix. It will be observed from Figure 5 that the permeability of the silt and clay overburden varied from 0 to 189 ft/yr. It will also be observed that the permeability of the Tropic Shale Formation is relatively low except within the upper 50 feet of the abutments in the more heavily fractured rock. Permeability tests in the upper 50 feet on the abutments in DH 04-3 and DH 04-5 show rates varying from 300 to 6,000 ft/yr. Below a depth of 50 feet in DH 04-3 on the right abutment, the permeability ranged from 0 to 394 ft/yr. Below a depth of 45 feet in DH 04-5 on the left abutment, the permeability ranged from 0 to 5 ft/yr.

5. LABORATORY TESTING

Laboratory tests performed to define the characteristics of the dam foundation included (1) Atterberg Limits, (2) in-place density, (3) consolidation (4) direct shear, and (5) slake durability. The results of the mechanical analyses, Atterberg Limits, dry unit weight and moisture content tests are summarized on the logs and in Table 1, Summary of Test Data contained in the Laboratory Testing Section of this report. The results of all tests are discussed below as follows:

A. Atterberg Limits

Fourteen Atterberg Limits tests were completed on soil samples recovered from the drill holes and test pits within the foundation area to determine the plasticity characteristics. It will be observed from Table 1 that the liquid limit varied from 20 to 58 while the plasticity index ranged from 5 to 34. Thirteen of the 14 samples classify as lean clay, with one sample classifying as fat clay.

Eight sections of bedrock core were pulverized from TP 5 at 6 and 9 feet, DH 04-1 at 53 and 73 feet, DH 04-2 at 26 feet, DH 04-3 at 14 feet and DH 04-5 at 41 and 48 feet to define the characteristics of the Tropic Shale mudstone. The liquid limit of these samples ranged from 43 to 82 while the plasticity index varied from 24 to 50. Six of the eight samples classify as fat clay, with two classifying as lean clay.

B. In-Place Density

The in-place dry density was determined for nine samples obtained at select locations, and the results of these tests are also included in Table 1, Summary of Test Data. It will be observed that the in-place density varied from 82.0 to 120.3 pcf.

C. Consolidation Tests

The compressibility, collapse and expansive characteristics of the clay were evaluated by performing eight consolidation tests on undisturbed samples recovered from DH 04-1, DH 04-2 and TP 7. The results of the consolidation tests are presented in the Laboratory Testing Section of this report. During the performance of the consolidation tests, each sample was loaded at the natural moisture content until a load intensity of 0.28 tsf had been reached. At this point in the loading cycle, each sample was permitted to absorb water without any increase in the load intensity. Soils having collapsible characteristics settle without any increase in the load when they become wet or saturated. It will be observed from these figures that the two samples from Test Pit 7 at 3 and 9 feet in depth exhibited some slight collapse characteristics.

Expansive soils always experience an increase in void ratio on absorbing water. It will be observed that five of the eight samples from the drill holes swelled when water was added. A summary of the Atterberg Limits and percent swell/collapse for each of the samples tested is shown on the following table.

Test Hole	Depth (ft)	Soil Type	Atterberg Limits		Dry Unit Weight (pcf)	Moisture Content (%)	Percent Swell (%)
			Liquid Limit	Plastic Index			
DH 1	5-6.5	CL-1	32	14	120.3	9.8	1.4
DH 1	15-16.5	CL-2	37	19	119.4	8.7	3.1
DH 1	25-26.5	CL-2	34	18	112.4	14.3	1.2
DH 1	35-36.5	CL-2	49	31	105.2	17.5	1.6
DH 1	45-46	CH	50	34	100.7	23.1	0
DH 2	15-16.5	CH	58	34	111.8	19.3	4.3
							Percent Collapse (%)
TP 7	3-4	CL-ML	26	6	86.9	6.5	1.2
TP 7	9-10	CL-1	33	15	89.6	9.1	< 0.5

D. Direct Shear

To obtain an indication of the drained shear strength of the cohesive material, two consolidated drained direct shear tests were performed on samples from TP 7 at 6 feet. One test was performed on an undisturbed block of the lean clay, and one test was performed on a re-molded sample compacted to a density of approximately 98% of the maximum density as determined by ASTM D 698. The results are presented in the Laboratory Testing Section of this report. A summary of the results from the direct shear tests are shown in the following table:

Test Hole	Depth (ft)	Soil Type	Condition	Friction Angle ϕ (degrees)	Cohesion (psf)
TP 7	6	CL-2	Undisturbed	29.9	144
TP 7	6	CL-2	Remolded	30.2	288

E. Slake Durability

Slaking tests were performed in accordance with ASTM D 4644 on the weathered shale / mudstone. The results of the test are shown in the following table:

Test Hole	Depth (ft)	Classification	Location	Slake Durability Index (%)
04-1	53	CH	MAX. SECTION	34.2
04-1	73	CH	MAX. SECTION	6.7
04-2	26	CH	TOE LEFT ABUTMENT	2.9
04-3	14	CH	RIGHT ABUTMENT	0.0
04-5	41	CL-2	LEFT ABUTMENT	3.4
04-5	48	CL-2	LEFT ABUTMENT	2.4

V. BORROW INVESTIGATION

1. IMPERVIOUS BORROW

Based upon the geologic studies, test holes located within the foundation footprint and observation of soils within gullies throughout the basin, sufficient impervious material appears to exist with the reservoir basin to construct an earthen embankment. In addition to the drill holes and test pits performed in the foundation area, 11 additional test pits were excavated throughout the basin at locations as shown in Figure 2. The test pit logs are included in the Test Hole Log Section and it will be observed that the soil profile in 10 of the 11 pits consists predominately of dry, hard lean clay with some interbedded silt and sand. Test Pit 13, located at the upper end of the basin, encountered silty sand with clay layers to a depth of 12 feet.

Information on material type and material distribution for test pits from the 1997 Engineering Memorandum (included in the appendix) was considered satisfactory and, as such, these areas within the basin were not covered with test pits during this investigation.

A. Laboratory Testing

Laboratory tests performed to define the characteristics of the impervious borrow included (1) Atterberg Limits, (2) mechanical analysis, (3) in-place density and natural moisture content, (4) soil moisture-density relation (proctor), (6) direct shear, (8) dispersive clay, and (9) laboratory permeability. The results of the mechanical analyses, Atterberg Limits, dry unit weight and moisture content tests are summarized on the logs and in Table 1, Summary of Test Data. The results of all tests are discussed below as follows:

(1) Atterberg Limits

Twenty six Atterberg Limits tests were completed on soil samples recovered from the drill holes and test pits within the foundation and reservoir basin area to determine the

plasticity characteristics. It will be observed from Table 1 that the liquid limit varied from 20 to 58 while the plasticity index ranged from 5 to 34. Twenty five of the 26 samples classify as lean clay, with one sample classifying as fat clay.

(2) Mechanical Analyses

Mechanical analyses were completed on twenty-six samples of the soil overburden recovered from the reservoir basin. The clay and silt samples contained 0% percent gravel and between 0 and 47% sand. The percent finer than a No. 200 sieve ranged from 53 to 100, with an average of 90%. A sand layer encountered in TP 3 from 0 to 1 feet had 25% gravel and 2% silt. A sand layer encountered in TP 4 at 5.5 feet had 0% gravel and 18% silt.

(3) Natural Moisture Content

The natural moisture content of twenty six samples was determined with values ranging from 3.4 to 23.1%. It will be noted that the natural moisture content of the samples from the test pits, which varied from 3 to 12 in depth, were all below 10%.

(4) Soil Moisture-Density Relation (Proctor) Tests

Three proctor tests were completed on samples of the lean clay / silty clay obtained from TP 04-1 at 3 feet, and TP 04-7 at 3 and 6 feet. The tests were completed in accordance with procedures outlined in ASTM D 698. The proctor curves are included in the Laboratory Testing Section. It will be noted that the maximum dry unit weight varies from 114 to 116 pcf and the optimum moisture content ranges from 14 to 16%.

(5) Dispersive Clay Tests

The dispersive characteristics of the impervious material were evaluated by performing pinhole tests on nine samples. The results of these tests are shown on Table 1 in the Laboratory Testing Section. Tests were conducted on samples from the test pits in the reservoir basin. The following table is a summary of the classification categories:

DISPERSIVE CLAY CHARACTERISTICS BY PIN HOLE TEST METHOD

CATEGORY	DESCRIPTION
D1, D2	DISPERSIVE
ND 3, ND 4	SLIGHTLY TO MODERATELY DISPERSIVE
ND 2, ND 1	NON-DISPERSIVE

It will be observed from the Summary of Test Data that 5 of the 9 samples classified as ND 2: non-dispersive, with the remaining 4 samples classifying as ND 3: slightly dispersive.

(6) Laboratory Permeability Tests

Constant head laboratory permeability tests were performed on three remolded samples of the lean clay obtained from the test pits in the reservoir basin. TP 1 at 3 feet, and TP 7 at 3 and 6 feet. The samples were placed in the permeability mold at 98% compaction and saturated using back-pressure techniques. The results of the tests are shown in the following table.

Test Hole	Depth (ft)	Soil Type	Coefficient of Permeability (ft/yr)
04-1	3	CL-1	0.09
04-7	3	CL-ML	0.23
04-7	6	CL-2	0.07

2. GRANULAR BORROW MATERIALS

Work performed during the investigation for granular borrow included identification of potential borrow areas, and limited laboratory testing of select soil samples to determine material properties. As stated above, no significant granular borrow sources were identified within the reservoir basin. Two commercially available granular borrow sources were identified within about 1 mile of the site as shown in Figure 3. The first site, referred to as Rose Pit, and is located across Highway 89 and just east of the Virgin River adjacent to Orderville. The second source is referred to as the Tate Pit and is located just east of the town of Mt. Carmel. Bucket samples of bank run material were collected from both the Rose and Tate gravel pits for laboratory testing. The sidewall of the cuts was also observed for variation in material layering. It was noted that in both of the cuts the sidewalls showed clay layers up to 6 feet thick interbedded among the sand and gravel deposits.

Gradation tests were completed on the bulk samples, and gradation curves are shown in the Laboratory Testing section of this report. The material in the Rose Pit classified as a well-graded gravel with silt and sand (GW-GM), while the material in Tate Pit classified as a poorly graded gravel with sand (GP).

Specific gravity and absorption tests were conducted these samples. The results of the tests show the gravelly sand at the Rose Pit to have an apparent specific gravity of 2.67 with absorption of 1.6%. The sandy gravel at the Tate Pit has an apparent specific gravity of 2.67 with absorption of 2.3%.

3. RIPRAP

No significant rock borrow sources were identified within the immediate vicinity of the reservoir basin. The most likely potential source of rock for use as riprap is a basalt formation near the town of Glendale or the limestone rock just south of the Orderville sewer lagoons. This same

limestone unit is also exposed at the northeast end of town. Potential riprap sources are identified in Figure 3.

Specific gravity and absorption tests were conducted both the limestone and basalt rock samples. The results of the tests show the basalt rock with an apparent specific gravity of 2.68 and an absorption of 0.9%. The limestone rock has an apparent specific gravity of 2.65 with an absorption of 0.8%.

Further testing of the rock material intended for use as riprap will be required during the final design stage of this project; however, it appears that either the limestone or basalt rock will serve satisfactorily as slope protection.

VI. FEASIBILITY ANALYSIS AND CONCLUSIONS

Based upon the information summarized in the previous sections, it is our opinion that a reservoir can be constructed at this site with a maximum storage capacity of about 8800 acre feet covering an area of 210 acres. We believe that an earthfill dam will be the most efficient structure for the reservoir. This opinion is based upon (1) the characteristics of the foundation material, (2) an adequate source of embankment material within the basin and (3) the lack of a good source of gravel and rock in close proximity to the site for construction of an RCC or rockfill type structure. Detailed analyses have, therefore, been limited to an earthfill type embankment.

1. EARTHFILL EMBANKMENT CROSS SECTION

The plan view and maximum section for the proposed embankment are presented in Figures 4 and 6. It will be observed from Figure 6 that a homogeneous embankment with an internal chimney filter/drain is proposed. Zone I will consist of relatively impervious material from foundation excavation and the reservoir basin. The material will be predominately lean clay. Material within the borrow is several percent below optimum moisture for placement and pre-wetting of the borrow areas will be required. Excavation methods will require mixing to blend silt and sand layers with the clay to achieve at least 50% minus No. 200 material. An 8 foot wide chimney filter/drain has been located downstream of centerline and will be designed as a crack stopper to protect the lean clay from piping and to intercept water, preventing saturation of the downstream embankment. Slope protection will be required, with rock riprap and bedding planned for the upstream slope and seeding planned for the downstream slope.

A 6 inch surface course of untreated road base is recommended to cap the crest of the dam to provide a finished surface. The crest should be sloped at 2% downward toward the reservoir to prevent ponding of rainwater.

A crest width of 25 feet has been assumed, with an upstream slope of 3 horizontal to 1 vertical and downstream slope of 2 horizontal to 1 vertical based upon the nature of the materials. It is

anticipated that a freeboard of between 7 and 10 feet will be required above the spillway level to provide protection from wave action and deformation associated with potential seismic activity. A conservative freeboard of 10 feet has been assumed for the feasibility study.

2. STABILITY ANALYSIS

Preliminary slope stability analyses were performed using strength parameters based upon limited field and laboratory testing. The analyses for the dam were performed for the upstream and downstream slopes for steady-state reservoir full conditions and the upstream slope for sudden draw-down conditions.

The stability analyses were performed using the slope stability program UTEXAS2, developed by Stephen Wright at the University of Texas for the U.S. Corps of Engineers. Spencer's Method satisfies both force and moment equilibrium and is considered to be a satisfactory procedure for solving limiting equilibrium problems The factor of safety is determined by dividing the forces resisting movement by those causing movement.

The phreatic surface was modeled for steady state seepage using a reservoir full condition and for sudden drawdown as shown on Figure 6. The results of the stability analyses are shown in Figure 6 and summarized in the following table:

Analysis	FACTOR OF SAFETY	REQUIRED MINUMUM FACTOR OF SAFETY
Downstream Slope Steady State	1.51	1.5
Upstream Slope Steady State	2.18	1.5
Upstream Slope Sudden Drawdown	1.2	1.2

Based upon the results of the preliminary stability analyses, it is our opinion that the proposed cross section will be adequate, with minor adjustments.

3. SETTLEMENT ANALYSIS

A settlement analysis was performed for the maximum section using the results of consolidation tests performed on undisturbed samples obtained from Drill Hole 04-1, 04-2 and Test Pit 04-7 and the computer model EMBANK. A settlement of 48 inches was computed at the center of the maximum section with about 1 inch at the upstream and downstream toes. Eighteen of the 48 inches occurs in the upper 10 feet where collapsible type soils were encountered. Based upon field observations as discussed previously, it is expected that the foundation bedrock will have an irregular surface which could lead to differential movement. It is our opinion that the embankment cannot tolerate this magnitude of settlement without adverse effects (i.e. cracking). It is recommended that excavation of the dam footprint be performed such that settlement is limited to less than 6 inches. This will require excavation of a portion of the overburden as shown in the cross section on Figure 6.

4. FOUNDATION TREATMENT

It is recommended that a portion of the overburden soil be excavated as discussed above to limit settlement. The excavated material can be used as embankment fill. Pre-wetting of this soil should be performed prior to excavation to allow for utilization as fill. A cutoff trench will be required extending through the weathered mudstone and into competent rock.

The field investigations revealed significant fracturing of the bedrock at select locations – principally on the abutments. The results of the permeability tests show that significant seepage loss can be expected through the bedrock abutments. Due to the nature of the foundation bedrock, it is believed that a majority of the seepage will be a result of secondary permeability through fractures and joints, rather than primary permeability. To mitigate the potential harmful effects of large seepage losses, we anticipate that final design to include the following:

A. Impervious Clay Cut-Off Trench

We recommend that an impervious clay cut-off trench extend through the overburden soil and weathered bedrock and be seated a minimum of 5 feet into competent bedrock. Fractures and joints beneath the impervious cut-off and sand filter should be cleaned for a depth of at least twice the width of the fracture opening and filled with dental grout. The base of the cutoff should not be exposed for more than ~24 hours to prevent air slacking and cracking of the mudstone.

B. Grout Curtain

Based on the permeability test results and the condition of the recovered bedrock core, we recommend a foundation grouting program for the abutments. To assess the costs of such a program, a preliminary grout curtain design has been completed. The grout curtain will be located beneath the centerline of an earthfill type structure and will consist of a triple row grout curtain placed up both abutments as shown in Figure 5.

C. Downstream Filter and Drain

A downstream filter and drainage blanket is recommended beneath the downstream side of the dam as shown in Figure 6. This mitigates potential for piping of embankment material and facilitates drainage of seepage which may bypass the cut-off.

A collector toe drain is recommended for the entire length of the dam. In addition to the toe drain, interceptor finger drains should be placed at select locations throughout the downstream footprint of the dam to identify areas where seepage occurs and carry the seepage to the downstream toe drain. Manholes should be placed at the intersection of each finger drain with the toe drain to allow monitoring.

5. OPINION OF PROBABLE COST

Based upon results of the preliminary investigation and the proposed embankment cross section discussed above, a cost analysis has been performed which represents our opinion of probable cost (OPC) associated with construction of the dam embankment. The cost is shown in the following tables below. The value does not include the cost of land or piping to bring water to the reservoir. It should be recognized that the quantity of foundation excavation and, hence, earthfill is based on limited borings across the valley floor and that these quantities may vary significantly when additional data is obtained. The cost assumes that sand, gravel and riprap will be available from sources identified within a 5 mile radius of the site. Although hydraulic analysis and spillway design was beyond the scope of this study, it is assumed that the spillway can be designed to pass around the right abutment.

OPC FOR TOP OF DAM ELEVATION 5550 FEET

Item	Quantity	Unit	Unit Price	Total Price
Mobilization & Demobilization (10%)	1	Lump Sum		$ 750,345.00
Earthfill, Zone I – Dam Embank.	1,401,650	CU. YD.	$ 3.00	$ 4,204,950.00
Earthfill, Zone II – Filter / Drain	69,500	CU. YD.	$ 25.00	$ 1,737,500.00
Rock Riprap	23,700	CU. YD.	$ 30.00	$ 711,000.00
Grout Curtain	25,000	LIN. FT.	$ 30.00	$ 750,000.00
Outlet Pipe & Appurtenant Structures	500	LIN. FT.	$ 200.00	$ 100,000.00
		SUBTOTAL		**$ 8,253,795.00**
Engineering / Contingencies		(Estimated at 30% for Feasibility Stage)		$ 2,476,138.00
		TOTAL		**$ 10,729,934.00**

OPC FOR TOP OF DAM ELEVATION 5560 FEET

Item	Quantity	Unit	Unit Price	Total Price
Mobilization & Demobilization (10%)	1	Lump Sum		$ 1,011,460.00
Earthfill, Zone I – Dam Embank.	2,026,200	CU. YD.	$ 3.00	$ 6,078,600.00
Earthfill, Zone II – Filter / Drain	91,400	CU. YD.	$ 25.00	$ 2,285,000.00
Rock Riprap	29,700	CU. YD.	$ 30.00	$ 891,000.00
Grout Curtain	25,000	LIN. FT.	$ 30.00	$ 750,000.00
Outlet Pipe & Appurtenant Structures	550	LIN. FT.	$ 200.00	$ 110,000.00
		SUBTOTAL		**$ 11,126,060.00**
Engineering / Contingencies		(Estimated at 30% for Feasibility Stage)		$ 3,337,818.00
		TOTAL		**$ 14,463,878.00**

Assuming 10 feet of freeboard, a storage capacity of 6800 ac ft is obtained with the top of dam at elevation 5550 feet, resulting in a cost per acre foot of $1,578. A capacity of 8800 ac ft is obtained with the top of dam at elevation 5560 feet, resulting in a cost per acre foot of $1,644.

6. ADDITIONAL STUDIES REQUIRED FOR FINAL DESIGN

Work required to complete the reservoir design includes the following:

- Hydrologic analysis for freeboard, spillway and outlet work design.
- Outlet works and spillway design.(It appears that the spillway can be efficiently designed to pass around the right abutment.)
- Additional foundation investigation-anticipated to include about one boring every two hundred feet along the embankment alignment.
- Additional borrow investigations to verify that at least 1.5 times the quantity of materials needed for construction exist within the proposed borrow areas.
- Additional laboratory testing to evaluate properties of foundation and embankment materials. These tests will include triaxial shear, and sulfate tests.
- Final stability, seepage, and settlement analyses.
- Final embankment design
- Final design report.
- Preparation of plans and specifications.

Figures

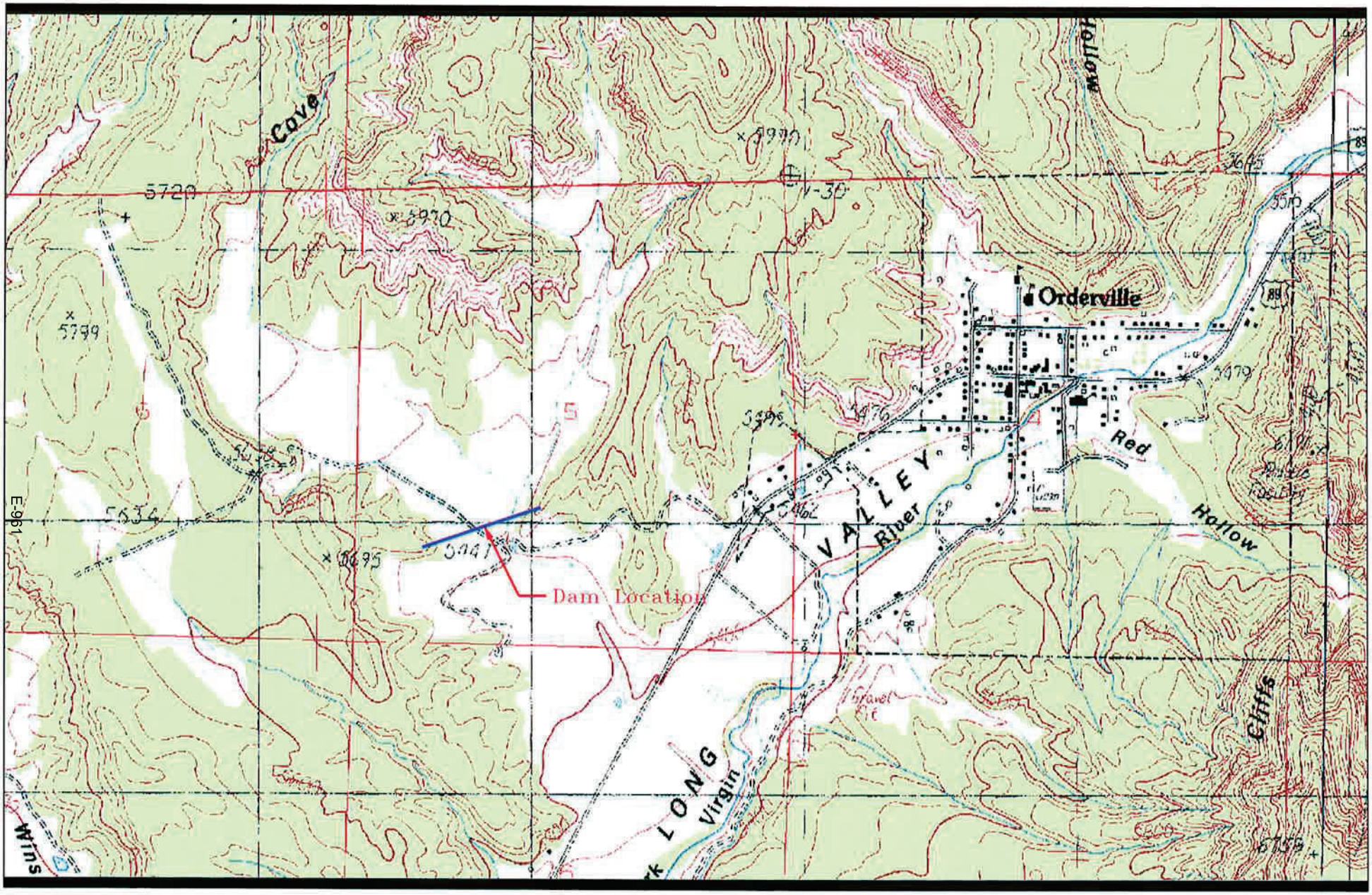

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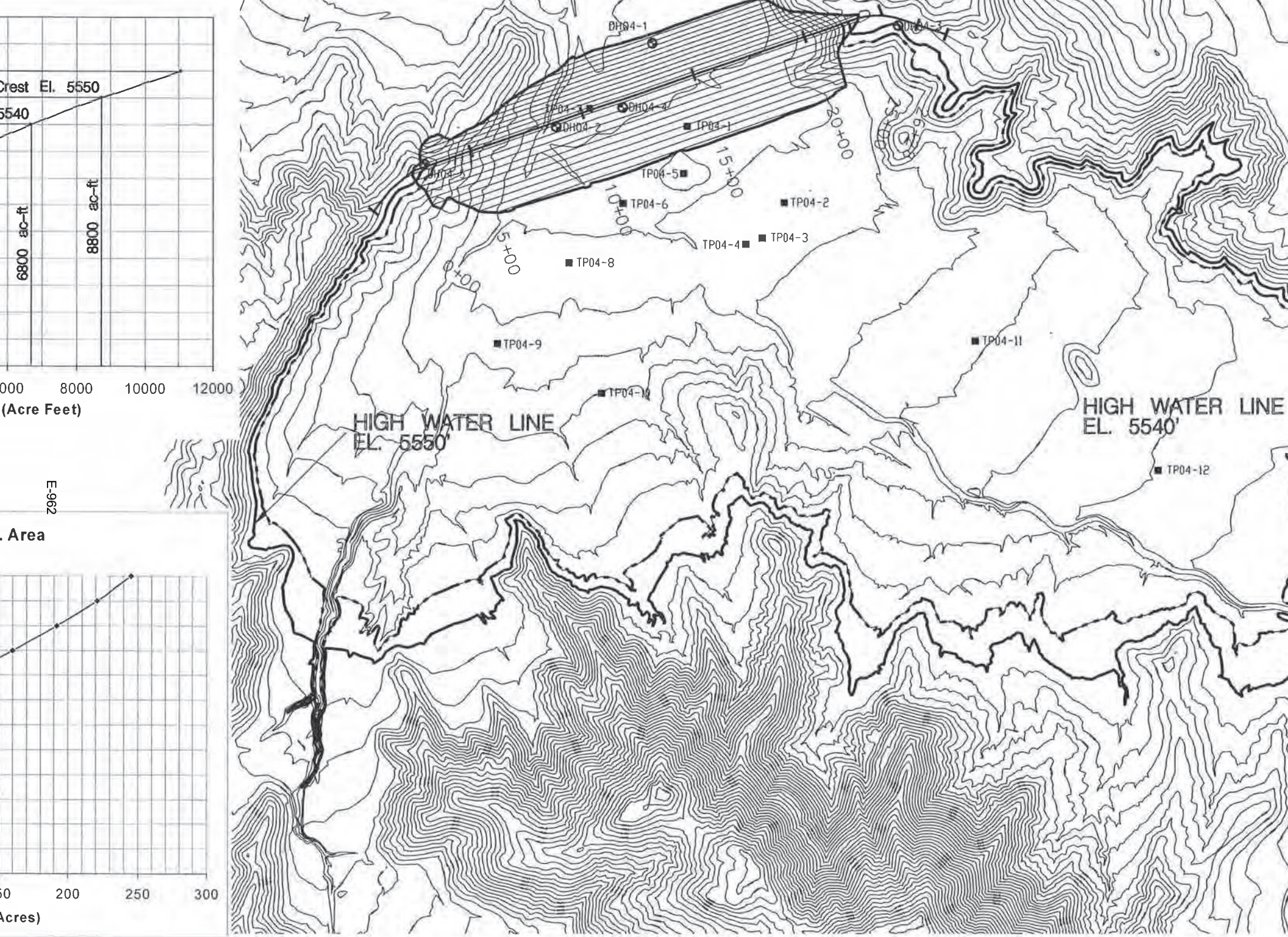
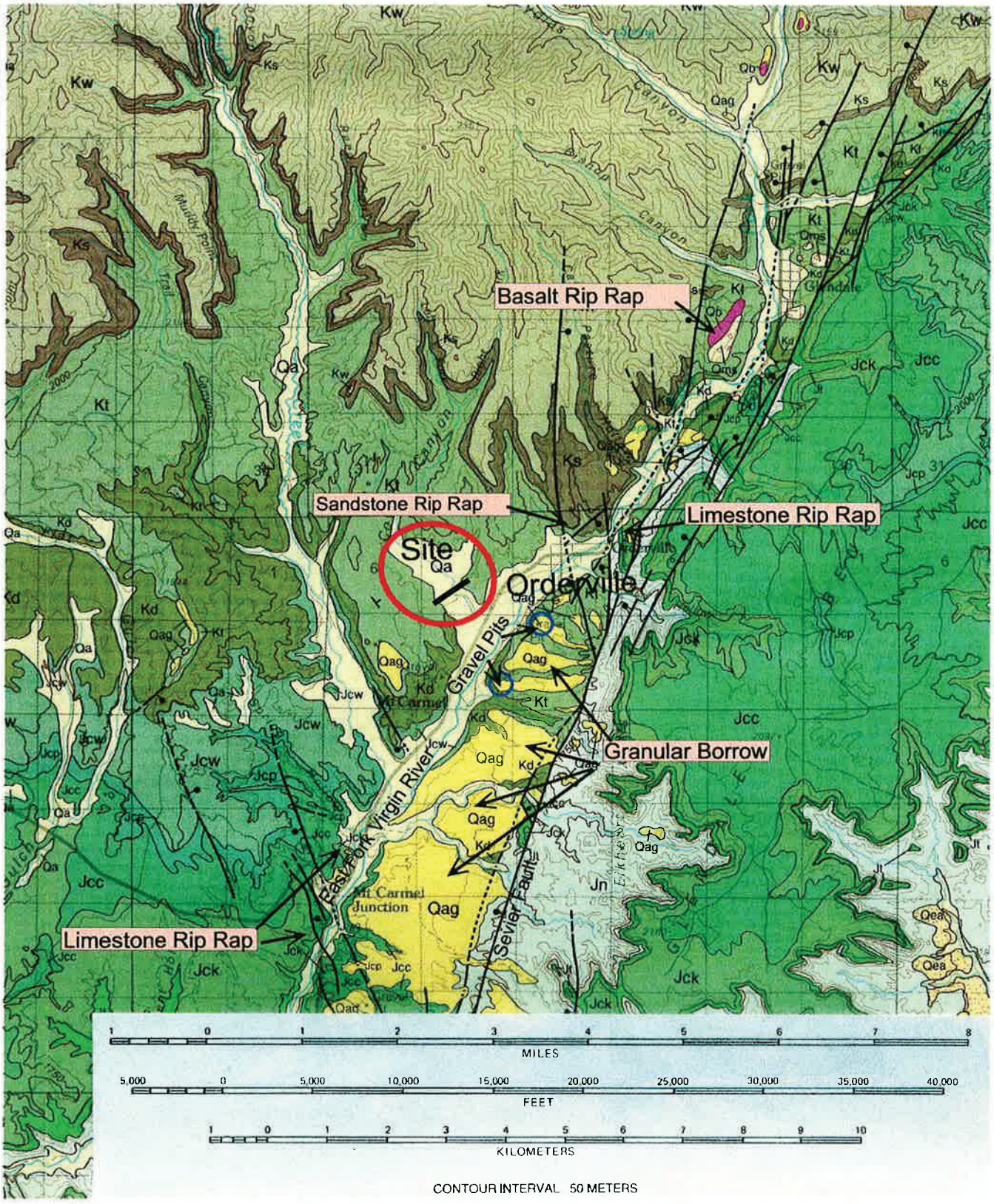
Figure 1 **SITE PLAN**

Cove Dam
Orderville, Utah


Crest El. 5550
5540
6800 ac-ft
8800 ac-ft
000
8000
10000
12000
(Acre Feet)
E-962
. Area
50
200
250
300
Acres)
DH04-1
DH04-3
DH04-4
DH04-2
DH04-5
TP04-1
TP04-2
TP04-3
TP04-4
TP04-5
TP04-6
TP04-8
TP04-9
TP04-10
TP04-11
TP04-12
20+00
15+00
10+00
5+00
0+00
HIGH WATER LINE
EL. 5550'
HIGH WATER LINE
EL. 5540'



See text for description of Geologic Units

Modifed from Geologic Map of Kane County, Doelling etal, 1989

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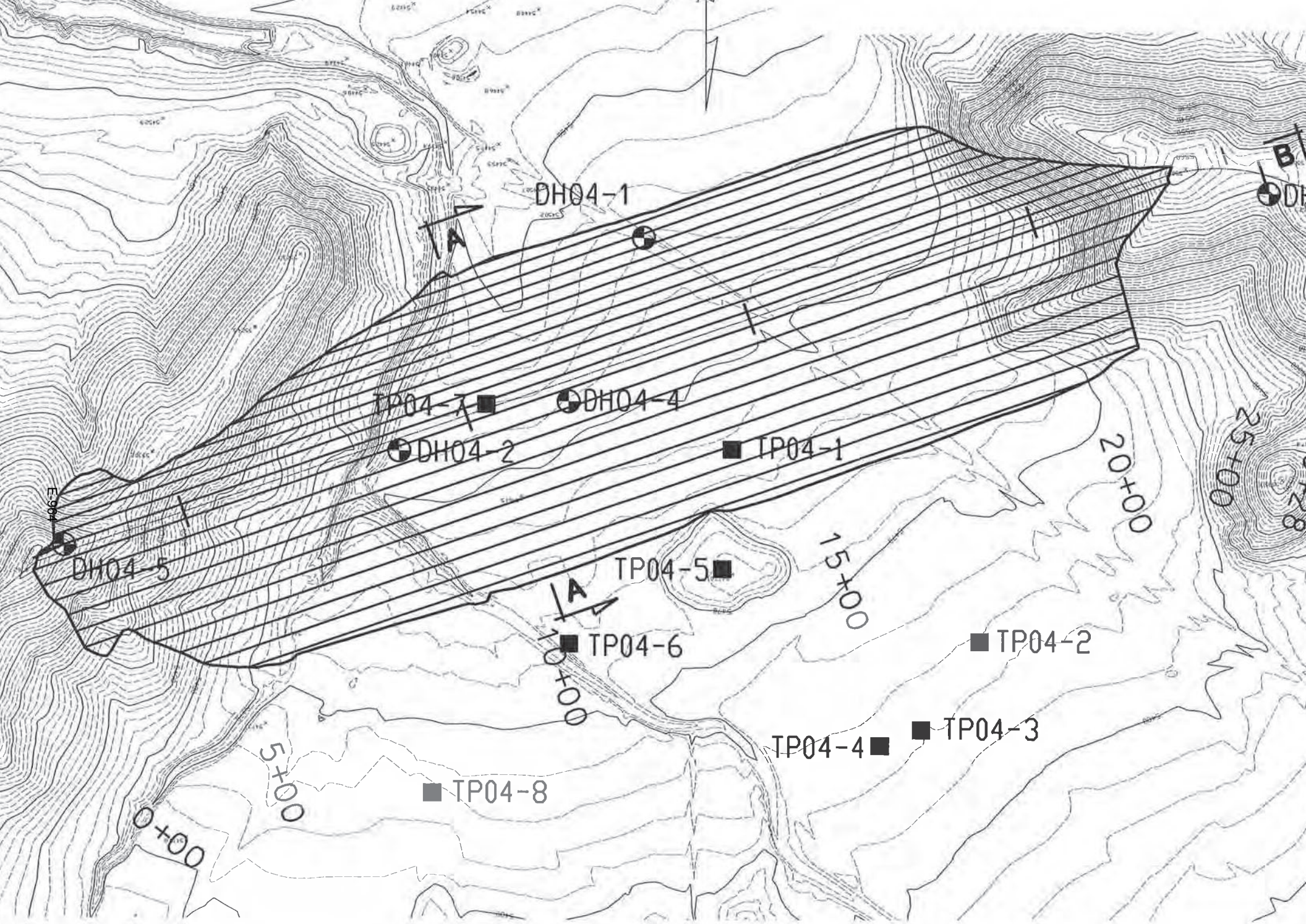
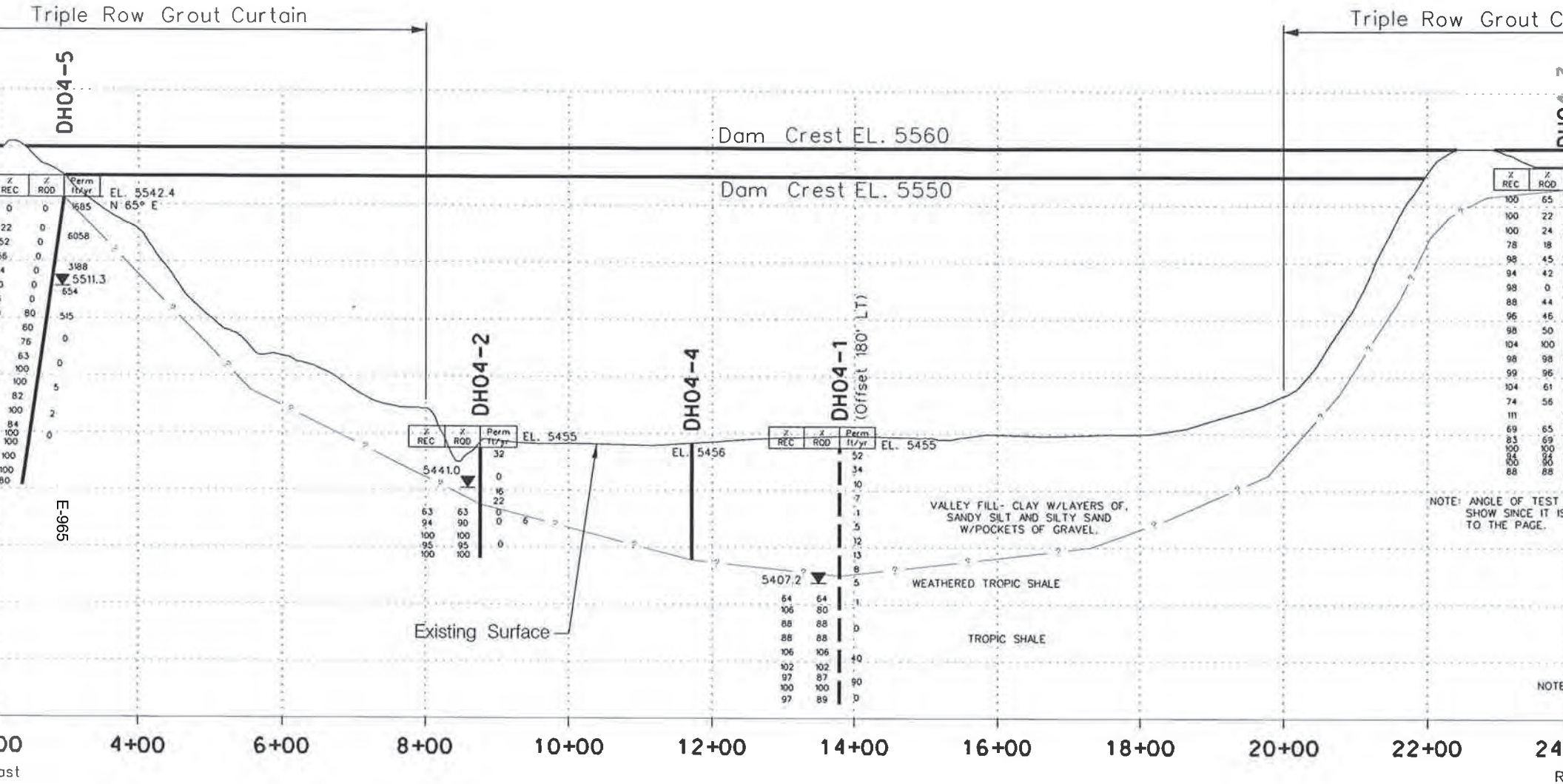
Provo, Utah

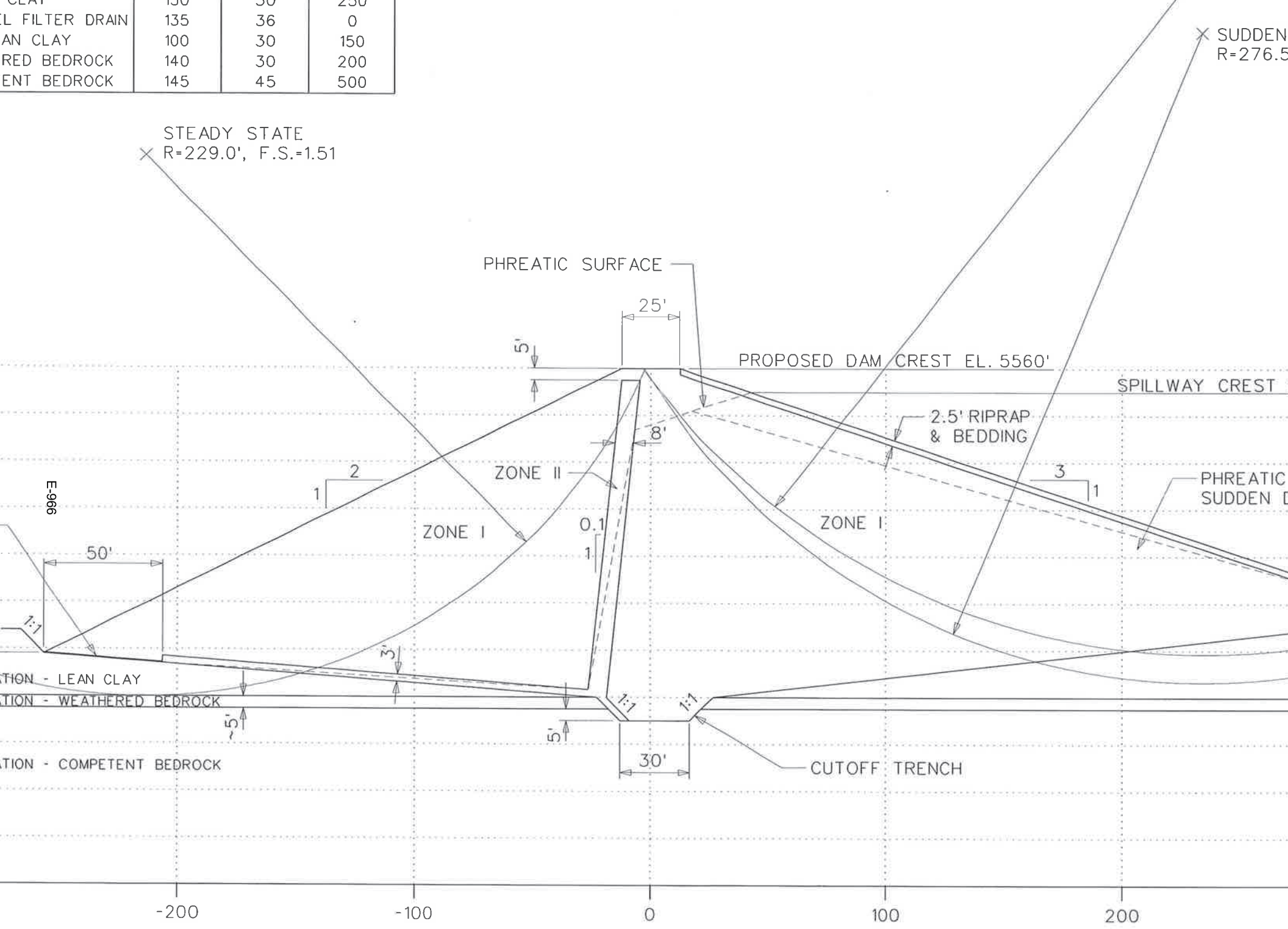
Figure 3 Geologic Map of Cove Dam Area with Potential Borrow Sources
Project *Cove Dam Site, Feasibility Study*
Location *Orderville, Kane County, Utah*


DH04-1
A
TP04-7
DH04-4
DH04-2
TP04-1
DH04-5
TP04-5
A
TP04-6
TP04-2
TP04-4
TP04-3
TP04-8
0+00
5+00
10+00
15+00
20+00
25+00
B



GEOLOGIC CROSS-SECTION (PROFILE)

CLAY	150	30	250
L FILTER DRAIN	135	36	0
AN CLAY	100	30	150
RED BEDROCK	140	30	200
ENT BEDROCK	145	45	500



Borings

DRILL HOLE LOG

BORING NO. 04-1

Sheet: 1 of 2

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 4/13/04
LOCATION: SEE SITE PLAN - MAXIMUM SECTION — ELEVATION: ~5454.0'
DRILLER: D. SAMPSON, N. BAILEY — LOGGED BY: M.H., V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.W. CASING TO 51.5'
DEPTH TO WATER - INITIAL: ▽ N.M. AFTER 24 HOURS: ▽ 46.8' 6/3/04

Elev. (Feet)	Depth (Feet)	Lithology	Sample Type	Sample Rec. (In.)	See Legend	USCS	Material Description	Permeability, ft/yr	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5450							lt. brown, dry, firm — SILTY CLAY W/SAND, calcareous	52								
	5			6	5,3,3	CL-ML										
							lt. brown, dry, hard — LEAN CLAY		120.3	9.8	32	14	0	10	90	CT
5445				8	Pushed 1.00+	CL-1		34								
	10			5	7,9,11	CL	lt. brown, dry, very stiff — CLAY W/SAND									
5440								10								
	15			12	Pushed 1.00+	CL-2	lt. brown, dry, hard — SANDY CLAY		119.4	8.7	37	19	0	17	83	CT
5435								7								
	20			5	9,12,17	CL,SM	lt. brown, dry, very stiff — SILTY CLAY W/SILTY SAND LENSES & LAYERS									
5430								1								
	25			12	Pushed 1.00+	CL-2	lt. brown, dry, hard		112.4	14.3	34	18	0	6	94	CT
5425								5								
	30			6	8,12,13	CL	med. to lt. brown, dry, very stiff, w/white stringers — LEAN CLAY	12								
5420																
	35			18	Pushed 1.00+	CL-2	med. brown, moist, very stiff	13	105.2	17.5	49	31	0	3	97	CT
5415																
	40			18	4,6,8 0.72	CL	med. brown, moist to slightly wet, stiff	8								
5410																
	45			12	Pushed 0.72	CL-2/CH	grayish-med. brown, moist, stiff, w/white stringers — LEAN TO FAT CLAY W/SOME SAND	5	100.7	23.1	50	34	0	6	94	CT
5405							TROPIC SHALE FORMATION									
	50															

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LEGEND

- 2,3,2 ← Blow Count per 6"
- 0.45 ← Torvane (tsf)
- Disturbed Sample
- Core
- 100,60 ← Rock Quality Designation (RQD)
- Percent Sample Recovery
- Undisturbed Sample
- ▽ Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

DRILL HOLE LOG

BORING NO. 04-1

Sheet: 2 of 2

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 4/13/04
LOCATION: SEE SITE PLAN - MAXIMUM SECTION — ELEVATION: ~5454.0'
DRILLER: D. SAMPSON, N. BAILEY — LOGGED BY: M.H., V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.W. CASING TO 51.5'
DEPTH TO WATER - INITIAL: ▽ N.M. AFTER 24 HOURS: ▽ 46.8' 6/3/04

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	Rec. (In.)	See Legend	USCS	Material Description	Permeability, ft/yr	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
				18	18,28,36	CL	dk. gray, moist, hard **SLIGHTLY SHALEY CLAY** very highly weathered bedrock, w/many gypsum stringers	1								
5400				19	Core 64,64	CH				16.4	80	50	0	0	100	
	55			64	Core 106,80	-	dk. gray **HIGHLY WEATHERED MUDSTONE** few gypsum stringers									
5395							dk. gray **LESS WEATHERED MUDSTONE** shells									
	60			53	Core 88,88	-	dk. gray	0								
5390							**SLIGHTLY WEATHERED MUDSTONE**									
	65			53	Core 88,88	-	dk. gray slickenside									
5385																
	70			64	Core 106,106	-	0.25" clay seam									
5380						CH	white-gray **BENTONITE W/SAND & LIMESTONE GRAVEL**	40		13.2	70	45	0	0	100	
	75			61	Core 102,102	-	dk. gray									
5375							**MUDSTONE**									
	80			35	Core 97,87	-	broken zone									
5370				50	Core 100,100	-	dk. gray, some black corbonaceous lenses	90								
	85						white-gray **BENTONITE**									
5365				44	Core 97,89	-	dk. gray, some black corbonaceous lenses **MUDSTONE**	0								
	90															
5360																
	95															
5355																
	100															

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LEGEND

- 2,3,2 ← Blow Count per 6"
- 0.45 ← Torvane (tsf)
- Disturbed Sample
- Core 100,60 ← Rock Quality Designation (RQD)
- Percent Sample Recovery
- Undisturbed Sample
- ▽ ← Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

DRILL HOLE LOG

BORING NO. 04-2

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 4/16/04
LOCATION: SEE SITE PLAN - TOE, LEFT ABUTMENT — ELEVATION: ~5458.0'
DRILLER: D. SAMPSON, N. BAILEY — LOGGED BY: M.H., V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.W. CASING TO 21.5' THEN N.Q. CORE
DEPTH TO WATER - INITIAL: ▽ N.M. AFTER 24 HOURS: ▽ 17.0' 6/3/04

Elev. (Feet)	Depth (Feet)	Lithology	SAMPLE Type	SAMPLE Rec. (In.)	See Legend	USCS	Material Description	Permeability, ft/yr	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
	0			9	2,4,6	CL	lt. brown, dry to moist, firm, w/roots — SILTY CLAY	32								
5455																
	5			14	Pushed 1.00+	CL	dk. brown, slightly moist, hard — LEAN CLAY W/GYPSUM STRINGERS									
				7	14,22,33	CL-2	dk. brown, slightly moist, hard	0		12.2	45	31	0	2		98
5450																
	10			10	15,22,33	CL	dk. brown, moist, hard, some gypsum — LEAN CLAY W/SOME SAND SIZE SANDSTONE FRAGMENTS	16								
5445																
	15			18	Pushed 1.00+	CH	dk. brown, moist, hard — FAT CLAY		111.8	19.3	58	34	0	0	100	CT
5440								22								
	20			18	9,15,33	-	dk. gray — VERY HIGHLY WEATHERED MUDSTONE very high slaking, rapid	6								
5435				26	Core 63,63	-	LESS WEATHERED MUDSTONE	0								
	25			56	Core 94,90	CH	dk. gray, dry mech. open 0.2' joint 0.25" clay seam	0		12.5	70	47	0	0	100	
5430																
	30			48	Core 100,100	-	dk. gray, weakly calcareous — MUDSTONE calcareous, high slaking									
5425																
	35			34	Core 95,95	-	a few white silt lenses	0								
5420				36	Core 100,100	-										
	40															
5415																
	45															
5410																
	50															

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LEGEND

- 2,3,2 ← Blow Count per 6"
- 0.45 ← Torvane (tsf)
- Disturbed Sample
- Core 100,60 ← Rock Quality Designation (RQD)
- Percent Sample Recovery
- Undisturbed Sample
- ▽ ← Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

DRILL HOLE LOG

BORING NO. 04-3

Sheet: 1 of 2

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 4/26/04
LOCATION: SEE SITE PLAN - RIGHT ABUTMENT — ELEVATION: ~5546.0'
DRILLER: D. SAMPSON, M. BARBOUR — LOGGED BY: M.H., V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.Q. CORE AT 60° FROM HORIZONTAL, TREND S18° E
DEPTH TO WATER - INITIAL: ▽ N.M. AFTER 24 HOURS: ▽ 71.0' 6/3/04

Elev. (Feet)	Depth (Feet)	Lith-ology	Sample Type	Sample Rec. (In.)	See Legend	USCS	Material Description	Permeability, ft/yr	Dry Density, pcf	Atter. Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5545							gray-brown **CLAY/VERY WEATHERED MUDSTONE**	48								
	5			24	Core 100,65	-	gray-brown to brown-gray gypsum									
5540				60	Core 100,22	-	gray-brown	314								
	10															
5535				61	Core 100,24	CH	gray-brown, dry **SILTY MUDSTONE** calcareous coating, very highly weathered & fractured, multiple angle - haphazard, some gypsum coating on joints, shaley & friable			13.7	54	33	0	0	100	
	15															
5530				23	Core 78,18	-		1245								
	20															
5525				59	Core 98,45	-		1135								
	25						gray-white, some rust staining **BENTONITE**									
							brown **SHALEY MUDSTONE** 100% water loss	1398								
5520	30			56	Core 94,42	-	dk. gray w/white bedding **SILTSTONE/MUDSTONE**	1989								
				59	Core 98,0	-	interbedded dk. gray & brown, gypsum bedding **SILTY MUDSTONE** calcareous									
5515	35							1202								
	40			53	Core 88,44	-	interbedded dk. gray & brown w/white stratification clay seam									
5510																
	45			58	Core 96,46	-	**MUDSTONE** dk. gray w/brown, some rust stains, some shells, slow slaking	736								
5505																
	50			59	Core 98,50	-										

06/16/04 10:46:49 A

LEGEND

- 2,3,2 ← Blow Count per 6"
- 0.45 ← Torvane (tsf)
- Core ← Disturbed Sample
- 100,60 ← Rock Quality Designation (RQD)
- Percent Sample Recovery
- Undisturbed Sample
- Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

DRILL HOLE LOG

BORING NO. 04-3

Sheet: 2 of 2

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 4/26/04
LOCATION: SEE SITE PLAN - RIGHT ABUTMENT — ELEVATION: ~5546.0'
DRILLER: D. SAMPSON, M. BARBOUR — LOGGED BY: M.H., V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.Q. CORE AT 60° FROM HORIZONTAL, TREND S18° E
DEPTH TO WATER - INITIAL: ▽ N.M. AFTER 24 HOURS: ▽ 71.0' 6/3/04

Elev. (Feet)	Depth (Feet)	Lithology	SAMPLE Type	SAMPLE Rec. (In.)	See Legend	USCS	Material Description	Permeability, ft/yr	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5500	55		Core	62	104,100	-	dk. gray more competent, no bedding, shells, open joint at 53.4' to 53.7', 0.2" clay seam — MUDSTONE	34								
5495	60		Core	59	98,98	-	dk. gray, some white bedding, trace of gypsum	394								
5490	65		Core	59	99,96	-	rust stain & coating — SILTY MUDSTONE									
5485	70		Core	62	104,61	-	shells very hard septarian nodule	51								
	75		Core	44	74,56	-	gray, high slaking — SHALE gray — BENTONITE									
5480	80		Core	62	111,?	-	core is stuck in inner barrel and has not been removed, may contain bentonite 100% water loss	69								
5475	85		Core	41	69,65	-	dk. gray 40° slickenside MUDSTONE calcareous, some slaking, some lt. gray wavy bedding	341 0								
5470	90		Core	29	83,69	-	0.25" clay seam									
			Core	60	100,100	-	dk. gray clay seam, not calcareous									
5465	95		Core	28	94,94	-										
			Core	24	100,100	-	lt. gray — BENTONITE black & white — LIMESTONE/VOLCANIC ASH BENTONITE									
5460	100		Core	42	88,88	-	dk. gray — MUDSTONE									

LEGEND

- 2,3,2 ← Blow Count per 6"
- 0.45 ← Torvane (tsf)
- Core ← Disturbed Sample
- 100,60 ← Rock Quality Designation (RQD)
- Percent Sample Recovery
- ← Undisturbed Sample
- ▽ ← Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

06/16/04 04:02:52 P

RB&G ENGINEERING INC.
Provo, Utah

DRILL HOLE LOG

BORING NO. 04-4

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 4/30/04
LOCATION: SEE SITE PLAN - MAXIMUM SECTION — ELEVATION: ~5458.0'
DRILLER: D. SAMPSON, M. BARBOUR — LOGGED BY: M.H., V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.W. CASING
DEPTH TO WATER - INITIAL: ▽ N.M. AFTER 24 HOURS: ▽ DRY AT 29.3' 6/3/04

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Rec. (In.)	See Legend	USCS	Material Description	Permeability, ft/yr	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5455	0					CL	lt. brown, dry — SANDY LEAN CLAY									
	5															
5450																
	10			7	7,11,14	CL	lt. brown, dry, very stiff — SILTY CLAY									
5445																
	15															
5440																
	20			10	11,14,19	CL	lt. brown, dry, very stiff — SILTY CLAY W/SILTY SAND LENSES									
5435																
	25						gray — harder									
5430																
	30			14	11,15,20	CL/SC	mottled rusty & yellow-brown, slightly moist to dry, hard — SANDY CLAY									
5425																
	35			18	15,32,56	-	brown-gray, slightly moist, hard — VERY HIGHLY WEATHERED MUDSTONE TO VERY HARD CLAY w/gypsum, w/calcite crystals & stringers									
5420																
	40			12	24,66	-	brown-gray, slightly moist, hard — HIGHLY WEATHERED CLAYEY MUDSTONE									
5415							BEDROCK - TROPIC SHALE FORMATION									
	45															
5410																
	50															

06/16/04 10:47:25 AI

LEGEND

- 2,3,2 ← Blow Count per 6"
- 0.45 ← Torvane (tsf)
- Disturbed Sample
- Core
- 100,60 ← Rock Quality Designation (RQD)
- Percent Sample Recovery
- Undisturbed Sample
- ▽ ← Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

DRILL HOLE LOG

BORING NO. 04-5

Sheet: 1 of 2

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 5/4/04
LOCATION: SEE SITE PLAN - LEFT ABUTMENT — ELEVATION: ~5542.4'
DRILLER: D. SAMPSON, M. BARBOUR — LOGGED BY: M.H., V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.Q. CORE AT 60° FROM HORIZONTAL, TREND N65° E
DEPTH TO WATER - INITIAL: ▽ N.M. AFTER 24 HOURS: ▽ 35.0' 6/3/04

Elev. (Feet)	Depth (Feet)	Lithology	Sample Type	Sample Rec. (In.)	See Legend	USCS	Material Description	Permeability, ft/yr	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5540	0															
				0	Core 0,0	-	VERY HIGHLY WEATHERED TROPIC SHALE FORMATION	1685								
5535	5															
	10			13	Core 22,0	-	brown-gray VERY HIGHLY WEATHERED CLAYEY MUDSTONE TO CLAY W/MUDSTONE FRAGMENTS	6058								
5530	15			31	Core 52,0	-	MUDSTONE RUBBLE W/CLAY MATRIX									
5525	20			34	Core 56,0	-	MUDSTONE BROKEN TO RUBBLE	3188								
5520	25			14	Core 24,0	-	brown-gray									
5515	30			48	Core 80,0	-	brown-gray, calcareous	654								
5510	35			58	Core 96,0	-	MOTTLED & MIXED LAYERS OF DARK GRAY & BROWN MUDSTONE more competent, w/random gypsum stringers, near vertical fractures at 33' to 38', some friable shaley layers 1" to 2" thick									
5505	40			60	Core 100,80	CL-2	brown-gray, dry	515		4.7	43	26	0	9	91	
	45			64	Core 90,60	-	w/clay seams, shells									
5500	50					CL-2	dk. gray, dry, shells CALCAREOUS MUDSTONE	0		12.6	47	24	0	2	98	

06/16/04 04:03:11 PM

LEGEND

- 2,3,2 — Blow Count per 6"
- 0.45 — Torvane (tsf)
- Core — Disturbed Sample
- 100,60 — Rock Quality Designation (RQD)
- Percent Sample Recovery
- Undisturbed Sample
- Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

DRILL HOLE LOG

BORING NO. 04-5

Sheet: 2 of 2

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 5/4/04
LOCATION: SEE SITE PLAN - LEFT ABUTMENT — ELEVATION: ~5542.4'
DRILLER: D. SAMPSON, M. BARBOUR — LOGGED BY: M.H., V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.Q. CORE AT 60° FROM HORIZONTAL, TREND N65° E
DEPTH TO WATER - INITIAL: ▽ N.M. AFTER 24 HOURS: ▽ 35.0' 6/3/04

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Rec. (In.)	See Legend	USCS	Material Description	Permeability, ft/yr	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
				59	Core 98,76	-	dk. gray									
5495	55			54	Core 98,63	-	dk. gray									
5490	60			53	Core 100,100	-	dk. gray, few shells — SHALEY MUDSTONE, friable, very slow slaking									
5485	65			60	Core 100,100	-	dk. gray, no gypsum, w/big white shells									
	70			54	Core 90,82	-										
5480							SHALE TO BENTONITE									
	75			60	Core 100,100	-	dk. gray w/few white lenses — CALCAREOUS MUDSTONE									
5475							dk. to lt. gray, very soft dk. gray — SHALEY BENTONITE									
	80			50	Core 84,84	-	dk. gray									
5470				12	Core 100,100	-	CALCAREOUS MUDSTONE									
	85			60	Core 100,100	-										
5465							very soft — SHALEY BENTONITE									
	90			60	Core 100,100	-	dk. gray — CALCAREOUS MUDSTONE									
5460	95			52	Core 100,100	-										
							LIMESTONE									
5455	100			24	Core 80,80	-	dk. gray — CALCAREOUS MUDSTONE W/SHELLS									

Permeability, ft/yr: 0, 5, 2, 0

LEGEND
- 2,3,2 ← Blow Count per 6"
- 0.45 ← Torvane (tsf)
- Core ← Disturbed Sample
- 100,60 ← Rock Quality Designation (RQD)
- Percent Sample Recovery
- Undisturbed Sample
- Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test

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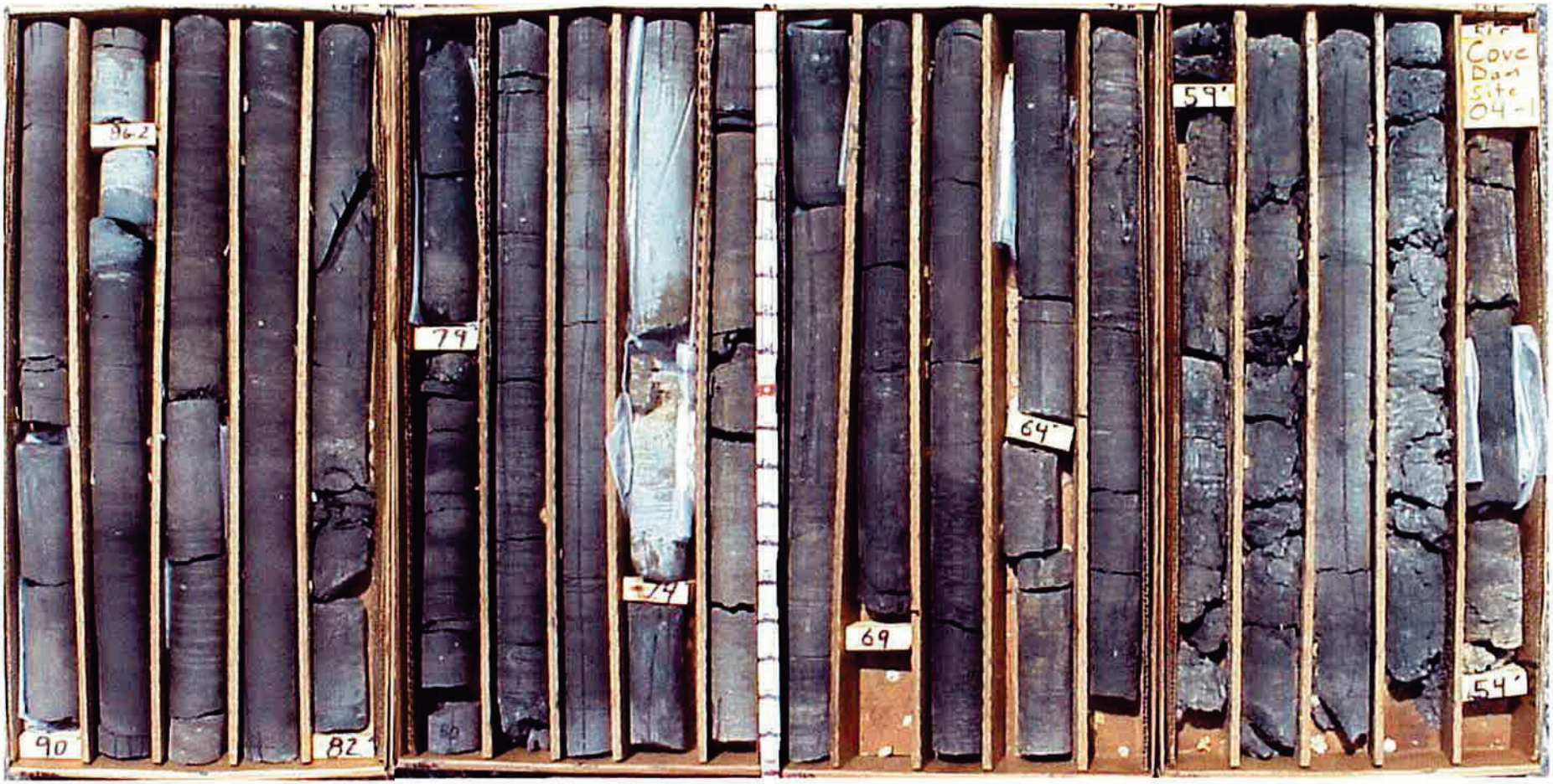
Top



Bottom

E-976

Depth Cored
51.5 to 90 feet

NQ Core Dia. 1.875 in.
Length of Core Box 2 ft.

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Figure Core Photos, Drill Hole # 04-1 *Center Section*
Project *Cove DamSite Feasibility Study*
Location *Orderville, Kane County, Utah*

04-2

Top



Bottom

E-977

Depth Cored
21.5 to 39 feet

NQ Core Dia. 1.875 in.
Length of Core Box 2 ft.

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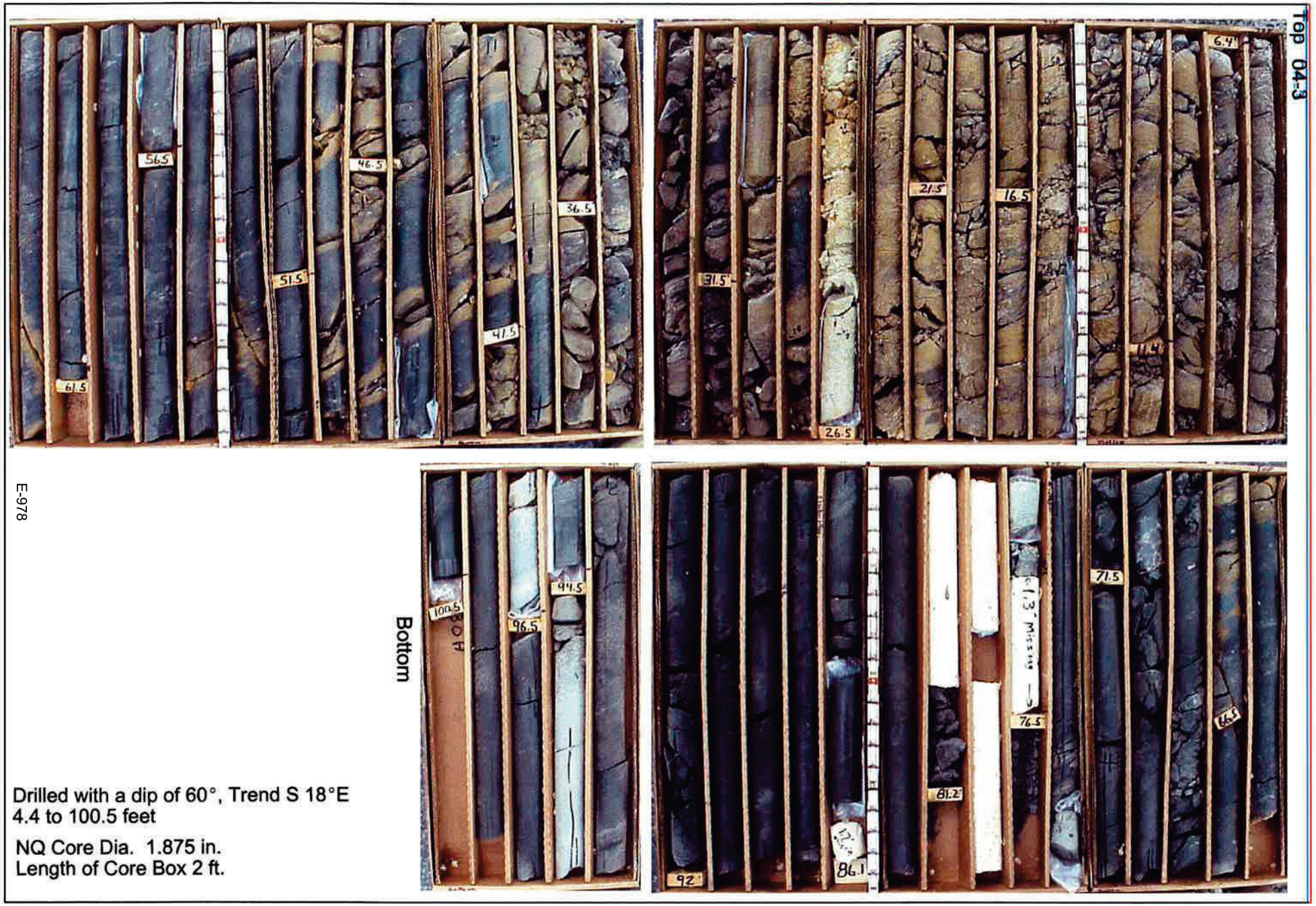
Provo, Utah

Figure Core Photos, Drill Hole # 04-2 ~~Center~~ Max Section
Project *Cove DamSite Feasibility Study*
Location *Orderville, Kane County, Utah*

near toeof slope @ left abutment



Drilled with a dip of 60°, Trend S 18°E
4.4 to 100.5 feet

NQ Core Dia. 1.875 in.
Length of Core Box 2 ft.

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Provo, Utah

Figure Core Photos, Drill Hole # 04-3 *Right Abutment*
Project *Cove Dam Site Feasibility Study*
Location *Orderville, Kane County, Utah*



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Provo, Utah

Figure Core Photos, Drill Hole # 04-5 *Left Abutment*
Project *Cove Dam Site Feasibility Study*
Location *Orderville, Kane County, Utah*

Test Pits

TEST PIT LOG

PIT NO. 04–1

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 6/1/04
LOCATION: SEE SITE PLAN — ELEVATION: ~5463.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY — AFTER 24 HOURS: ▽ DRY

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	SAMPLE USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5460				3 Rings Block Bucket	CL-1	1" fine silty sand layer		4.8	26	12	0	3	97	
	5			Ring Block	CL-2	**LEAN CLAY** lt. brown to brown, dry, hard, some pinhole structure, minor mineral stringers	95.1	6.4	35	16	0	2	98	
5455						1" fine silty sand layer								
	10			Ring Block	CL-2			3.4	31	15	0	26	74	
						1" fine silty sand layer								
				Bag	CL	1" fine silty sand layer								
5450														
	15													
5445														
	20													

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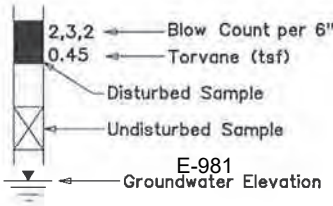
LEGEND



UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

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TEST PIT LOG

PIT NO. 04–2

Sheet: 1 of 1

PROJECT: COVE DAM
PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D.
DATE: 6/2/04
LOCATION: SEE SITE PLAN
ELEVATION: ~5474.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY AFTER 24 HOURS: ▽ DRY

Elev. (Feet)	Depth (Feet)	Lithology	SAMPLE Type	SAMPLE Type	SAMPLE USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5470	5			Bag	CL	**LEAN CLAY W/FINE SAND** lt. brown to brown, very dry, hard, sand intermixed throughout entire depth of test pit, some distinct pockets but no continuous layers, some pinhole structure, macro-hole structure in upper 3', trace minerals		8.6	40	20	0	2	98	
				Bag	CL-2									
5465	10			Bag	CL									
				Bag	CL-1			5.8	31	13	0	12	88	
5460	15													
5455	20													

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LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

TEST PIT LOG

PIT NO. 04-3

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 6/2/04
LOCATION: SEE SITE PLAN — ELEVATION: ~5476.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY — AFTER 24 HOURS: ▽ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lithology	Sample Type	Sample Type	USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5475	0		Bag	SP		**SAND W/GRAVEL** medium grained sand, fine grained gravel					25	73	2	
			Bag	CL										
				SM	2" silty sand layer									
	5													
5470			Bag	CL		**LEAN CLAY W/SAND** lt. brown to brown, dry, hard, intermixed, fine, some pinhole structure, some silt lenses, calcite stringers								
			Bag	CL										
	10			SP-SM	2" sand w/silt layer									
5465				SM	2" silty sand layer									
			Bag	CL										
	15													
5460														
	20													

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LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

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TEST PIT LOG

PIT NO. 04-4

Sheet: 1 of 1

PROJECT: COVE DAM | PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. | DATE: 6/2/04
LOCATION: SEE SITE PLAN | ELEVATION: ~5475.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY AFTER 24 HOURS: ▼ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	SAMPLE USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
				Bag	CL									
5470	5				SM	2" sand layer at 5.5'					0	82	18	
				Bag	CL	**LEAN CLAY** lt. brown to brown, dry, hard, some small sand pockets, pinhole structure, trace minerals								
				Bag	CL									
5465	10													
5460	15													
	20													

06/15/04
11:02:45 AM

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LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test

TEST PIT LOG

PIT NO. 04-5

Sheet: 1 of 1

PROJECT: COVE DAM
CLIENT: K.C.W.C.D.
LOCATION: SEE SITE PLAN
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY AFTER 24 HOURS: ▽ NOT MEASURED

PROJECT NO.: 200401.025
DATE: 6/2/04
ELEVATION: ~5477.0'
LOGGED BY: M. STILSON

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
					CL	**LEAN CLAY**								
5475														
				Bag	GP	**GRAVEL W/SAND** fairly clean, sub-angular, mostly 0.75" to 3" sizes, a few cobbles up to 12"								
	5													
				Bag	CH				58	34				
5470						**HEAVILY WEATHERED MUDSTONE** dk. brown, moist, very hard								
				Bag	CH				59	31				
	10													
5465														
	15													
5460														
	20													

06/15/04
11:03:01 AM

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LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

TEST PIT LOG

PIT NO. 04-6

Sheet: 1 of 1

PROJECT: COVE DAM
CLIENT: K.C.W.C.D.
LOCATION: SEE SITE PLAN
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY AFTER 24 HOURS: ▽ NOT MEASURED

PROJECT NO.: 200401.025
DATE: 6/2/04
ELEVATION: ~5466.0'
LOGGED BY: M. STILSON

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	SAMPLE USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5465	0													
				Bag	CL									
	5													
5460				Bag	CL	**LEAN CLAY W/FINE SAND** lt. brown to brown, dry, hard, intermixed, some sand pockets, pinhole structure, minerals								
				Bag	CL									
	10													
5455				Bag	CL									
	15													
5450														
	20													

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LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
▽ Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

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TEST PIT LOG

PIT NO. 04–7

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 6/2/04
LOCATION: SEE SITE PLAN — ELEVATION: ~5456.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY — AFTER 24 HOURS: ▽ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lith-ology	Sample Type	Sample Type	USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5455	0					**LEAN CLAY** dry, pinhole structure, macro-holes to 3'								
				Ring	CL-1		82.0	9.1	28	11	0	13	87	
				2 Blocks	CL-ML		86.9	6.5	26	6	0	10	90	CT
						SILTY CLAY								
	5													
5450				Block Bucket	CL-2				37	18	0	3	97	DS
						LEAN CLAY lt. brown to brown, dry, hard, pinhole structure								
				Block	CL-2		89.6	9.1	33	15	0	3	97	
	10													
5445														
				Bag	CL									
	15													
5440														
	20													

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LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test
DS - Direct Shear Test

TEST PIT LOG

PIT NO. 04–8

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 6/2/04
LOCATION: SEE SITE PLAN — ELEVATION: ~5475.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY — AFTER 24 HOURS: ▽ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	SAMPLE USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
						SILTY CLAY W/SAND lt. brown to brown, dry, hard, pinhole structure								
				Bag	CL-1			6.9	33	14	0	6	94	
5470	5													
				Bag	CL	**LEAN CLAY** lt. brown to brown, dry, hard, pinhole structure, minerals								
				Bag	CL-2			6.7	46	25	0	2	98	
5465	10													
				Bag	CL									
5460	15													
	20													

06/11/04
11:00:17 AM

LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

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Provo, Utah

TEST PIT LOG

PIT NO. 04–9

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 6/2/04
LOCATION: SEE SITE PLAN — ELEVATION: ~5483.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY AFTER 24 HOURS: ▽ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	SAMPLE USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5480	0			Bag	CL									
	5			Bag	CL-2	**LEAN CLAY W/FINE SAND** lt. brown to brown, dry, hard, pinhole structure, trace minerals		7.8	37	21	0	1	99	
5475				Bag	CL									
	10			Bag	CL-2			6.3	31	15	0	6	94	
5470														
	15													
5465														
	20													

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11:00:31 AM

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LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

TEST PIT LOG

PIT NO. 04–10

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 6/2/04
LOCATION: SEE SITE PLAN — ELEVATION: ~5500.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY AFTER 24 HOURS: ▽ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
				Bag	CL-2			6.9	38	20	0	6	94	
5495	5			Bag	CL	**LEAN CLAY** lt. brown to brown, dry, hard, trace pinhole structure, more minerals, trace sand at 3'								
				Bag	CL-2			8.5	43	22	0	6	94	
5490	10			Bag	CL									
5485	15													
	20													

06/11/04
11:00:46 AM

LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
▽ ← Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

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Provo, Utah

TEST PIT LOG

PIT NO. 04-11

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 6/2/04
LOCATION: SEE SITE PLAN — ELEVATION: ~5498.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY — AFTER 24 HOURS: ▽ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	SAMPLE USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5495	0			Bag	CL-ML	**SILTY CLAY W/SAND** lt. brown to brown, dry, hard, pinhole structure, fine sand - intermixed		4.4	20	5	0	43	57	
	5			Bag	CL-ML									
5490														
	10			Bag	CL-2	**LEAN CLAY W/SAND** lt. brown to brown, dry, hard, pinhole structure, fine sand - intermixed		5.7	34	16	0	17	83	
				Bag	CL-ML	**SILTY CLAY W/SAND** lt. brown to brown, dry, hard, pinhole structure, fine sand - intermixed								
5485	15													
5480	20													

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LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

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Provo, Utah

TEST PIT LOG

PIT NO. 04–12

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 6/2/04
LOCATION: SEE SITE PLAN — ELEVATION: ~5520.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY — AFTER 24 HOURS: ▽ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
				Bag	CL-ML	**SILTY CLAY W/SAND** lt. brown to brown, dry, hard								
5515	5			Bag/ Block	ML	shows layering **SANDY SILT** lt. brown to brown, dry, hard		4.4		NP	0	47	53	
5510	10			Bag	CL-ML	**SILTY CLAY W/SAND** lt. brown to brown, dry, hard								
				Bag	CL-2	**LEAN CLAY** lt. brown to brown, dry, hard		7.2	36	16	0	2	98	
5505	15													
	20													

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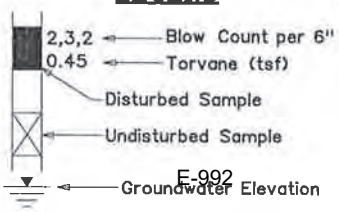
11:01:14 AM

LEGEND



UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

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Provo, Utah

TEST PIT LOG

PIT NO. 04–13

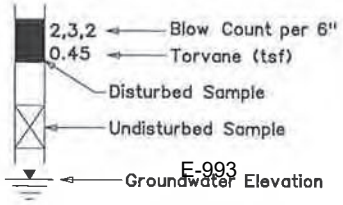
Sheet: 1 of 1

PROJECT: COVE DAM
PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D.
DATE: 6/2/04
LOCATION: SEE SITE PLAN
ELEVATION: ~5548.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY AFTER 24 HOURS: ▽ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	SAMPLE USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
						6" clay layer								
				Bag	SM									
						8" clay layer								
5515	5					**SILTY SAND W/CLAY LAYERS**								
				Bag	SM	lt. brown to brown, dry								
						12" clay layer								
				Bag	SM									
5510	10													
				Bag	SM									
5505	15													
	20													

06/11/04
11:01:30 AM

LEGEND



UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

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Laboratory Testing

Table 1

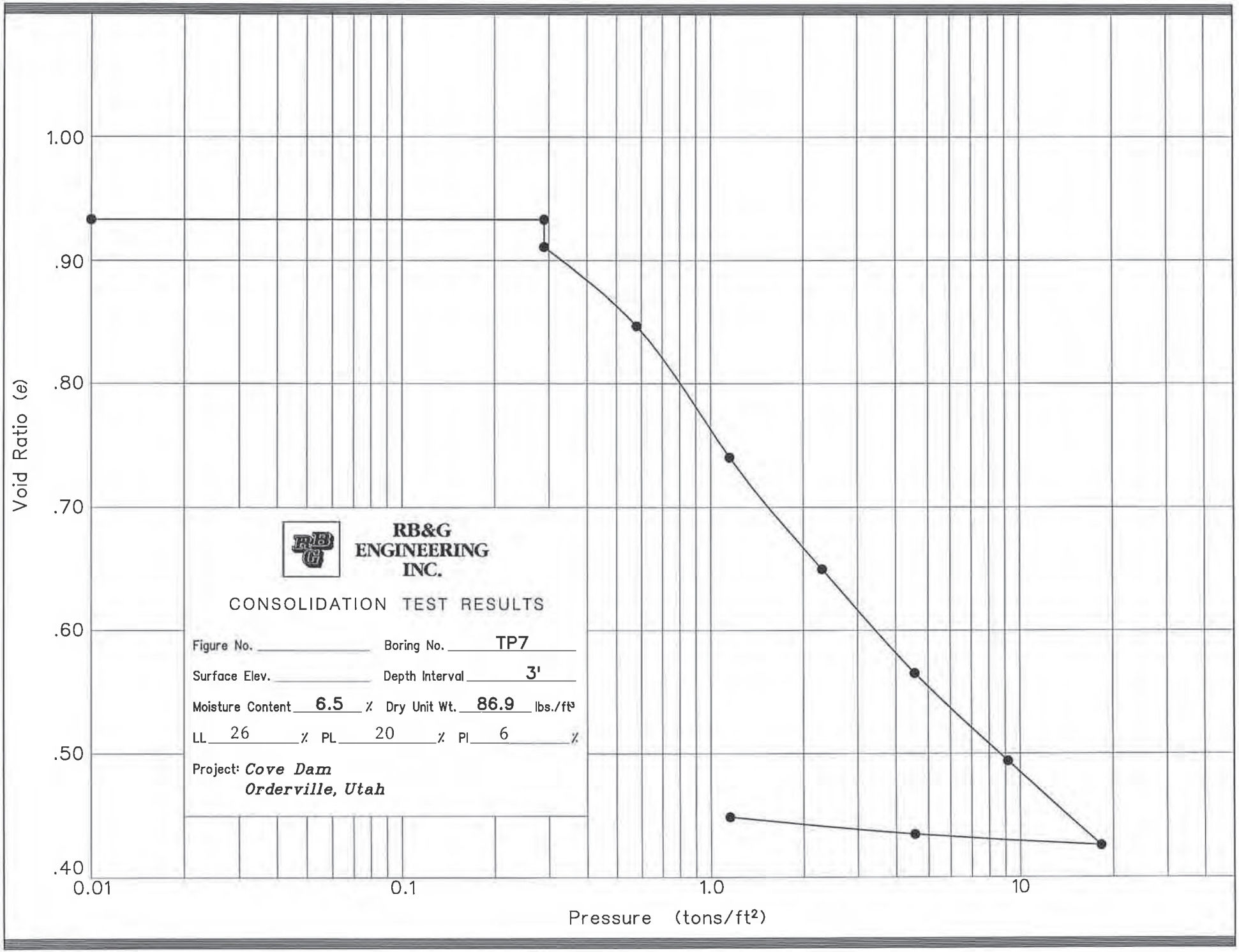
SUMMARY OF TEST DATA

PROJECT Cove Dam
LOCATION Kane County, Utah

PROJECT NO. 200401-025
FEATURE

HOLE NO.	DEPTH BELOW GROUND SURFACE (ft)	MATERIAL	IN-PLACE		PINHOLE TEST RESULTS	ATTERBERG LIMITS			MECHANICAL ANALYSIS			UNIFIED SOIL CLASSIFICATION SYSTEM (modified)
			DRY UNIT WEIGHT (pcf)	MOISTURE (%)		LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT & CLAY	
DH-1	5-6	Soil	120.3	9.8		32	18	14	0	10	90	CL-1
	15-16.5	Soil	119.4	8.7		37	18	19	0	17	83	CL-2
	25-26.5	Soil	112.4	14.3		34	16	18	0	6	94	CL-2
	35-36.5	Soil	105.2	17.5		49	18	31	0	3	97	CL-2
	45-46	Soil	100.7	23.1		50	16	34	0	6	94	CL-2/CH
	53	Bedrock		16.4		82	30	50	0	0	100	CH
	73	Bedrock		13.2		70	25	45	0	0	100	CH
DH-2	6.5-8	Soil		12.2		45	14	31	0	2	98	CL-2
	15-16.5	Soil	111.8	19.3		58	24	34	0	0	100	CH
	26	Bedrock		13.5		70	23	47	0	0	100	CH
DH-3	14	Bedrock		13.7		54	21	33	0	0	100	CH
DH-5	41	Bedrock		4.7		43	17	26	0	9	91	CL-2
	48	Bedrock		12.6		47	23	24	0	2	98	CL-2
TP-1	3-4	Soil		4.8	ND2	26	16	12	0	3	97	CL-1
	6-7	Soil		6.4	ND2	35	19	6	0	2	98	CL-2
	9-10	Soil		3.4	ND3	31	16	15	0	26	74	CL-2
TP-2	6-7	Soil		8.6		40	20	20	0	2	98	CL-2
	12-12.5	Soil		5.8	ND3	31	18	13	0	12	88	CL-1
TP-3	0-1	Soil							25	73	2	SP
TP-4	5.5	Soil							0	82	18	SM
TP-5	6	Bedrock				58	24	34				CH
	9	Bedrock				59	28	31				CH
TP-7	2	Soil	82.0	9.1	ND2	28	17	11	0	13	87	CL-1
	2-3	Soil	86.9	6.5	ND3	26	20	6	0	10	90	CL-ML
	6-7	Soil		4.0	ND2	37	19	18	0	3	97	CL-2
	9-10	Soil	89.6	9.1		33	18	15	0	3	97	CL-2
TP-8	3-4	Soil		6.9	ND3	33	19	14	0	6	94	CL-1
	9-10	Soil		6.7	ND2	46	21	25	0	2	98	CL-2
TP-9	6-7	Soil		7.8		37	16	21	0	1	99	CL-2
	12-12.5	Soil		6.3		31	16	15	0	6	94	CL-2
TP-10	3-4	Soil		6.9		38	18	20	0	6	94	CL-2
	9-10	Soil		8.5		43	21	22	0	6	94	CL-2
TP-11	3-4	Soil		4.4		20	15	5	0	43	57	CL-ML
	9-10	Soil		5.7		34	18	16	0	17	83	CL-2
TP-12	6-7	Soil		4.4				NP	0	47	53	ML
	12-12.5	Soil		7.2		36	20	16	0	2	98	CL-2

NP=Nonplastic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.60
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.40
Void Ratio (e)
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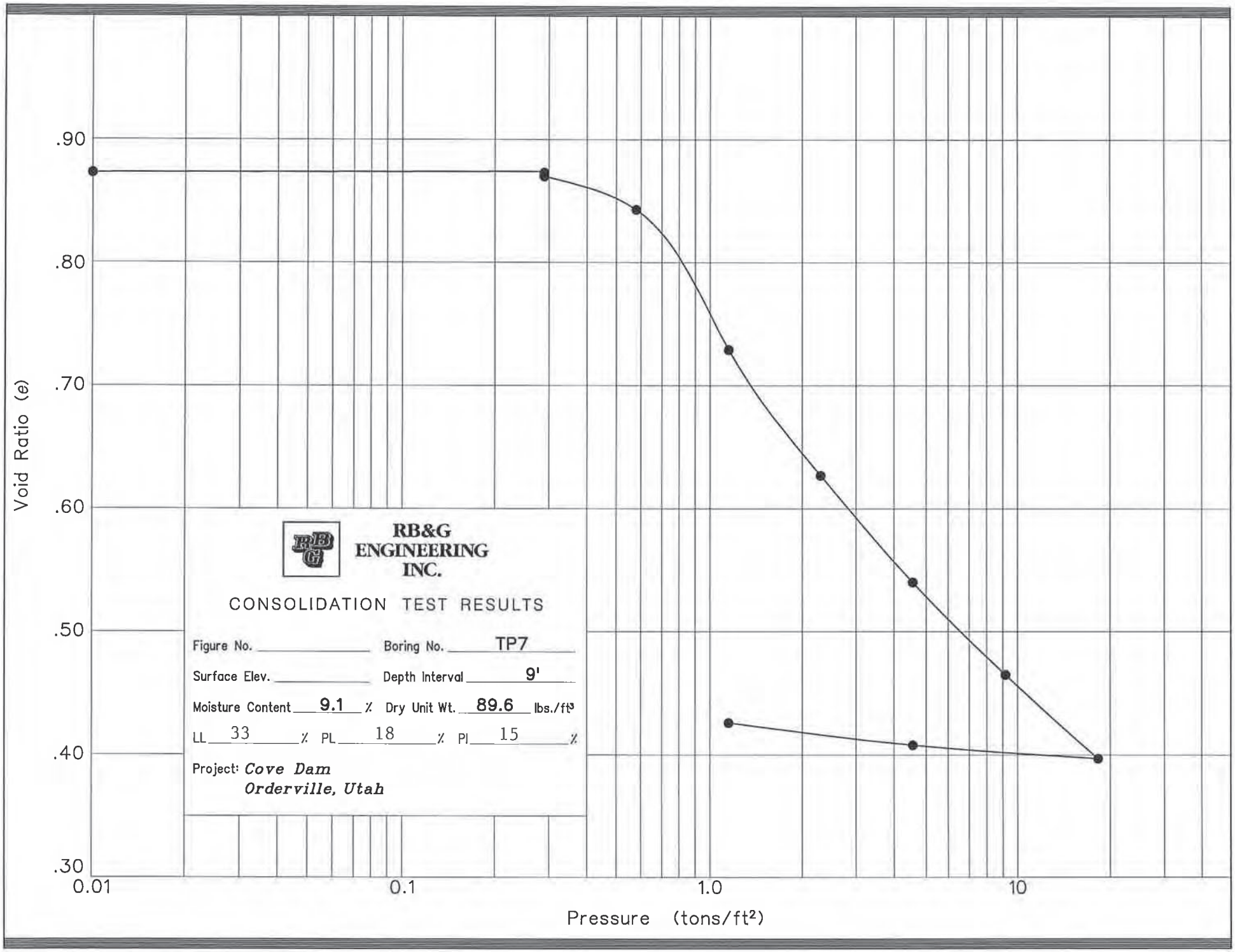
0.1
1.0
10
Pressure (tons/ft²)
RB&G
ENGINEERING
INC.
CONSOLIDATION TEST RESULTS
Figure No. _____ Boring No. TP7
Surface Elev. _____ Depth Interval 3'
Moisture Content 6.5 % Dry Unit Wt. 86.9 lbs./ft³
LL 26 % PL 20 % PI 6 %
Project: Cove Dam
Orderville, Utah

E-996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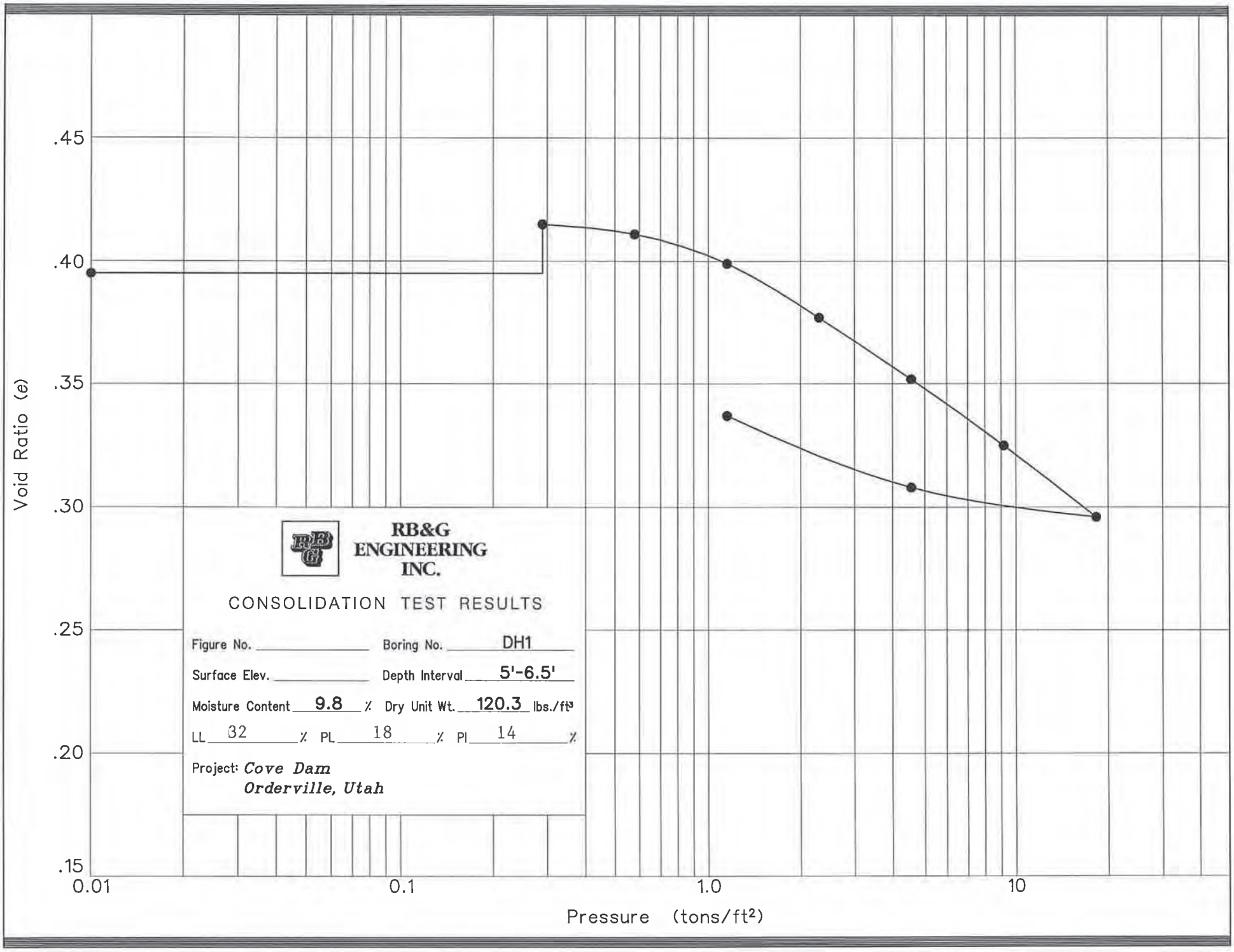
Void Ratio (e)
0.01
0.1
1.0
10
Pressure (tons/ft²)
RB&G
ENGINEERING
INC.
CONSOLIDATION TEST RESULTS
Figure No. _____ Boring No. TP7
Surface Elev. _____ Depth Interval 9'
Moisture Content 9.1 % Dry Unit Wt. 89.6 lbs./ft³
LL 33 % PL 18 % PI 15 %
Project: Cove Dam
Orderville, Utah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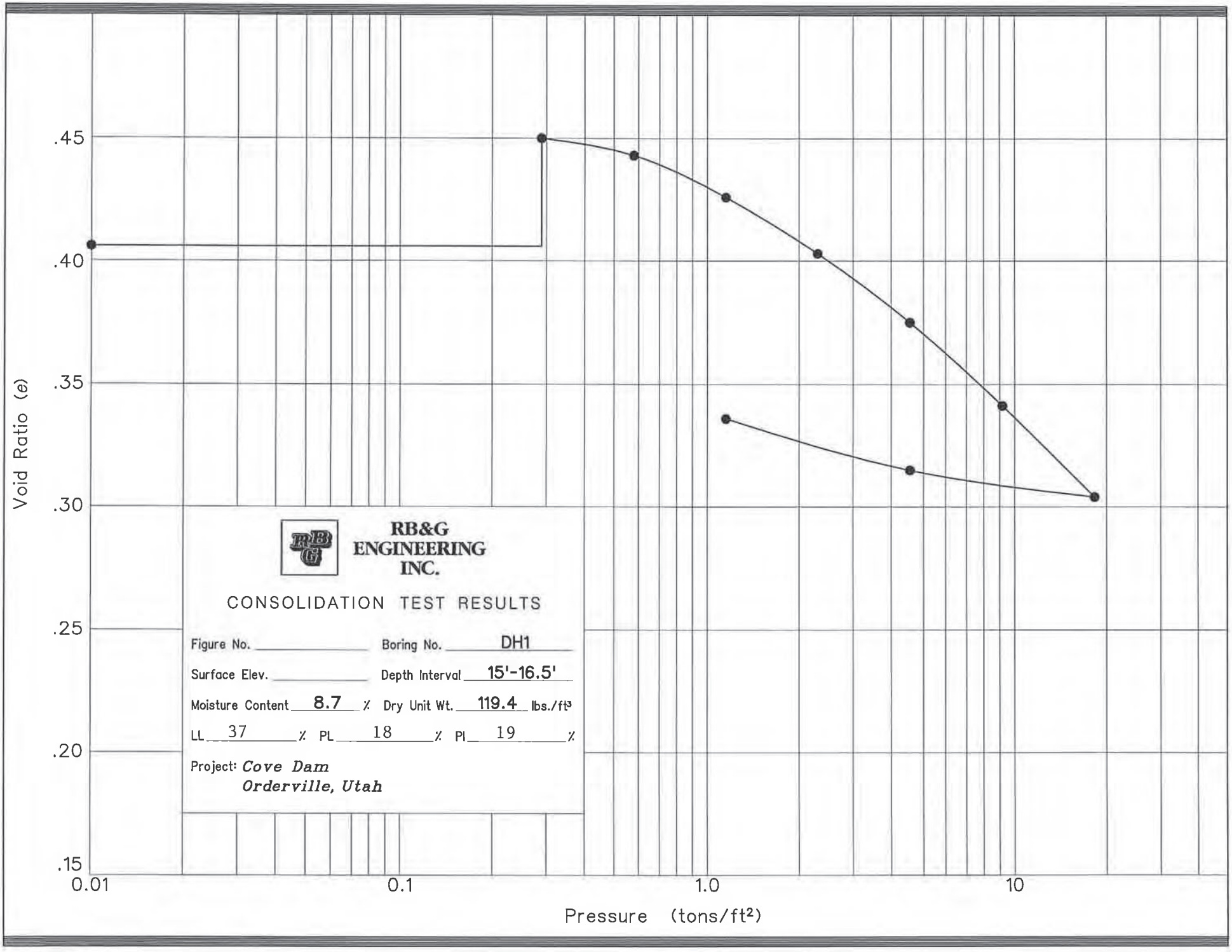
Void Ratio (e)
0.01
0.1
1.0
10
Pressure (tons/ft²)
RB&G ENGINEERING INC.
CONSOLIDATION TEST RESULTS
Figure No.
Boring No. DH1
Surface Elev.
Depth Interval 5'-6.5'
Moisture Content 9.8 % Dry Unit Wt. 120.3 lbs./ft³
LL 32 % PL 18 % PI 14 %
Project: Cove Dam
Orderville, Utah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Void Ratio (e)
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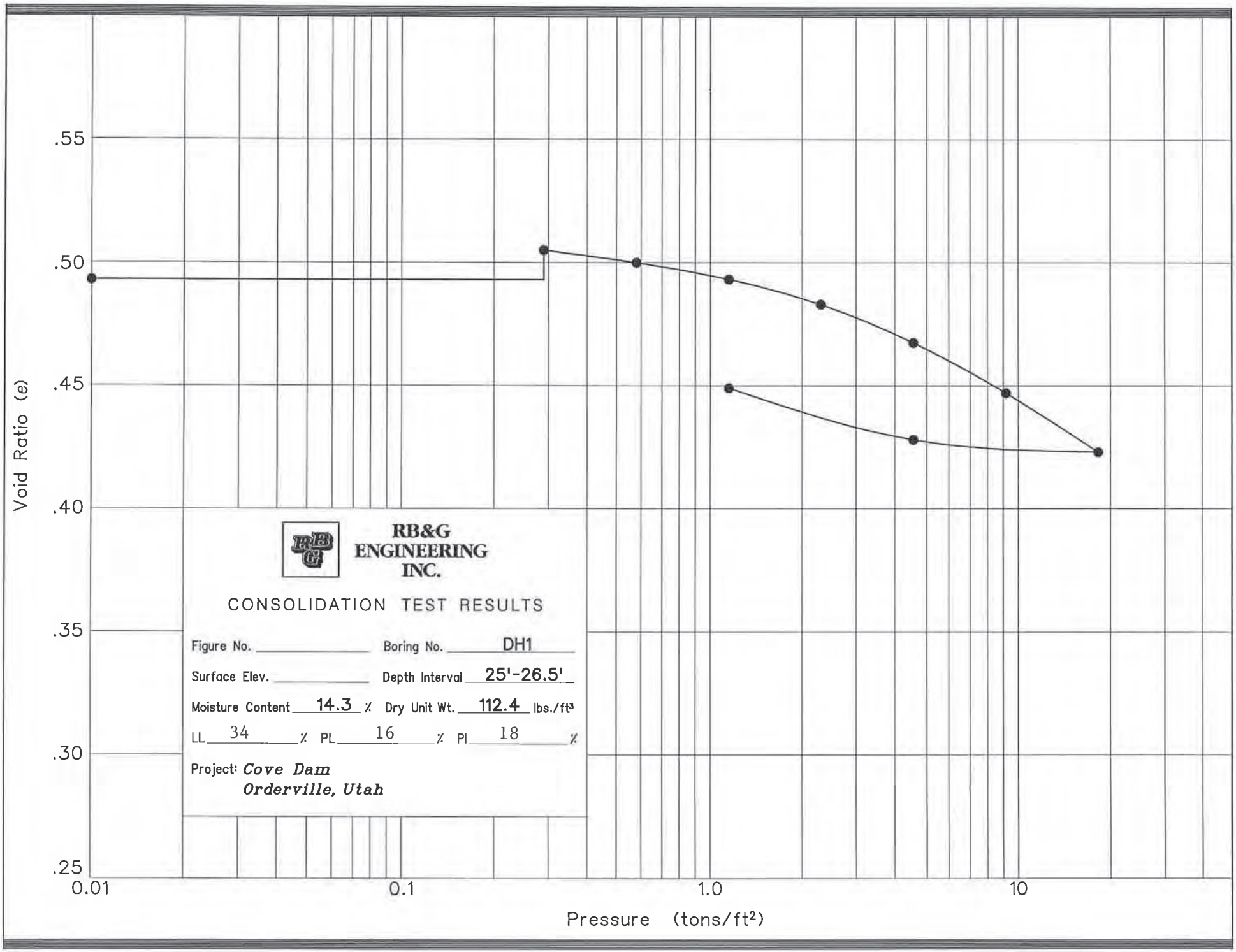
0.1
1.0
10
Pressure (tons/ft²)
RB&G ENGINEERING INC.
CONSOLIDATION TEST RESULTS
Figure No.
Boring No. DH1
Surface Elev.
Depth Interval 15'-16.5'
Moisture Content 8.7 % Dry Unit Wt. 119.4 lbs./ft³
LL 37 % PL 18 % PI 19 %
Project: Cove Dam
Orderville, Utah

E-999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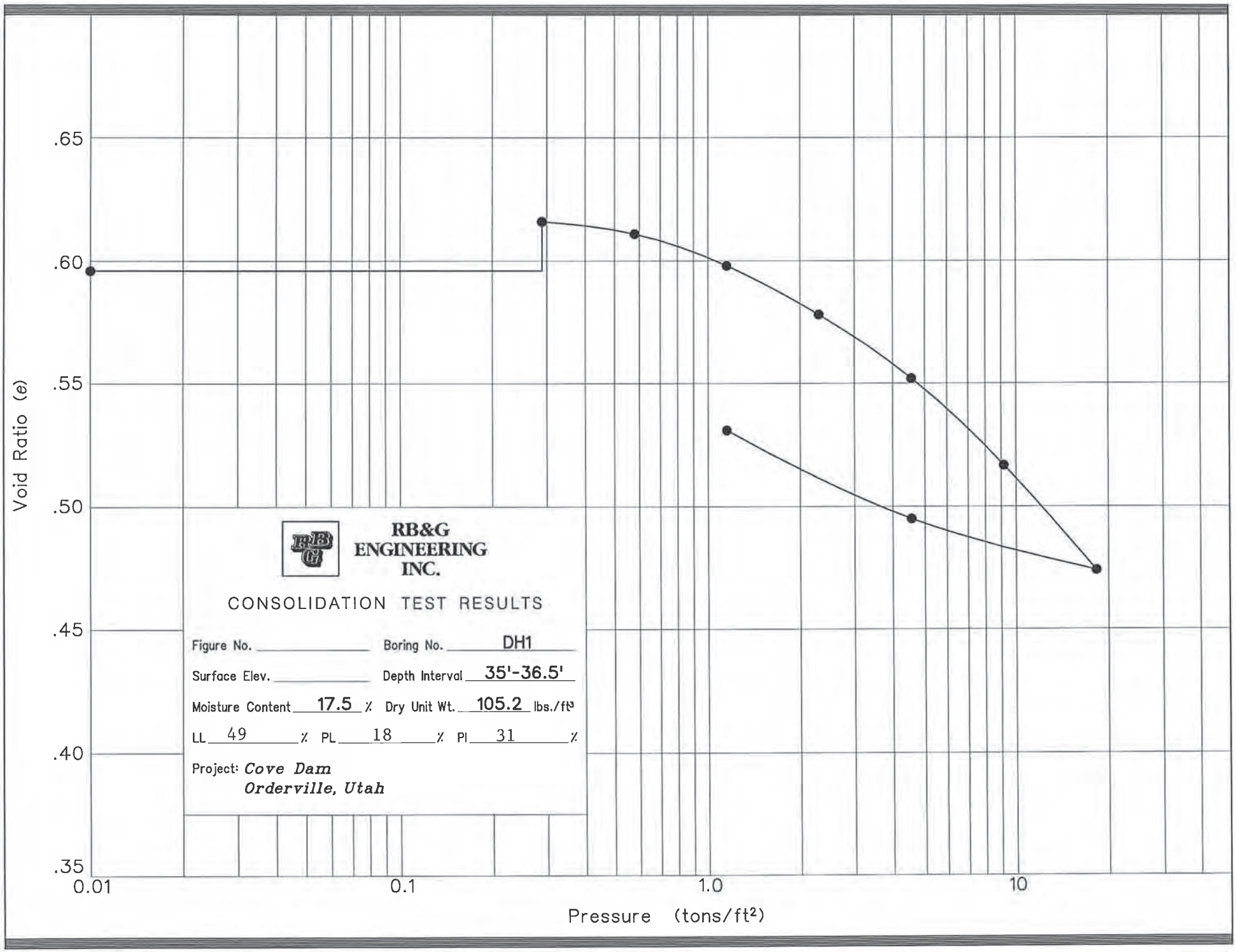
1.0
10
Pressure (tons/ft²)
RB&G ENGINEERING INC.
CONSOLIDATION TEST RESULTS
Figure No. _____ Boring No. DH1
Surface Elev. _____ Depth Interval 25'-26.5'
Moisture Content 14.3 % Dry Unit Wt. 112.4 lbs./ft³
LL 34 % PL 16 % PI 18 %
Project: Cove Dam
Orderville, Utah

E-1000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Void Ratio (e)
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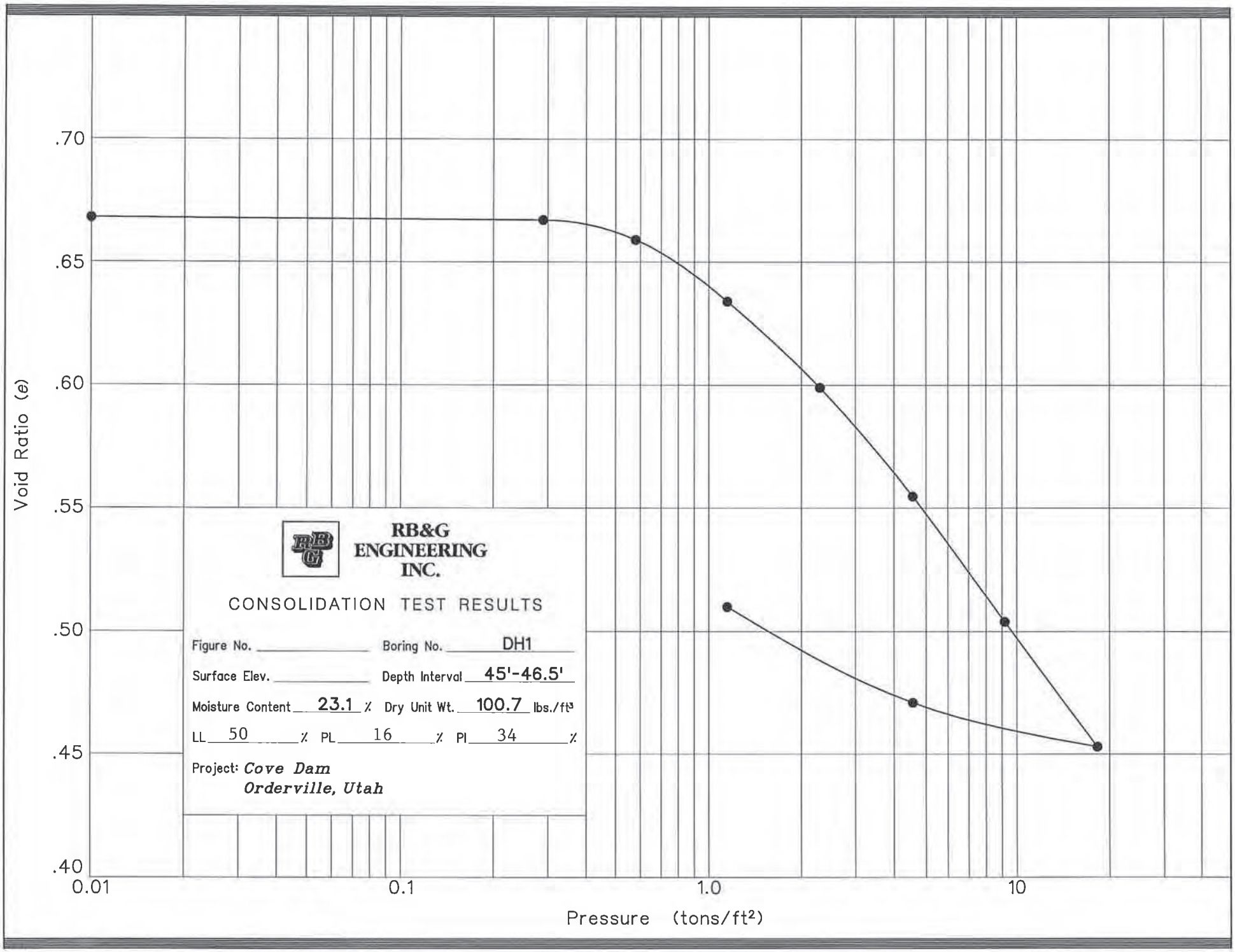
0.1
1.0
10
Pressure (tons/ft²)
RB&G ENGINEERING INC.
CONSOLIDATION TEST RESULTS
Figure No.
Boring No. DH1
Surface Elev.
Depth Interval 35'-36.5'
Moisture Content 17.5 % Dry Unit Wt. 105.2 lbs./ft³
LL 49 % PL 18 % PI 31 %
Project: Cove Dam
Orderville, Utah

E-1001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.40
Void Ratio (e)
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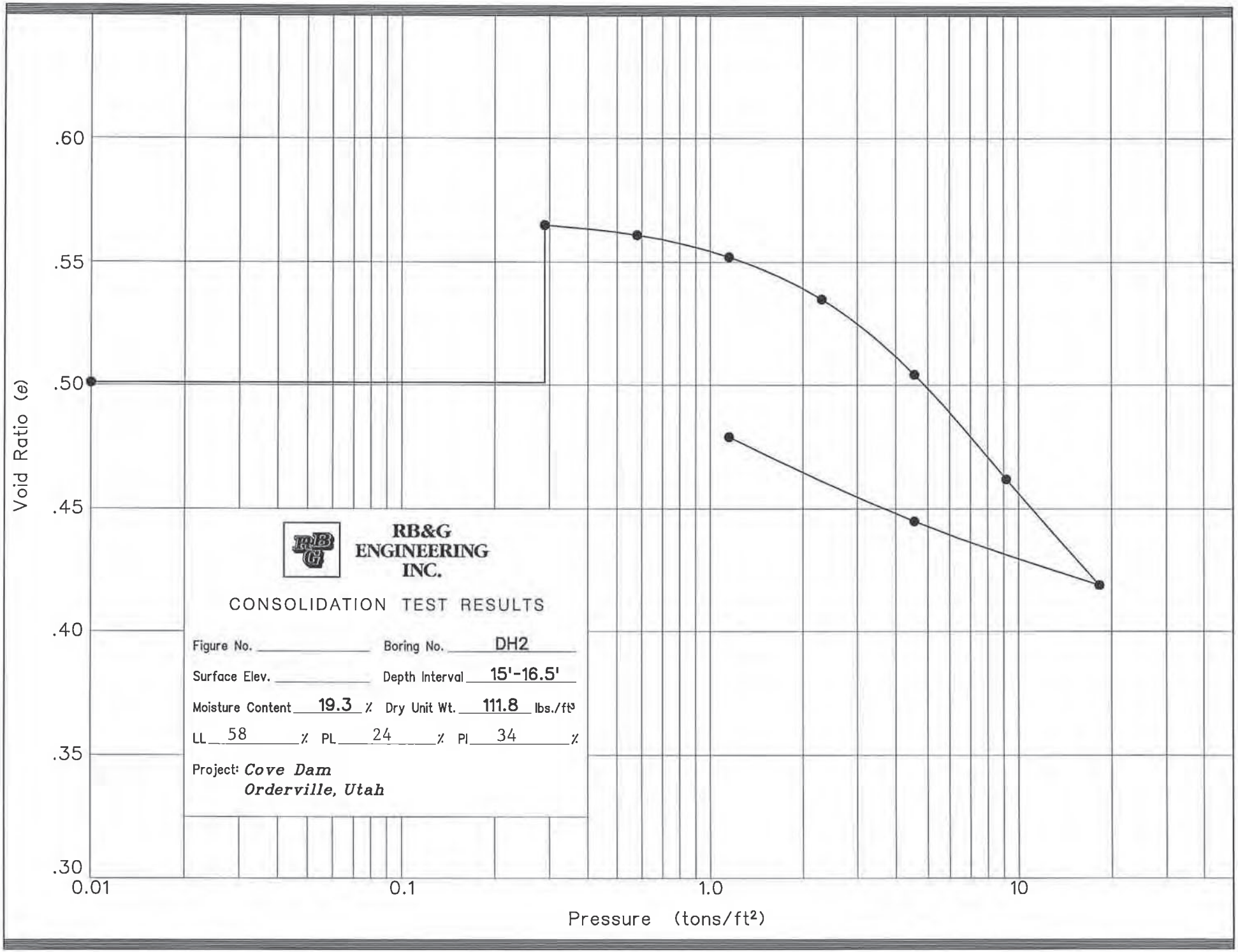
0.1
1.0
10
Pressure (tons/ft²)
RB&G ENGINEERING INC.
CONSOLIDATION TEST RESULTS
Figure No. _____ Boring No. DH1
Surface Elev. _____ Depth Interval 45'-46.5'
Moisture Content 23.1 % Dry Unit Wt. 100.7 lbs./ft³
LL 50 % PL 16 % PI 34 %
Project: Cove Dam
Orderville, Utah

E-1002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Void Ratio (e)
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0.1
1.0
10
Pressure (tons/ft²)
RB&G ENGINEERING INC.
CONSOLIDATION TEST RESULTS
Figure No. _____ Boring No. DH2
Surface Elev. _____ Depth Interval 15'-16.5'
Moisture Content 19.3 % Dry Unit Wt. 111.8 lbs./ft³
LL 58 % PL 24 % PI 34 %
Project: Cove Dam
Orderville, Utah

E-1003

RB&G ENGINEERING INC.
1435 West 820 North, Provo, Utah 84601
801 374-5771 Provo
801 521-5771 Salt Lake City

PROJECT NO.	200401.025

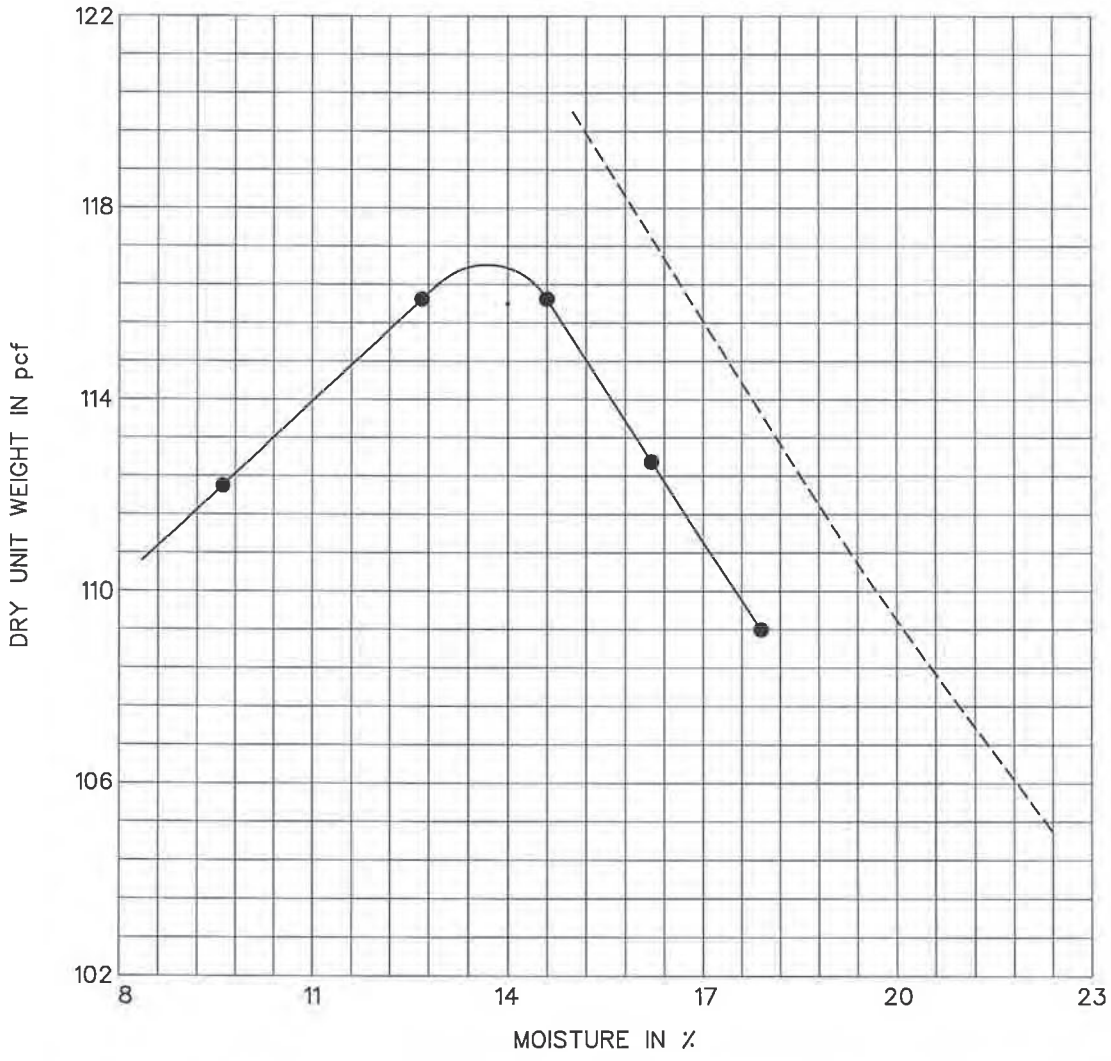
MOISTURE-DENSITY RELATION (PROCTOR)

Project	COVE DAM			Date	6/9/04
Location	ORDERVILLE, UTAH / TEST PIT NO. 1 AT 3'			Technician	G. PEASLEE
Material Description	LT. BROWN TO BROWN LEAN CLAY	USCS	CL-1	Method	ASTM D 698

Procedure Used[1]	A
Classification Procedure[2]	Test

[1] A-No. 4 Sieve, B-⅜" Sieve, C-¾" Sieve
[2] Visual as per ASTM D 2488, Test as per ASTM D 2487

Preparation Method	Moist
Rammer Used	Manual
As-Received Moisture Content (%)	-



Maximum Dry Density (pcf)	**116.0**
Optimum Moisture Content (%)	**14.0**
Modified Maximum Density (pcf)	
Modified Optimum Moisture Content (%)	

– – – – – 100% Saturation Curve

Specific Gravity of Soil	2.70	Est.

OVERSIZE CORRECTION-ASTM D 4718

Specific Gravity of Soil +¾		
Percent Oversize		

Type of Specific Gravity is BULK Unless Otherwise Indicated

RB&G ENGINEERING INC.
1435 West 820 North, Provo, Utah 84601
801 374-5771 Provo
801 521-5771 Salt Lake City

PROJECT NO.	200401.025

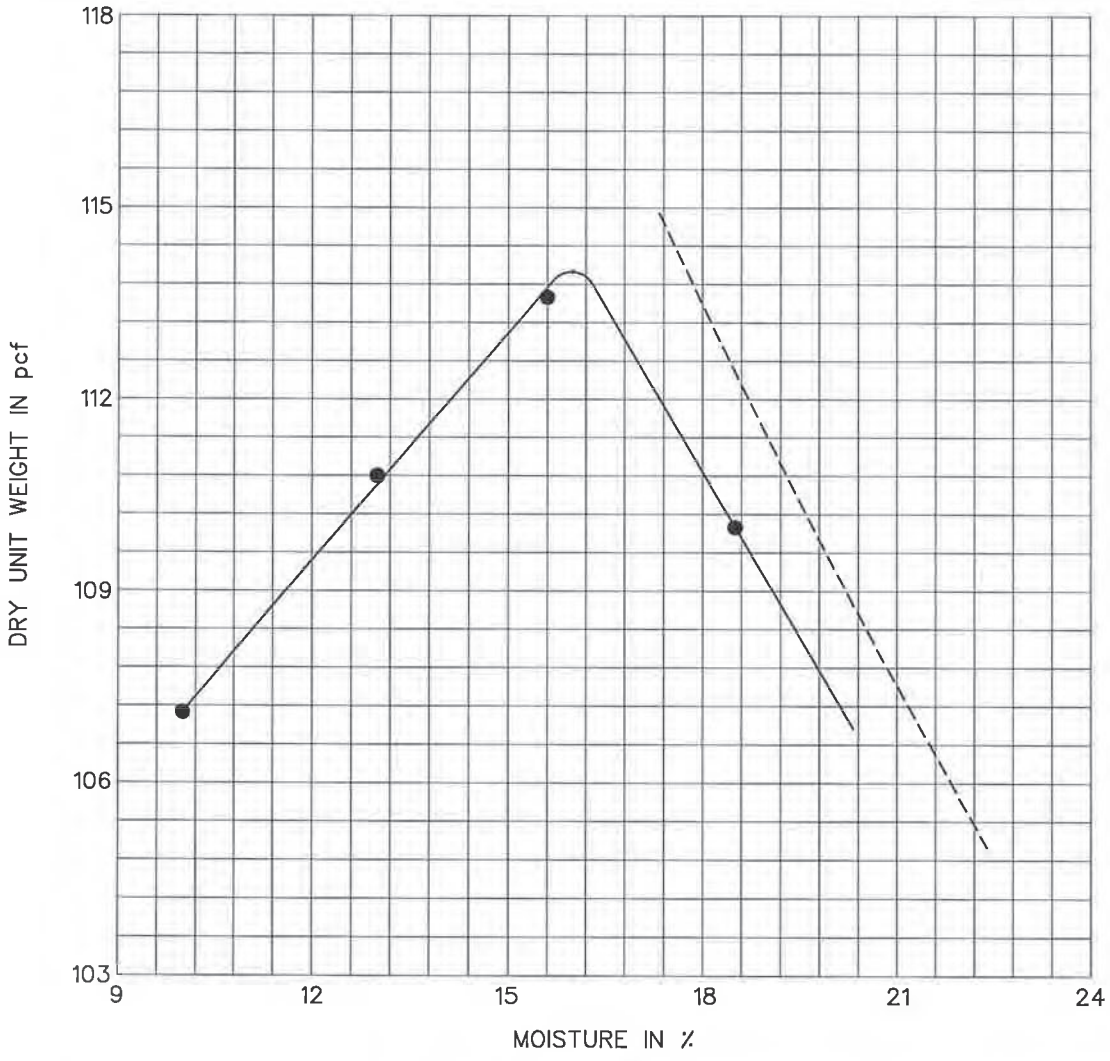
MOISTURE-DENSITY RELATION (PROCTOR)

Project	COVE DAM			Date	6/9/04
Location	ORDERVILLE, UTAH / TEST PIT NO. 7 AT 3'-4'			Technician	G. PEASLEE
Material Description	LT. BROWN TO BROWN SILTY CLAY	USCS	CL-ML	Method	ASTM D 698

Procedure Used[1]	A
Classification Procedure[2]	Test

[1] A-No. 4 Sieve, B-3/8" Sieve, C-3/4" Sieve
[2] Visual as per ASTM D 2488, Test as per ASTM D 2487

Preparation Method	Moist
Rammer Used	Manual
As-Received Moisture Content (%)	-



Maximum Dry Density (pcf)	114.0
Optimum Moisture Content (%)	16.0
Modified Maximum Density (pcf)	
Modified Optimum Moisture Content (%)	

------ 100% Saturation Curve

Specific Gravity of Soil	2.70	Est.

OVERSIZE CORRECTION-ASTM D 4718

Specific Gravity of Soil +3/4		
Percent Oversize		

Type of Specific Gravity is BULK Unless Otherwise Indicated

RB&G ENGINEERING INC.
1435 West 820 North, Provo, Utah 84601
801 374-5771 Provo
801 521-5771 Salt Lake City

PROJECT NO.	200401.025

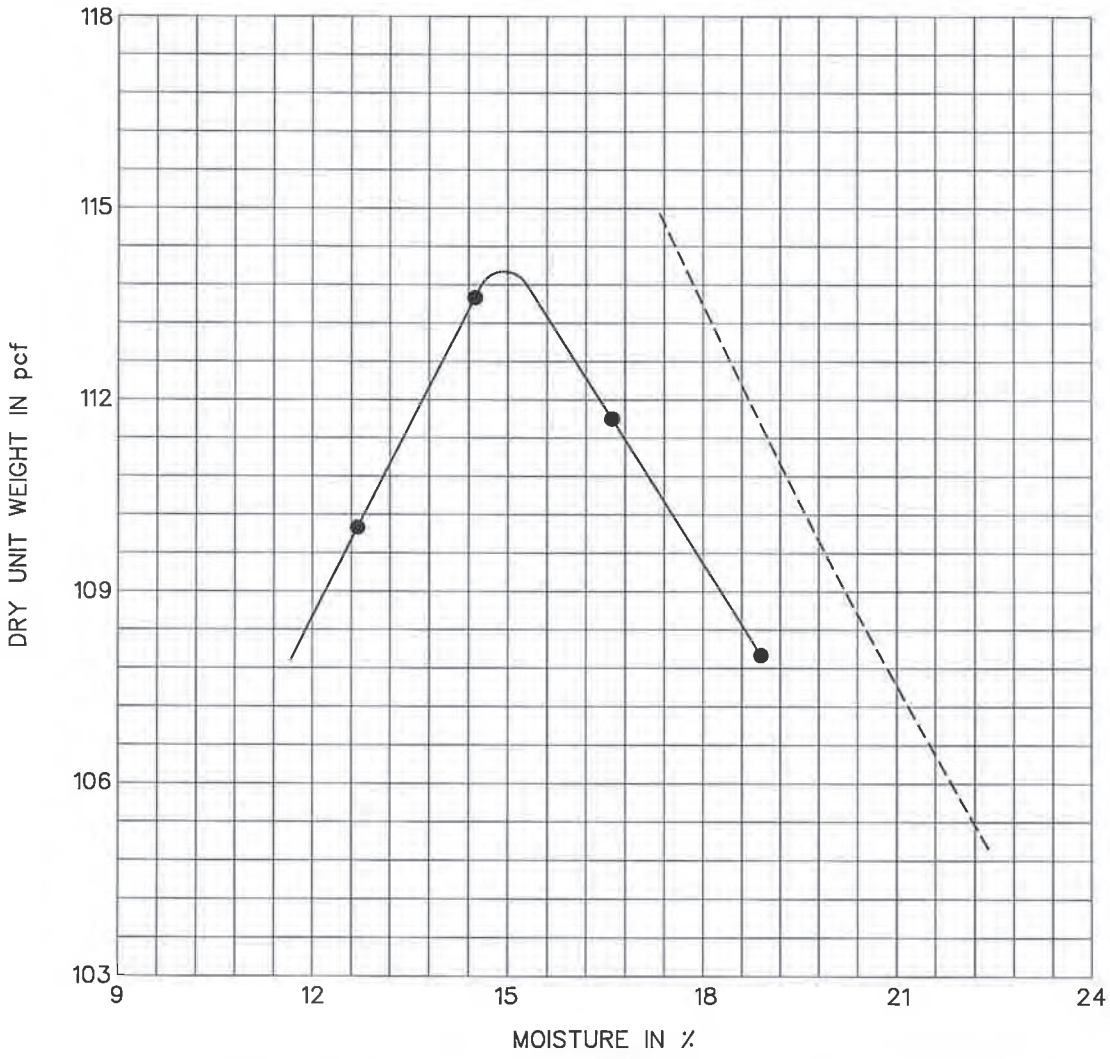
MOISTURE-DENSITY RELATION (PROCTOR)

Project	COVE DAM			Date	6/9/04
Location	ORDERVILLE, UTAH / TEST PIT NO. 7 AT 6'			Technician	G. PEASLEE
Material Description	LT. BROWN TO BROWN LEAN CLAY	USCS	CL-2	Method	ASTM D 698

Procedure Used[1]	A
Classification Procedure[2]	Test

[1] A-No. 4 Sieve, B-⅜" Sieve, C-¾" Sieve
[2] Visual as per ASTM D 2488, Test as per ASTM D 2487

Preparation Method	Moist
Rammer Used	Manual
As-Received Moisture Content (%)	4.0



Maximum Dry Density (pcf)	**114.0**
Optimum Moisture Content (%)	**15.0**
Modified Maximum Density (pcf)	
Modified Optimum Moisture Content (%)	

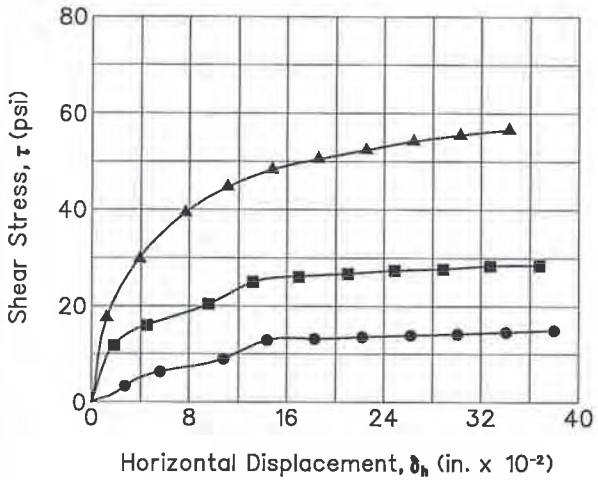
– – – – – 100% Saturation Curve

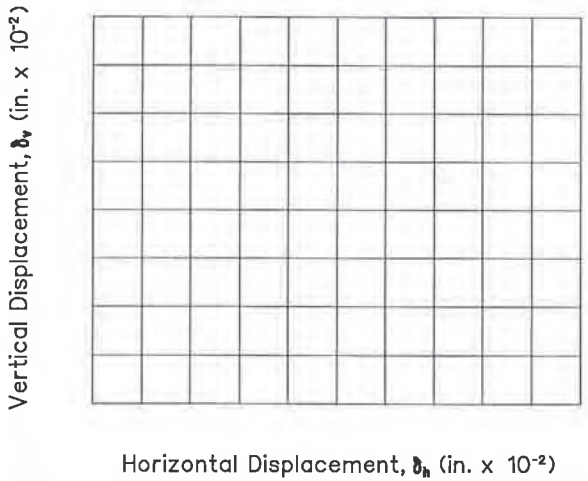
Specific Gravity of Soil	2.70	Est.

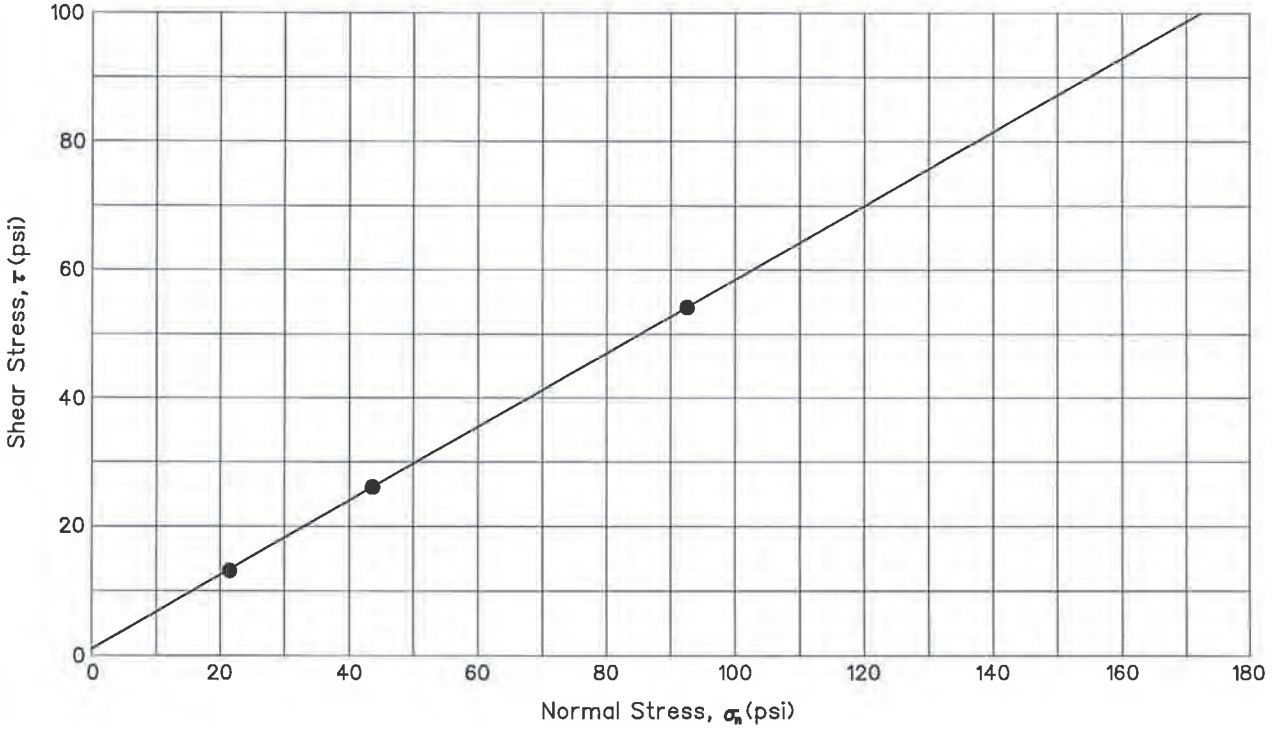
OVERSIZE CORRECTION-ASTM D 4718

Specific Gravity of Soil +¾		
Percent Oversize		

Type of Specific Gravity is BULK Unless Otherwise Indicated







Test No. or Symbol	Sample Size (inches)	Sample Data		Degree of Saturation (%)	Normal Stress δn (psi)	Maximum Shear Stress τ (psi)	Strain Rate (inches/minute)	Shear Strength Parameters	
		Dry Density (pcf)	Moisture Content (%)					Friction Angle ϕ (degrees)	Cohesion (c/psi)
●	2.375	80.4	10.4	~100	21.5	12.9	.0013	29.9	1
■	2.375	82.3	10.4	~100	43.7	26.1	.0013		
▲	2.375	87.1	8.5	~100	92.6	54.2	.0013		

E-1007

RB&G ENGINEERING INC.
Provo, Utah

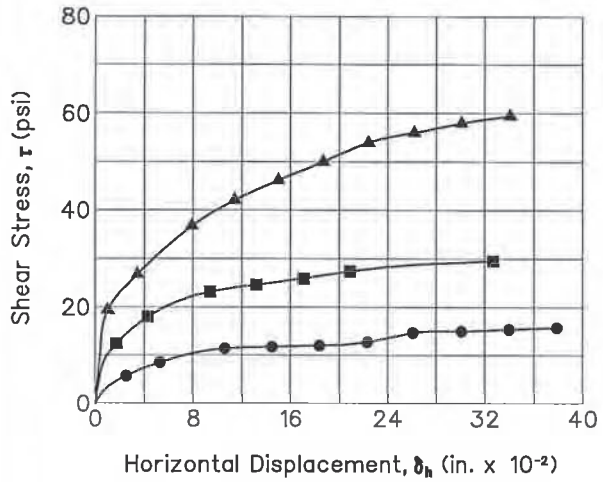
DIRECT SHEAR TEST

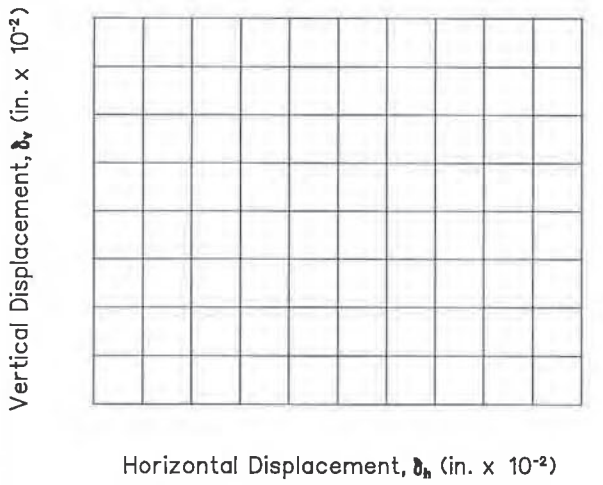
Project: *Cove Dam*
Orderville, Utah

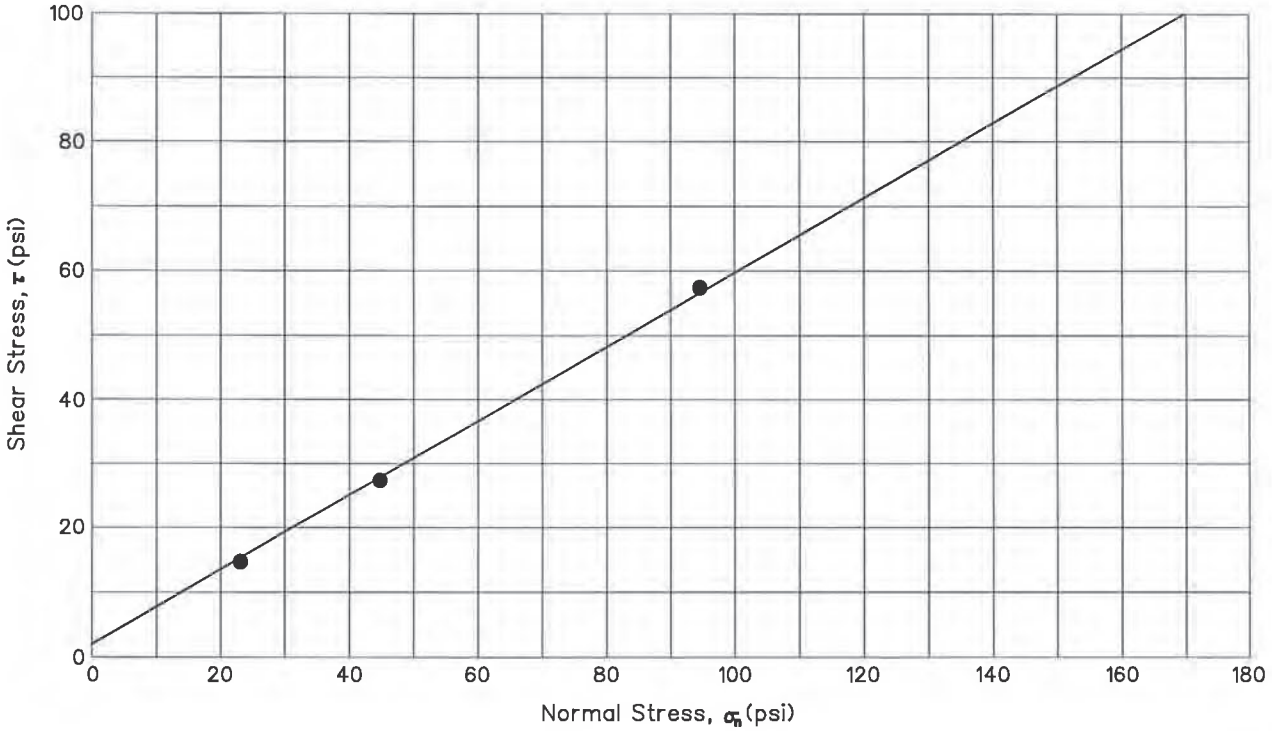
HOLE NO.: TP7

DEPTH: 6'

Figure







REMOLDED SAMPLE COMPACTED TO 98% MAXIMUM DENSITY

Test No. or Symbol	Sample Size (inches)	Sample Data: Dry Density (pcf)	Sample Data: Moisture Content (%)	Degree of Saturation (%)	Normal Stress σ_n (psi)	Maximum Shear Stress τ (psi)	Strain Rate (inches/minute)	Shear Strength Parameters: Friction Angle φ (degrees)	Shear Strength Parameters: Cohesion (c/psi)
●	2.375	111.5	15.1	100	23.1	14.7	.0013	30.2	2
■	2.375	111.5	15.1	100	44.8	27.4	.0013		
▲	2.375	111.5	15.1	100	94.6	57.9	.0013		

E-1008

RB&G ENGINEERING INC.
Provo, Utah

DIRECT SHEAR TEST

Project: *Cove Dam*
Orderville, Utah

HOLE NO.: TP7

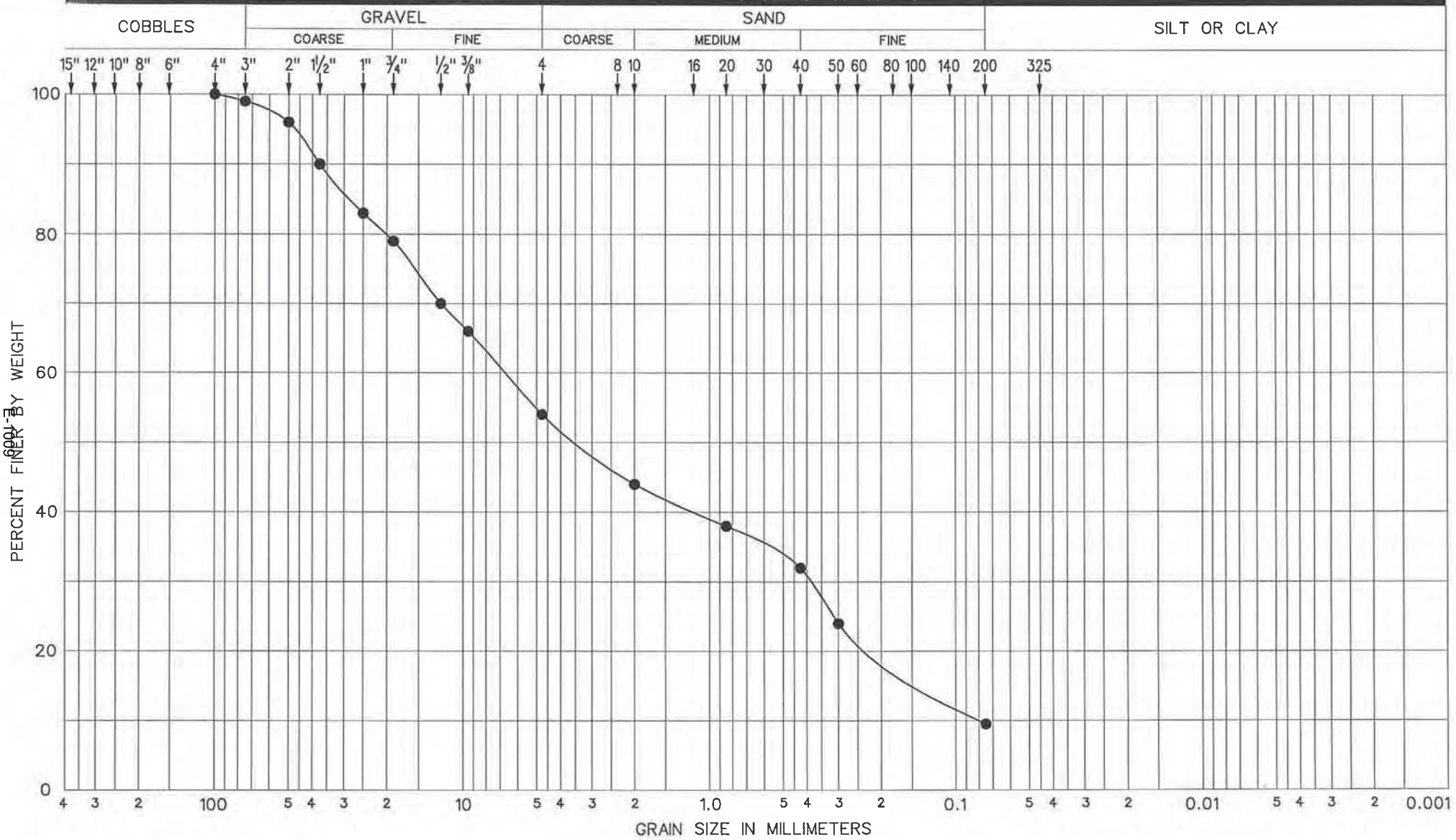
DEPTH: 6'

Figure

RB&G ENGINEERING INC.
1435 West 820 North, Provo, Utah 84601
801 374-5771 Provo
801 521-5771 Salt Lake City

PROJECT NO.	200401.025

SIEVE ANALYSIS (GRADATION)



6004-3

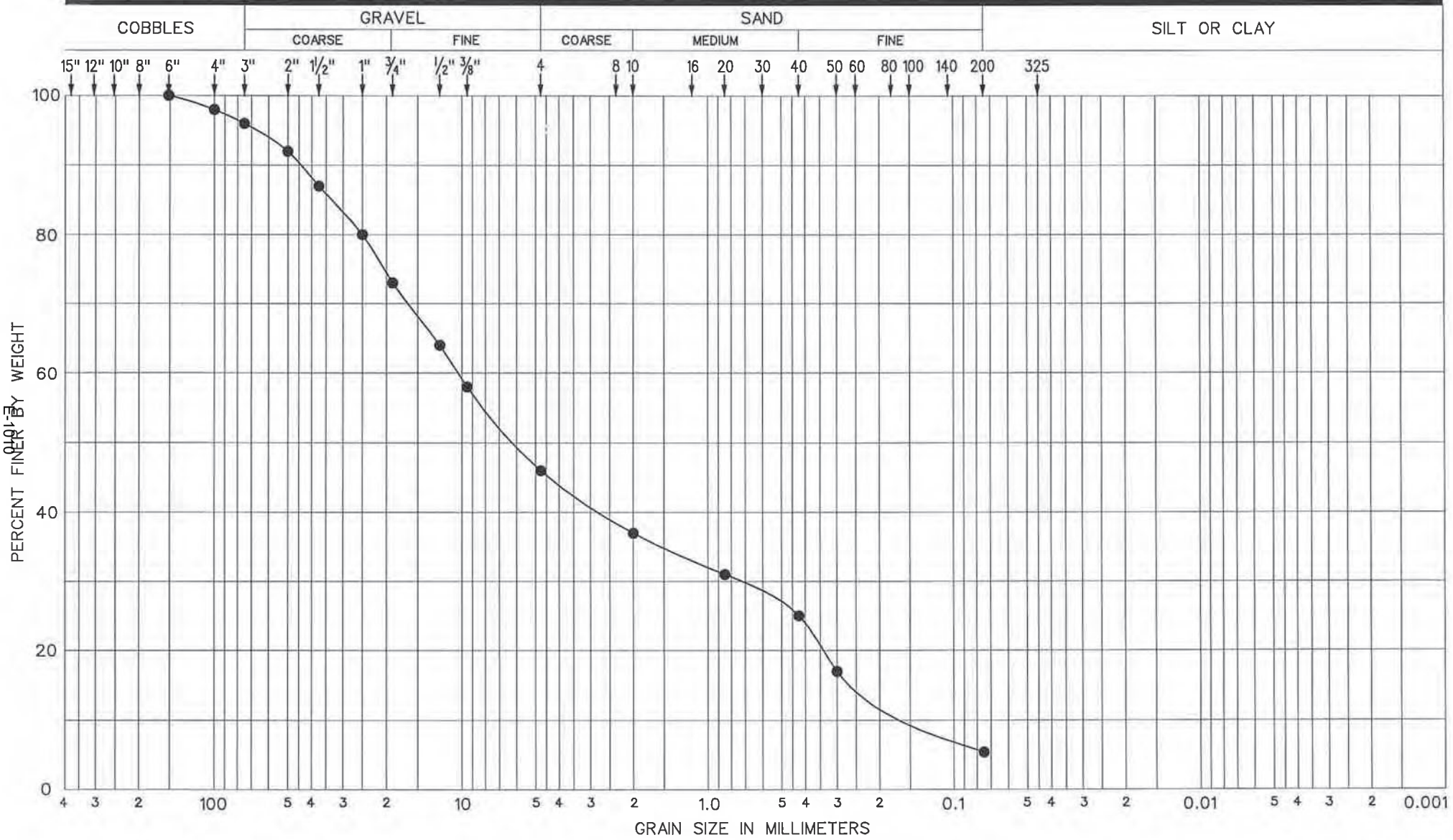
Project	COVE DAM		
Location	ORDERVILLE, UTAH		
Sample No./Depth	ROSE PIT		
Material Description	WELL GRADED GRAVEL W/SILT & SAND	USCS	GW-GM

Date	6/10/04
Technician	K. BRADFORD
Procedure	PLAIN WATER
Method	ASTM C117, C136, C566

RB&G ENGINEERING INC.
1435 West 820 North, Provo, Utah 84601
801 374-5771 Provo
801 521-5771 Salt Lake City

PROJECT NO.	200401.025

SIEVE ANALYSIS (GRADATION)



E-1070

Project	COVE DAM		
Location	ORDERVILLE, UTAH		
Sample No./Depth	TATE PIT		
Material Description	POORLY GRADED GRAVEL W/SAND	USCS	GP

Date	6/10/04
Technician	K. BRADFORD
Procedure	PLAIN WATER
Method	ASTM C117, C136, C566

Appendix

DIVISION OF WATER RESOURCES
Engineering Geology Section
1594 West North Temple, Suite 210
Box 145201
Salt Lake City, Utah 84114-6201

MEMORANDUM

October 6, 1997

Post-it® Fax Note 7671	Date 10/6/97	# of pages ▶ 15
To Brad Price	From Dan Aubrey	
Co./Dept. RB46	Co. Water Resources	
Phone #	Phone # 538-7283	
Fax # 801-374-5773	Fax #	

TO: Ben Everitt
Chief Geologist

FROM: Dan Aubrey
Engineering Geologist

SUBJECT: Test Pits At Cove Dam Site Near Orderville, Kane County, Utah.

Introduction and Location

On Wednesday, June 4th at the request of Kane County Water Conservancy District I supervised the digging of a number of test pits along the proposed alignments for two offstream damsites in the lower reaches of Cove Canyon. The lower alignment, including both abutments is located in the SW¼ of Sec.5, T41S, R7W, SLB&M. The right abutment of the upper alignment is located in the SE¼ of Sec. 6, while the left abutment is located in the NW¼ of Sec. 5, T41S, R7W, SLB&M (see Figure 1). A total of nine test pits were located and logged, six pertaining to the upper alignment and three along the lower alignment (see Figure 1).

These sites had been identified during a reconnaissance level inventory of Virgin River damsites during the mid- to late 1980's. Not until 1996 did this location receive any further attention concerning its viability as a potential damsite(s). Franson-Nobel & Associates, Inc., in June of 1996, completed a reconnaissance level evaluation, in part, to help in the preparation of preliminary cost estimates. Continued interest in the site by both the Kane County Water Conservancy District and the Washington County Water Conservancy District resulted in this first review of the site from a geology and geotechnical point of view.

Given a storage of 6,700 acre-feet, a dam at the lower alignment would have to be approximately 98 feet high and at the upper alignment a dam would have to be about 103 feet high to store this amount of water. A dam of this height at the upper site may require the placement of a dike in the saddle just upstream of the right abutment.

Geologic Setting

The proposed Cove damsites are located in an alluvial valley, tributary to Long Valley and the East Fork Virgin River, that has been cut into a sequence of Cretaceous and Tertiary sedimentary rocks consisting mostly of sandstone and shale. Based on a review of pertinent geologic maps and literature the bedrock exposed in the abutments and underlying the alluvium in the reservoir basins is of the Cretaceous aged Tropic Shale Formation. The shale is predominantly gray, carbonaceous, calcareous, and includes bentonitic horizons and thin lenticular sandstones. The residual soil is a silty to sandy clay (CL to CH). Capping abutment ridges is a thin light brown deposit of gravel containing pebbles and cobbles of gray and red

quartzite, grey to black chert, and grey limestone. Alluvium which covers the flat valley floor of the Cove is predominantly light to medium brown, fine to very fine grained sand with silt, and clay.

Based on research of water well logs, depth to bedrock in Long Valley (underlying the East Fork Virgin River) is approximately 50 feet. Making the assumption that tributaries are graded to the main valley results in projected depth to bedrock under the lower alignment of about 40-45 feet, and under the upper alignment of about 35-40 feet. The valley is approximately 1,000 feet wide at the lower alignment and about 1,500 feet wide at the upper alignment.

Discussion of Test Pits and Geotechnical Considerations

Figure 2 is a graphic representation of the materials encountered in the test pits. In general the materials encountered were very fine grained sand to silt and clay (SM, ML, & CL). The two test pits (#'s 2 & 7) located at the base of the right abutment, at each damsite, encountered some gravel. The gravel is contributed from the colluvial slopes of the abutment. Test pit #5 which was located in the drainage near the left abutment of the upper alignment encountered the most granular material. Here 6.5 feet of poorly graded sandy gravel contains cobbles to 14" diameter. Calcite (calcium carbonate) stringers are moderately abundant to very abundant in the test pits below 6 or 7 feet, in most of the test pits. Restricted access prevented us from placing test pits on or near the left abutments of either alignment.

Based on the test pits it appears that there is an abundance of cohesive material available for dam construction, however, the test pits did not identify an adequate source of granular material. At this level of investigation (considering only the geology and geotechnical aspects) it does not appear that one alignment has any advantage over the other.

Geologic Hazards

Following digging of the test pits, I performed a preliminary geologic hazards review of the sites. The summary of geologic hazards (see Table 1) accompanies this report. While most of the hazards listed in the summary, rate in the unlikely hazards category there are two geologic hazards which fall into the probable category and five which rate as possible hazards. These are identified as follows:

Probable Hazards — 1. Ground shaking due to an earthquake centered on the nearby Sevier Fault, and 2. Expansive clays which occur in the Tropic Formation throughout southern Utah.

Possible Hazards -- 1. Liquefaction, 2. Tectonic subsidence, and 3. Slope failure are all related to proximity of the Sevier Fault. 4. Collapsible soils and 5. Pipable/Erodible hazards are related to the identification in the test pits of very fine grained sand and non-cohesive silt.

Further study will be necessary to determine what impact these seven hazards might have on a dam constructed at either of these sites.

Conclusions and Recommendations

Based on information from the test pits and geologic hazards evaluation the following conclusions can be reached:

1. There is an abundance of cohesive material available, including some bentonite outcroppings in the Tropic Shale.

2. Only a very limited amount of granular material is available, and nothing that is suitable as rip rap was identified.
3. At this level of investigation one site does not seem to have any substantial advantage over the other.
4. Either site is capable of storing 6,700 acre-feet of water.
5. Proximity of these sites to the Sevier Fault and the presence of expansive clays and very fine grained non-cohesive soils are geologic hazards.
6. As part of a preliminary design, additional studies should address specific hazards.

The following recommendations are suggested:

1. A seismic hazards evaluation of the Sevier Fault will be needed to determine what impact this hazard might have on these damsites.
2. Laboratory testing of soil samples is necessary to determine if a soils/foundation hazard exists.
3. A careful cost estimate ought to be prepared for these sites so a benefit /cost ratio can be developed.
4. From a geologic and geotechnical view the next step would be to pursue investigation of the subsurface conditions by drilling, sampling and testing (permeability, blow counts, etc.) along the proposed alignment.

ABLE # 1

SUMMARY OF GEOLOGIC HAZARDS

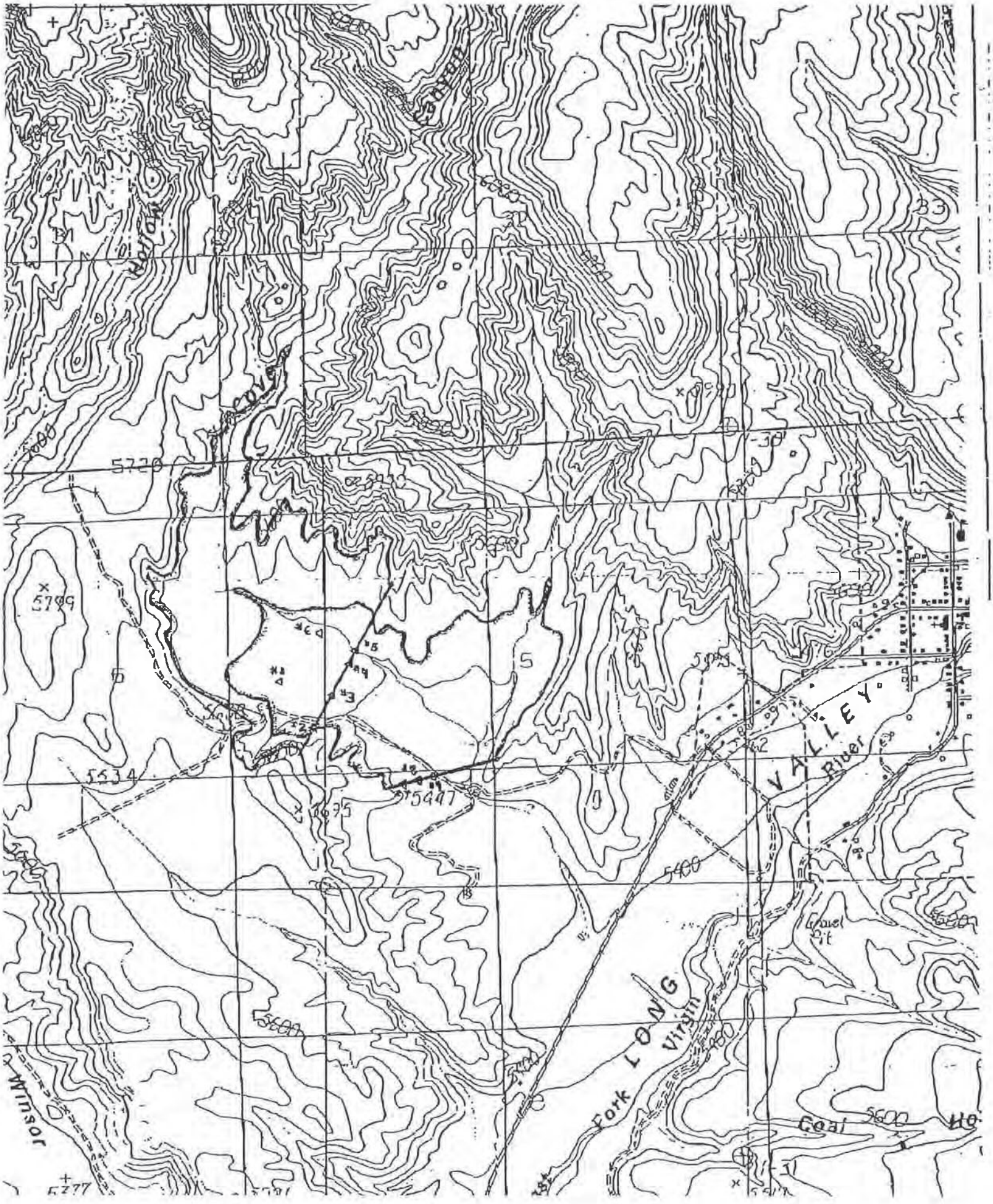
COVE DAMSITES

	Hazard Rating*			Further Study Recommended**
	Probable Hazard	Possible Hazard	Unlikely Hazard	
Earthquake				
Ground shaking	E,F			G
Liquefaction		AF		S
Surface faulting			X	
Tectonic deformation		E,RB		G
Slope failure		A,RB		G
Seiche			X	
Slope Failure (Non-seis)				
Rock fall			X	
Landslide			X	
Debris flow			X	
Found/Embank Problems				
Collapsible soils		AF		S
Expansive clays	F,A			S
Sensitive clays			X	
Organic soils			X	
Soluble salts			X	
Erodable/Erodible		E		S
Karst			X	
Differential settlement			X	
Non-engineered fill			X	
Hydrologic				
Shallow ground-water			X	
Springs/Seeps			X	
Flooding				
Stream/Lake			X	
Upstream dam failure			X	
Spillway capacity			X	
Dam overtopping			X	

*Hazard Rating - Probable-evidence is strong that the hazard exists and mitigation measures should be taken. Possible-hazard may exist, but evidence is uncertain and further study is recommended. Unlikely-no evidence was found to indicate that the hazard is present.

Abbreviations; E = embankment, F = foundation, AF = alluvial foundation, BF = bedrock foundation, A = abutments, RB = reservoir basin, SL = shore line, DST = down stream toe, UST = up stream toe, DSF = down stream face, USF = up stream face, SP = spillway, & NA = Not applicable.

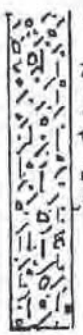
**Further Study (S-soil/foundation, G-geotecnical/engineering, H-hydrologic, SIP-study in progress, MIP-mitigation measures in progress) is recommended to address the hazard (see Conclusions and Recommendations).


5720
5709
5534
5447
5400
5600
Josuw
Fork
Virgin
River
Gravel
Pit
Coal
Hollow

Upper Alignment

ML-CL
lt-md tan, calcareous sandy clayey silt to sandy silty clay. sand fine to very fine grained. dry, loose to compact with depth calcite stringers 7"-14"

TP #2



ML-CL
md brn to gy-brn 20% caliche covered gravel and cobbles to 12'. mostly sandy clayey silt to silty sandy clay
dry, loose
calcareous.
sand very fine grained.
gravel subrounded to subangular

TP #3



SM-ML-CL
md orange-brn to brn silty sand to sandy clayey silt to sandy silty clay
dry, loose, crumbles easily.
calcareous
calcite stringers from 7' to 14'.
clay content increased with depth
sand very fine grained.

TP #4



SM-ML-CL
lt orange-brn silty sand to sandy clayey silt to sandy silty clay.
dry, loose, crumbles easily.
calcareous
calcite stringers from 6" to 14.5"
clay content increases with depth, more compact.
roots to 6' deep

TP #5



GP, CH
poorly graded sand, gravel mix with cobbles to 14", 0"-6.5" caliche coated, subangular to rounded gravel. most gravel to less than 3" dia.
6.5' to 13' damp to moist, grey clay-high plasticity, white calcite stringers throughout. calcareous.

TP #6



SM-CH
ground cove
close to wi
spaced brn
sand to ma
and boulde
0"-2½' gr
silty sand
loose, crumi
2½'-12' gra
to clay. lt
md gy-br
calcareous
stringers

E-1017

Lower Alignment

Legend

- Clay
- Silt
- Sand
- Gravel

TP #1



CL-CH
lt-brn to md-gy-brn sandy, silty clay.
dry, loose, dense from 8"-12".
calcareous - abundant calcite stringers below 8". dense clay is gy.
occasional pebbles in upper 5'.

TP #2



SM-ML-CL
light brown silty sand to sandy silt to sandy, silty clay
dry, loose crumbles easily
calcareous

TP #3



SM-ML-CL
light brown silty sand to sandy silt to sandy, silty clay
dry, loose crumbles easily clay content increase with depth, more compact.
calcareous, calcite stringers from 6"-15"

See Map for Test Pit Locatic

Figure #2

22-144 200 SHEETS

Importance of alfalfa hay and reason for use in determining the Cove Reservoir Project Cost/Benefit ratio.

Alfalfa is a key part of the western United States agricultural business and has been for a long time. Western states have a played a key role in alfalfa's historical development in the United States which has led to its current status as the nation's third most important agricultural crop. Its production in the west was worth $8.5 billion in 2018. Currently, alfalfa is a critical rotation crop and cash crop in all western states.

1. **Alfalfa Hay is a Major Animal Feed Source for Livestock in Southwestern Utah –** Alfalfa hay is a major feed source that supports livestock, milk production, and other industries in southwestern Utah. Although alfalfa is not the most profitable crop grown in southwest Utah, it competes well with grain and vegetable crops. Moreover, the risk of growing alfalfa is much lower than many other crops, making year-to-year profits steady. Alfalfa is resilient to unpredictable weather conditions and alfalfa markets have remained much more constant than other crops. Utah has a long-lasting demand for livestock feed, which produces local food for consumers. A study conducted in 2020 (reference "the importance of western alfalfa production article) showed that 10 of the 11 western states studied, reported that alfalfa is increasing in acreage or importance in their state and anticipated that this trend would continue. The most frequent reasons cited for this trend is increased demand by an expanding dairy industry, other market demands, and a lack of profitable alternative crops.
2. **High Quality Hay Can be Grown in Southwestern Utah –** Higher quality alfalfa hay can be grown in the project area due to the high elevation in the area. Research has shown that producers' fields located in the central part of Utah from 5,000 to 7,000 feet in elevation can grow exceptionally high qualify hay. The higher quality is attributed to cooler growing-season temperatures at high elevations. Alfalfa cultivators with greater fall dormancy are often better adapted to the shorter growing seasons at higher elevations, and slower growth initiation can improve alfalfa quality. Cooler temperatures seem to reduce alfalfa stem elongation, resulting in a higher leaf-to-stem ratio for alfalfa grown at higher elevations. Non-fibrous carbohydrates are the needed source of energy in beef finishing and dairy cow diets, which include starch and water-soluble carbohydrates like sugars and fructans, as well as readily digestible fiber. Non-fibrous carbohydrates are especially valuable in beef finishing diets because the marbling that makes meat tender and juicy requires high-energy feed.
3. **High Water Use Efficiency –** Alfalfa has a greater water use efficiency than most other crops. Alfalfa has deeper roots (as deep as 15 feet in some places) and a longer growing season than many other crops. Additionally, the entire aboveground portion of the plant is harvested multiple times per year.
4. **Irrigation Flexibility –** As a perennial, naturally drought-tolerant crop, alfalfa has incredible tolerance to irregular irrigation. In fact, irrigation can stop at almost any point in the season without causing long-term damage to the crop. Alfalfa goes dormant when it is water-stressed, but usually completely rebounds when irrigation continues (Lindenmeyer et al., 2011). This flexibility can be a critical aspect for potential water banking/leasing programs. It also reduces risks associated with drought and water

delivery systems failures, because water delivery issues could decimate many annual crops with poor irrigation flexibility.

5. **Low Input –** Unlike many annual and perennial crops, alfalfa requires few chemical inputs. Alfalfa is a perennial legume and requires no nitrogen fertilizer, which is often one of the most expensive inputs for annual crops. Nitrogen contamination of water from increased corn acreage in the Midwest is a major concern that resulted in part from declining alfalfa production in that region. A portion of most nitrogen fertilizer applications also volatilize into the atmosphere adding to the greenhouse gas effect. In addition to less nitrogen, alfalfa also requires much less pesticides and tillage than most annual and even perennial crops.
6. **Resilient and Adaptable –** Few crops are as resilient to difficult growing conditions as alfalfa. It can grow in almost any elevation and almost any type of soil (from sandy to clay soils). This is critical for crops in southwest Utah, where elevation changes are drastic, and soils vary widely. Grain, fruit, nut, and vegetable crops are much more sensitive to weather conditions and often fail when early or late frosts occur. Alfalfa can also utilize rainfall better than many other annual crops. As a perennial crop, established alfalfa utilizes rainfall in the early spring long before most annual crops are even planted.
7. **Benefits Other Crops in Rotation –** Alfalfa works with soil bacteria to convert nitrogen in the atmosphere to forms usable by plants. After alfalfa is terminated, large quantities of nitrogen can remain in the soil. This can usually result in savings of about $150/acre during the two crops that follow alfalfa from withholding or reducing nitrogen fertilizer applications (Yost et al., 2014b; Creech et al., 2015). In addition to nitrogen, crops that follow alfalfa in a crop rotation generally yield up to 10-15% greater and require less pesticides (Stanger and Lauer, 2008; Yost et al., 2014a). Alfalfa can also be grown with grasses in pastures providing nitrogen for the grasses, increased production during the hot summer months when cool- season grasses are less productive, and beneficially using soil water below pasture grass roots.
8. **Improves Soil, Water, and Air Quality –** Perennial crops like alfalfa help reduce soil erosion, which is one of the primary causes of irreversible soil degradation. Alfalfa also can often improve some physical (aggregate stability) and biological (organic matter and potentially mineralizable nitrogen) properties of soil (Congreves et al., 2015). Most annual crops require multiple passes of annual tillage, especially in organic production. Tillage is a major contributor to soil erosion. Most strategies that involve changing fertilizer management only offer small improvements, whereas the addition of a perennial crop like alfalfa could nearly meet the nitrogen reduction goals (Iowa nutrient reduction strategy, 2012). Alfalfa is highly valued by organic and conventional farmers alike for its soil health- building characteristics.
9. **Supports Wildlife Habitats** – The water used to irrigate alfalfa can create lush oases for wildlife habitats. Various wildlife species including birds, herbivores and important species such as foxes, hawks and eagles are abundant in alfalfa fields.
10. **Pollinator and Insect Diversity –** The health of bees and other pollinators are vital to the fruit and vegetable industries throughout the West. Alfalfa (mainly mature plants on field edges, ditches, seed alfalfa production, etc.) is one of the major sources of pollen. Other beneficial insects that keep pest insects in check are commonly found in alfalfa fields and provide benefit to the agro-ecosystem for neighboring crops.

11. **Harvest Flexibility and Storage** -The harvest window for alfalfa is much wider than many other crops. Although the quality of the crop will decrease as alfalfa matures, quality is often not overly critical unless alfalfa is being used for lactating dairy cows. This allows for high amounts of flexibility. Furthermore, the arid West also usually provides rain-free days between cutting and baling to produce excellent quality hay. Unlike some fruits and vegetables, alfalfa-like grain crops that are properly dried and stored can maintain its quality for long periods of time. It does not need to enter the market or be consumed quickly. This allows farmers to stockpile feed for their livestock or store their products until markets and prices are favorable.

The price of alfalfa hay was selected for determining the benefits of the Cove Reservoir project because of its importance as a major feed source, its economic value, and suitability to Utah's local climate and growing season. Other benefits of alfalfa hay include its water use efficiency, status as a drought-tolerant crop, minimal need for fertilizer, importance as a rotational crop, and the benefits provided toward increasing pollination.

INTERDISCIPLINARY TEAM ANALYSIS RECORD CHECKLIST

Project Title: Proposed Cove Reservoir and the Bald Knoll and Black Knoll borrow pits

NEPA Log Number:

File/Serial Number:

Project Leader: James Holland (BLM project leader)

Project Proposal:

FOR EAs/CXs: NP: not present; NI: resource/use present but not impacted; PI: potentially impacted
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STAFF REVIEW OF PROPOSAL:

NP/NI/PI NC	Resource	Date Reviewed	Signature	Review Comments (required for all NIs and PIs. PIs require further analysis.)
			CRITICAL ELEMENTS	
NI	Air Quality *(C. Gubler)*	08/01/19	/s/ C. Gubler	Emissions would be expected as part of the project however because it is a short term project impacts to air quality would be negligible.
NP	Areas of Critical Environmental Concern *(D. Gunn)*	06/10/19	/s/ Dan Gunn	There are no ACEC's identified within the project area.
NI	Cultural Resources *(B.Storm)*	9/13/19	/s/ Brian Storm	A cultural resources Class III inventory (project # U18TN0544) was conducted in the Black Knoll rip rap pit project area and Bald Knoll community pit in June 2019. The June 2019 inventory resulted in the identification of two new sites (42KA8972 and 42KA8973) and two isolated finds in the Black Knoll project area. Both sites are small surface lithic scatters sans diagnostic artifacts or features; the sites are recommended not eligible for inclusion to NRHP. Isolated finds (IO-6, IO-7) consisted of one and four flakes, respectively. The isolates have been fully documented, are not eligible for inclusion to the NRHP, and no additional research or preservation is required. A cultural resources Class III inventory (project # U84BL0697) was completed in the project area in July 1984. The original inventory identified two sites (42KA2677 and 42KA2678) within the project area. Neither site was located during the June 2019 inventory or during a 2018 inventory (project # U18ES0434). The sites were recommended not eligible for inclusion to the NRHP. The June 2019 inventory resulted in no new cultural resources being identified in the Bald Knoll project area. A cultural resources Class III inventory (project # U07BL0560) was completed for the initial pit in May 2007. The inventory resulted in the identification of two new sites (42KA6331 and 42KA6332) at the south end of the project area. Both sites are recommended as eligible for inclusion to the NRHP. Site 42KA6331 was visited in 2019. Expansion of the Bald Knoll community pit to the north will result in no adverse effect to historic properties, but the boundary of the pit needs to be

NP/NI/PI NC	Resource	Date Reviewed	Signature	**Review Comments** (required for all NIs and PIs. PIs require further analysis.)
				updated/altered to exclude these two sites to ensure adverse effects to the historic properties will be avoided by all future use of the pit.
NI	Environmental Justice *(C. Stewart))*	8/2/19	/s/ Clay Stewart	The proposed action would not have a disproportionate effect on low income or minority communities because these communities, in general, do not exist near the project areas.
NP	Farmlands (Prime or Unique) *(J. Reese)*	8/28/19	/s/ J. Reese	There are no farmlands within the proposed project area.
NI	Floodplains *(J. Holland)*	7/24/2019	/s/ James R Holland	No floodplains exist in the proposed project area.
NI	Invasive, Non-native Species *(L. Lefevre)*	7/24/19	/s/ Levi L. LeFevre	There are some invasive species present in the area, but are unlikely to be significantly impacted by the proposed action
PI	Native American Religious Concerns *(B.Storm)*	9/13/19	/s/ Brian Storm	Native American religious concerns will be identified by Tribal response to NEPA mailing as part of the Proposed Cove Reservoir Project EA. Such concerns are usually associated with potential impacts to prehistoric archaeological sites of their ancestors, which they consider as traditional cultural properties. As long as project stipulations are followed and traditional cultural properties including but not limited to prehistoric archaeological sites are avoided, no concerns are anticipated. Access and ceremonial use of any sacred site or traditional cultural property both known and unknown to the BLM will not be limited by proceeding with this project.
NP	Threatened, Endangered or Candidate Plant Species *(C. Gubler)*	08/01/2019	/s/ C. Gubler	
NI	Threatened, Endangered or Candidate Wildlife Species *(L. Church)*	7/24/19	/s/ L. Church	
NP	Wastes (hazardous or solid) *(T. Linton)*	9/9/19	/s/ T. Linton	No known or visible hazardous waste apparent at these locations.
NI	Water Quality *(J. Holland)*	7/24/2019	/s/ James R Holland	Because of the distance to surface water, the depth to ground water in the proposed project area, and the type of action that is being proposed, it is highly unlikely that any water resources would be affected.
NP	Wetlands/Riparian Zones *(L. Church)*	7/25/19	/s/L. Church	
NP	Wild and Scenic Rivers *(D. Gunn)*	6/10/19	/s/ Dan Gunn	There are no Wild and Scenic Rivers within the project area.
NP	Wilderness *(D. Gunn)*	6/10/19	/s/ Dan Gunn	There is no designated wilderness within the project area.
OTHER RESOURCES / CONCERNS*				
NI	Rangeland Health Standards and Guidelines *(C. Gubler)*	07/25/19	/s/ C. Gubler	Impacts to Rangeland health are not expected rip rap pits are in volcanic areas. Mining these areas for rock should not have an overall impact on rangeland health.
NI	Livestock Grazing *(J. Reese)*	08/28/2019	/s/ J. Reese	Impacts to Livestock grazing are expected to be minimal. The proposed sites consist mostly of Rock and do not produce enough forage to impact livestock grazing.
NI	Woodland / Forestry *(J. Reese)*	08/28/2019	/s/ J. Reese	Sites consist mainly of Pinyon and Juniper and are considered invaded sites not woodlands.

NP/NI/PI NC	Resource	Date Reviewed	Signature	**Review Comments** (required for all NIs and PIs. PIs require further analysis.)
NI	Vegetation *(J. Reese)*	08/28/2018	/s J. Reese	Impacts to vegetation would be minimal on these sites because they have mostly been invaded by Pinyon and Juniper and because of the rock content they are not expected to produce much vegetation.
NI	Fish and Wildlife *(L. Church)*	7/25/19	/s/ L. Church	Construction and maintenance that included vegetation removal in species that could support neotropical migratory birds should occur after neotropical Migratory bird nesting periods to prevent the potential for impacts to nesting birds April 15 –Aug 15, if clearance work by a qualified biologist precludes presence construction and maintenance outside of emergency maintenance could occur
NI	Soils *(J. Reese)*	08/28/2019	/s/ J. Reese	BMP's for soils should be included in the project design and stipulations. If BMP's are adhered to impacts to soils in the project areas would be minimal.
NI	Recreation *(D. Gunn)*	6/10/19	/s/ Dan Gunn	Recreational opportunities exist within the project area but are unlikely to be significantly impacted by approval and implementation of this project.
NI	Visual Resources *(D. Gunn)*	6/10/19	/s/ Dan Gunn	The project area lies within lands classified as VRI Classes III and IV, which allow for moderate to high levels of change to the characteristic landscape. The 2008 Kanab Field Office RMP states that VRM Class III and IV objectives "are applied as necessary to allow for exploration and the associated infrastructure to support mineral resource development in accordance with the Energy Policy and Conservation Act…"
NI	Geology /Paleontology *(J. Holland)*	7/24/2019	/s/ James R Holland	No unique geology exists within the proposed project area. Because of the igneous rock type found in the proposed pit area, no paleontological resources are present.
NI	Lands / Access *(Brandon Johnson)*	9/11/2019	/s/ Brandon Johnson	No rights-of-way or conflicting land use authorizations exist within the proposed project area. Access to pits would be off of existing roads on the KFO travel management plan.
NI	Fuels / Fire Management *(C. Gubler)*	08/01/19	/s/ C. Gubler	No impacts to fuels or fire management are forseen as a result of implementation of the proposed action.
NI	Socio-economics *(C. Stewart)*	8/2/19	/s/ Clay Stewart	The economic base for the area is primarily ranching and some mining. Nearby communities are supported by tourism (including outdoor recreation), construction, and light industry. There would be no displacements or disruption to established business or uses of the area.
NP	*BLM Natural Areas (D. Gunn)*	6/10/19	/s/ Dan Gunn	There are no BLM Natural Areas within the project area.

FINAL REVIEW:

Reviewer Title	Date	Signature	Comments
NEPA Coordinator (C. Stewart)	9/24/19		
Field Manager (W. Bunting)	9/24/19	Cheryl Stewart (for)	

NOTE: Review Comments should include information explaining how the specialist came to their conclusion - how does he/she know the element/resource is not present (site visit and date of visit, familiarity with location, etc.). For all 'NIs' give a brief explanation as to why that element/resource would not be impacted.

* The list of Other Resources / Concerns to be considered may vary by individual field office. Note: Native American Trust Responsibilities should be considered for FO's with Indian Mineral interests.

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NI	Rangeland Health Standards and Guidelines *(C. Gubler)*	07/25/19	/s/ C. Gubler	Impacts to Rangeland health are not expected rip rap pits are in volcanic areas. Mining these areas for rock should not have an overall impact on rangeland health.
NI	Livestock Grazing *(J. Reese)*	08/28/2019	/s/ J. Reese	Impacts to Livestock grazing are expected to be minimal. The proposed sites consist mostly of Rock and do not produce enough forage to impact livestock grazing.
NI	Woodland / Forestry *(J. Reese)*	08/28/2019	/s/ J. Reese	Sites consist mainly of Pinyon and Juniper and are considered invaded sites not woodlands.

NP/NI/PI NC	Resource	Date Reviewed	Signature	**Review Comments** (required for all NIs and PIs. PIs require further analysis.)
NI	Vegetation *(J. Reese)*	08/28/2018	/s J. Reese	Impacts to vegetation would be minimal on these sites because they have mostly been invaded by Pinyon and Juniper and because of the rock content they are not expected to produce much vegetation.
NI	Fish and Wildlife *(L. Church)*	7/25/19	/s/ L. Church	Construction and maintenance that included vegetation removal in species that could support neotropical migratory birds should occur after neotropical Migratory bird nesting periods to prevent the potential for impacts to nesting birds April 15 –Aug 15, if clearance work by a qualified biologist precludes presence construction and maintenance outside of emergency maintenance could occur
NI	Soils *(J. Reese)*	08/28/2019	/s/ J. Reese	BMP's for soils should be included in the project design and stipulations. If BMP's are adhered to impacts to soils in the project areas would be minimal.
NI	Recreation *(D. Gunn)*	6/10/19	/s/ Dan Gunn	Recreational opportunities exist within the project area but are unlikely to be significantly impacted by approval and implementation of this project.
NI	Visual Resources *(D. Gunn)*	6/10/19	/s/ Dan Gunn	The project area lies within lands classified as VRI Classes III and IV, which allow for moderate to high levels of change to the characteristic landscape. The 2008 Kanab Field Office RMP states that VRM Class III and IV objectives "are applied as necessary to allow for exploration and the associated infrastructure to support mineral resource development in accordance with the Energy Policy and Conservation Act…"
NI	Geology /Paleontology *(J. Holland)*	7/24/2019	/s/ James R Holland	No unique geology exists within the proposed project area. Because of the igneous rock type found in the proposed pit area, no paleontological resources are present.
NI	Lands / Access *(Brandon Johnson)*	9/11/2019	/s/ Brandon Johnson	No rights-of-way or conflicting land use authorizations exist within the proposed project area. Access to pits would be off of existing roads on the KFO travel management plan.
NI	Fuels / Fire Management *(C. Gubler)*	08/01/19	/s/ C. Gubler	No impacts to fuels or fire management are forseen as a result of implementation of the proposed action.
NI	Socio-economics *(C. Stewart)*	8/2/19	/s/ Clay Stewart	The economic base for the area is primarily ranching and some mining. Nearby communities are supported by tourism (including outdoor recreation), construction, and light industry. There would be no displacements or disruption to established business or uses of the area.
NP	*BLM Natural Areas (D. Gunn)*	6/10/19	/s/ Dan Gunn	There are no BLM Natural Areas within the project area.

FINAL REVIEW:

Reviewer Title	Date	Signature	Comments
NEPA Coordinator (C. Stewart)	9/24/19		
Field Manager (W. Bunting)	9/24/19	Cheryl Stewart (for)	

NOTE: Review Comments should include information explaining how the specialist came to their conclusion - how does he/she know the element/resource is not present (site visit and date of visit, familiarity with location, etc.). For all 'NIs' give a brief explanation as to why that element/resource would not be impacted.

* The list of Other Resources / Concerns to be considered may vary by individual field office. Note: Native American Trust Responsibilities should be considered for FO's with Indian Mineral interests.

AMENDMENT ONE TO THE
STATE-BASED PROTOTYPE PROGRAMMATIC AGREEMENT
BETWEEN THE
US DEPARTMENT OF AGRICULTURE,
NATURAL RESOURCES CONSERVATION SERVICE UTAH STATE OFFICE,
AND THE
UTAH STATE HISTORIC PRESERVATION OFFICER,
REGARDING CONSERVATION ASSISTANCE

WHEREAS, the Agreement was executed on April 4, 2015; and

WHEREAS, the Natural Resources Conservation Service (NRCS) Utah has requested that its Agreement be amended to primarily update the April 4, 2015 SPPA, which sunsets on April 4, 2025 and to further define training requirements for NRCS Utah's CRS personnel and its Conservation Planners and Partners; to provide more specific review procedures for NRCS Utah undertakings; and to fully revise the Appendices of the SPPA to further define conservation measures and their potential to affect cultural resources and historic properties; and

WHEREAS, NRCS Utah will send a copy of this executed amendment to the NRCS FPO, SHPO, and the Advisory Council on Historic Preservation;

NOW, THEREFORE, in accordance with Stipulation XV of the Agreement, NRCS Utah and the Utah State Historic Preservation Office (SHPO) agree that the Agreement is hereby amended to read as follows:

1. Amend the Agreement so it reads as follows:

STATE-BASED PROTOTYPE PROGAMMATIC AGREEMENT
BETWEEN THE
US DEPARTMENT OF AGRICULTURE,
NATURAL RESOURCES CONSERVATION SERVICE, UTAH STATE OFFICE
AND THE
UTAH STATE HISTORIC PRESERVATION OFFICE
REGARDING CONSERVATION ASSISTANCE

WHEREAS, the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) administers numerous voluntary assistance programs, special initiatives, and grant and emergency response programs for soil, water, and related resource conservation activities available to eligible private producers, States, commonwealths, Federally Recognized Tribal governments, other government entities, and other applicants for conservation assistance, pursuant to the Agricultural Act of 2018 (2018 Farm Bill, Public Law 113-79); Soil Conservation and Domestic Allotment Act of 1935 (Public Law 74-46, 16 U.S.C. 590 a-f, as amended); the Flood Control Act of 1944 (Public Law 78-534, as amended); the Watershed Protection and Flood Prevention Act (Public Law 83-566, as amended, 16 U.S.C. 1001-1012); the Agricultural and Food Act of 1981 (Public Law 97-98, 95 Stat. 1213); the Agricultural Credit Act (Public Law 95-3341, Title IV, Section 403); Food, Agriculture, Conservation and Trade Act of 1990 (Public Law 101-624); the Flood Control Act of 1936 (Public Law 74-738); the Food Security Act of 1985 (Public Law 99-198, as amended); the Federal Agricultural Improvement and Reform Act of 1996 (Public Law 104-127); and executive and secretarial orders, implementing regulations and related authorities; and

WHEREAS, NRCS, through its conservation assistance programs and initiatives, provides assistance for activities with the potential to affect historic properties eligible for or listed in the National Register of Historic Places (NRHP), including National Historic Landmarks (NHLs) and therefore constitute undertakings subject to review under Section 106 of the National Historic Preservation Act (NHPA), 16 U.S.C. 470f, and its implementing regulations, 36 CFR Part 800, including the provisions of these regulations addressing NHLs at 36 CFR Part 800.10; and

WHEREAS, NRCS has determined that the requirement to take into account the effects to historic properties of its undertakings may be more effectively and efficiently fulfilled through the use of a Prototype Programmatic Agreement (Prototype Agreement); and

WHEREAS, the NRCS Utah State Office has consulted with the Utah State Historic Preservation Officer/SHPO (SHPO) and followed the instructions in the ACHP letter that accompanied the Prototype Agreement, dated November 21, 2014; and

WHEREAS, NRCS also is responsible for fulfilling the requirements of the National Environmental Policy Act (NEPA), including the use of categorical exclusions, and coordinating NEPA and Section 106 reviews, as appropriate; and

WHEREAS, NRCS developed this Prototype Agreement in consultation with the National Conference of State Historic Preservation Officers (NCSHPO) and its members, interested Indian tribes, Native Hawaiian Organizations (NHO), interested historic preservation organizations, (such as the National Trust for Historic Preservation), and the Advisory Council on Historic Preservation (ACHP); and

WHEREAS, in accordance with 36 CFR Part 800.14(b)(4), the ACHP has designated this agreement as a Prototype Agreement, which allows for the development and execution of subsequent prototype agreements by individual NRCS State office(s) (State-based Prototype Agreements) to evidence compliance with Section 106; and

WHEREAS, this State-based Prototype Agreement (SPPA) for Utah conforms to the NRCS Prototype Agreement as designated by the ACHP on November 21, 2014, and therefore, does not require the participation or signature of the ACHP when the NRCS Utah State Office and Utah SHPO agree to the terms of the State-based Prototype Agreement; and

WHEREAS, this Prototype Agreement replaces the 2002 nationwide "Programmatic Agreement among the United States Department of Agriculture Natural Resources Conservation Service, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers relative to Conservation Assistance," as amended in 2011 and 2012, which expired on November 20, 2014; and

WHEREAS, the NRCS State Conservationist is the responsible federal agency official within the state for all provisions of Section 106, including consultation with the SHPO, NHOs, and government-to government consultation with Indian tribes to negotiate the State-based Prototype Agreement; and

WHEREAS, the State-based Prototype Agreement does not apply to undertakings occurring on or affecting historic properties on Tribal lands, as defined by Section 301(14) of the NHPA, without prior agreement and execution of a State-based Prototype Agreement with the concerned Indian tribe; and

WHEREAS, the NRCS has consulted with the Tribes in Utah and has invited the referenced Indian tribe(s) to enter into this State-based Prototype Agreement as a signatory; and

WHEREAS, this Prototype Agreement does not modify the NRCS' responsibilities to consult with Indian tribes and NHOs on all undertakings that might affect historic properties and properties of religious and cultural significance to them, regardless of where the undertaking is located, without prior agreement by the concerned Indian tribe or NHO, and recognizes that historic properties of religious and cultural significance to an Indian tribe or NHO may be located on ancestral homelands or on officially ceded lands near or far from current settlements; and

WHEREAS, when NRCS conducts individual Section 106 reviews for undertakings under this State-based Prototype Agreement, it shall identify and invite other agencies, organizations, and individuals to participate as consulting parties; and

NOW, THEREFORE, the NRCS Utah State Office and the Utah SHPO agree that undertakings in Utah shall be implemented in accordance with the following stipulations in order to take into account the effect of the undertaking on historic properties.

STIPULATIONS

NRCS shall ensure that the following stipulations are met and carried out:

I. Applicability.

a. Once executed by the NRCS and the Utah SHPO, this State-based Prototype Agreement sets forth the review process for all NRCS undertakings subject to Section 106 in the State of Utah.

b. Execution of this State-based Prototype Agreement supersedes any existing State Level Agreement with Utah SHPO executed under the previous NRCS nationwide Programmatic Agreement, but does not replace any existing project-specific Section 106 agreements (Memoranda of Agreement or Programmatic Agreements).

c. This State-based Prototype Agreement applies only when there is a Federal Preservation Officer (FPO) in the NRCS National Headquarters (NHQ) who meets the Secretary of the Interior's Professional Qualification Standards (48 FR 44716).

d. This State-based Prototype Agreement applies only where there is staffing or access to staffing (through contracted services or agreements with other agencies or Indian tribes) who meet the Secretary of Interior's Professional Qualification Standards.

II. Roles and Professional Qualifications.

a. The NRCS Utah State Conservationist is responsible for oversight of its performance under this State-based Prototype Agreement.

b. NRCS Utah shall ensure all NRCS staff or individuals carrying out Section 106 historic preservation compliance work on its behalf, including the NRCS Utah's Archaeological Program Specialists (APS) are appropriately qualified to coordinate the reviews of resources and historic properties as applicable to the resources and historic properties being addressed (site, building, structure, landscape, resources of significance to Indian tribes, NHOs, and other concerned communities). Thus, these staff and consultants must meet the Secretary of the

Interior's Professional Qualification Standards and have the knowledge to assess the resources within an undertaking's area of potential effects (APE).

c. The Utah State Conservationist is responsible for consultation with the Utah SHPO, as well as the government-to-government consultation with Tribes in the development of any consultation protocols. These responsibilities may not be delegated to any other staff, nor carried out on behalf of NRCS by another federal agency.

d. NRCS Utah APS or professional consultants shall provide technical historic property and resource information to the State Conservationist for use in Section 106 findings and determinations, after appropriate consultations with the SHPO, Indian tribes, and discussions with the landowner. The APS shall monitor and oversee the archaeological resources work and reporting of all NRCS Conservation Planners, Partner employees (Partners), and professional service consultants related to NRCS Utah undertakings. The APS shall make recommendations to the NRCS Utah State Conservationist in determining whether an undertaking has the potential to affect historic properties, triggering Section 106 review, pursuant to 36 CFR Part 800.3(a).

e. NRCS Utah Conservation Planners and Partners involved in implementing this State-based Prototype Agreement, after completion of NRCS' web, classroom, and field awareness training acquired through USDA's AgLearn training site, shall work with the APS personnel, as feasible, in completing historic preservation compliance (Section 106) field records for the agricultural producer's (NRCS Utah's client or voluntary applicant for assistance) files and for use in producing initial historic property identification records (as set forth and outlined in NRCS' operational guidance, the National Archaeological Resources Procedures Handbook, Title 190, Part 601).

f. NRCS Utah APS personnel shall oversee development of the scopes of work for investigation of the APEs for identified undertakings (see 36 CFR Part 800.4). NRCS Utah may use professional service contractors or consultants to assist with Archaeological resources compliance studies. NRCS Utah shall ensure these contractors meet the Secretary of Interior's Professional Qualifications Standards.

g. NRCS Utah remains responsible for all consultation with the SHPO, Indian tribes and THPOs, and all determinations of NRHP eligibility and effect. NRCS Utah may not delegate consultation for findings and determinations to professional services consultants or producers/applicants for conservation assistance.

h. Utah SHPO, if provided sufficient data on a proposed undertaking and APE for the proposed undertaking by the NRCS Utah state office shall consult and provide a response to NRCS within thirty (30) calendar days. The definition of sufficient data is provided in 36 CFR Part 800.11.

i. The ACHP shall provide technical guidance, participate in dispute resolution, and monitor the effectiveness of this agreement, as appropriate.

III. Training.

a. NRCS Utah shall require its Conservation Planners and Partners completing Archaeological resources identification and evaluation work to complete, at a minimum, the NRCS Web-based (in USDA AgLearn) and field Archaeological Resources Training modules. This training must be completed prior to completing archaeological resources compliance work and must be completed within the first year of employment with the NRCS. NRCS will also encourage personnel conducting archaeological resources identification and evaluation work to participate in the ACHP's Section 106 *Essentials* course.

b. NRCS Utah shall require APS personnel overseeing Archaeological resource work to take the NRCS archaeological Resources Training Modules (awareness training) and the ACHP's Section 106 *Essentials* course, or a course with similar content, if approved by the NRCS FPO. Training must be completed within the first calendar year after execution of this Agreement or within the first year of employment for new NRCS Utah APS personnel. NRCS APS personnel shall review and update training completion with their supervisors and include their training in their Individual Development Plans.

c. NRCS Utah may invite the Utah SHPO, Native American Tribal staff, and Tribal Historic Preservation Officers to participate in presentations at agency classroom or field trainings.

d. NRCS Utah shall encourage all personnel completing or overseeing archaeological resources work on behalf of the NRCS to take additional appropriate specialized training as provided by the Utah SHPO, Indian tribes, NHOs, the ACHP, National Park Service, General Services Agency or other agencies, as feasible.

IV. Lead Federal Agency.

a. For any undertaking for which NRCS Utah is the lead Federal agency for Section 106 purposes per 36 CFR Part 800.2(a)(2), NRCS Utah shall follow the terms of this State-based Prototype Agreement. NRCS Utah shall notify the Utah SHPO and the appropriate Native American Tribes of its involvement in the undertaking and the involvement of other State or Federal agencies, if any.

b. For any undertaking for which NRCS Utah is not the lead Federal agency for Section 106 purposes, including those undertakings for which NRCS Utah provides technical assistance to other USDA or other federal agencies, the terms of this State-based Prototype Agreement shall not apply to that undertaking. If the lead Federal agency agrees, NRCS may follow the approved alternative procedures in place for that agency.

V. Review Procedures.

a) In consultation with the Utah SHPO, NRCS Utah shall identify those undertakings with little to no potential to affect historic properties and list those undertakings in Appendix A of this State-based Prototype Agreement. Upon the determination by NRCS Utah that a proposed undertaking is included in Appendix A, further consultation for that undertaking is not required.

b) The list of undertakings provided in Appendix A may be modified through consultation and written agreement between NRCS Utah's State Conservationist and the Utah SHPO without requiring an amendment to this State-based Prototype Agreement. NRCS Utah's State Office will maintain the master list and will provide an updated list to all consulting parties with an explanation of the rationale (metadata) for classifying the undertakings accordingly.

c) Undertakings not identified in Appendix A shall require further review as outlined in Stipulation V.c of this State-based Prototype Agreement. Specific procedures used by NRCS Utah to streamline the Section 106 review process can be found in Appendix B, C, and D to this State-based Prototype Agreement; and in the NRCS National Archaeological Resources Procedures Handbook, Title 190, Part 601.

    1. NRCS may provide its proposed APE, identification of historic properties and/or scope of identification efforts, and assessment of effects in a single transmittal to the Utah SHPO and Indian Tribes, provided this documentation meets the substantive standards in 36 CFR Part 800.4-5 and 800.11.

    2. NRCS shall attempt to avoid adverse effects to historic properties whenever possible; where historic properties are located in the APE, NRCS shall describe how it proposes to modify, buffer, or move the undertaking to avoid adverse effects to historic properties.

    3. Where the NRCS proposes a finding of "no historic properties affected" or "no adverse effect" to historic properties, the Utah SHPO and Indian Tribes shall have 30 calendar days from receipt of this documented description and information to review it and provide comments. The NRCS shall take into account all timely comments.

        i. If the SHPO/Indian Tribe, or another consulting party, disagrees with NRCS' findings and/or determination, it shall notify the NRCS within the 30 calendar day time period. The NRCS shall consult with the SHPO/Indian Tribe/NHO or other consulting party to attempt to resolve the disagreement. If the disagreement cannot be resolved through this consultation, NRCS shall follow the dispute resolution process in Stipulation VIII below.

ii. If the SHPO or Indian Tribe does not respond to the NRCS within the 30 calendar day period and/or the NRCS receives no objections from other consulting parties, or if the SHPO/Indian Tribe concurs with the NRCS' determination and proposed actions to avoid adverse effects, the NRCS shall document the concurrence/lack of response within the review time noted above, and may move forward with the undertaking.

4. Where a proposed undertaking may adversely affect historic properties, NRCS Utah shall describe proposed measures to minimize or mitigate the adverse effects, and follow the process in 36 CFR Part 800.6, including consultation with other consulting parties and notification to the ACHP, to develop a Memorandum of Agreement to resolve the adverse effects.

VI. Emergency and Disaster Management Procedures (Response to Emergencies).

a. NRCS Utah shall notify the Utah SHPO immediately or within 48 hours of the emergency determination, following the NRCS Emergency Watershed Program (EWP) final rule (see Section 216, P.L. 81-516 Final Rule, 7 CFR Part 624 (April 2005).

b. The NRCS Utah State office shall prepare procedures for exigency (following the rules for NRCS' EWP regarding immediate threat to life and property requiring, response within 5 days) in consultation with the SHPO.

c. If the NRCS Utah State office has not developed specific procedures for responding to exigencies, NRCS Utah shall follow the recently approved guidelines for Unified Federal Review issued by the Department of Homeland Security, Federal Emergency Management Service (DHS, FEMA), the Council on Environmental Quality (CEQ), and the ACHP in July 2014, or the procedures in 36 CFR Part 800.12(b).

VII. Post Review Discoveries of Archaeological Resources Or Historic Properties and Unanticipated Effects to Historic Properties.

a. Where construction has not yet begun and an archaeological resource is discovered after Section 106 review is complete, NRCS Utah shall consult to seek avoidance or minimization strategies in consultation with Utah SHPO, and/or to resolve adverse effects in accordance with 36 CFR Part 800.6.

b. NRCS Utah shall ensure that every contract for assistance includes provisions for halting work/construction in the area when potential historic properties are discovered or unanticipated effects to historic properties are found after implementation, installation, or construction has begun. When such a discovery occurs, the producer who is receiving financial assistance or their contractor shall immediately notify NRCS Utah's State Conservationist's Office, APS personnel, supervisory NRCS personnel for the area, and the landowner/applicant.

1. NRCS Utah's APS shall inspect the discovery within 24 hours, if weather permits. In consultation with the local NRCS official (field office supervisor or District or Area Conservationist), concerned Indian tribes, the Utah SHPO, the NRCS State engineer or program supervisor, as appropriate, the landowner/producer (whomever NRCS is assisting), the APS shall establish a protective buffer zone surrounding the discovery. This action may require inspection by tribal experts in addition to APS.

2. All of NRCS Utah's contact with media shall occur only under the direction of the NRCS Public Affairs Officer, as appropriate, and the State Conservationist.

3. Security shall be established to protect the resources/historic properties, workers, and private property. Local law enforcement authorities will be notified in accordance with applicable State law and NRCS policy in order to protect the resources. Construction and/or work may resume outside the buffer only when the State Conservationist determines it is appropriate and safe for the resources and workers.

4. NRCS Utah's APS shall notify Utah SHPO and the ACHP no later than 48 hours after the discovery and describe NRCS' assessment of the National Register eligibility of the property, as feasible and proposed actions to resolve any adverse effects to historic properties. The eligibility determination may require the assessment and advice of concerned Indian tribes, Utah SHPO, and technical experts (such as historic landscape architects) not employed by NRCS.

5. Utah SHPO and ACHP shall respond within 48 hours from receipt of the notification with any comments on the discovery and proposed actions.

6. NRCS Utah shall take any comments provided into account and carry out appropriate actions to resolve any adverse effects.

7. NRCS Utah shall provide a report to the SHPO and the ACHP of the actions when they are completed.

c. When human remains are discovered, the NRCS Utah shall follow all applicable federal, Tribal, and state burial laws and ordinances, including the Native American Graves Protection and Repatriation Act, and implementing regulations, when on tribal or federal lands, and related human rights and health statutes, where appropriate. NRCS shall also refer to the ACHP's Policy Statement regarding *Treatment of Burial Sites, Human Remains and Funerary Objects* and the ACHP's Section 106 Archaeology Guidance. NRCS Utah shall also follow USDA and NRCS policy on treatment of human remains and consultation.

   1. NRCS Utah's discovery, treatment, and repatriation of human remains and burial objects will further comply with Utah Code Title 9 Chapter 8a Part 3, Section 309 (UT Code 9-8a-

309) when located on private lands in Utah.

VIII. Dispute Resolution.

a. Should any consulting or signatory party to this State-based Prototype Agreement object to any actions proposed or the manner in which the terms of the agreement are implemented, NRCS Utah's State Conservationist and APS personnel shall consult with such party to resolve the objection. If the State Conservationist determines that such objection cannot be resolved, they will:

   1. Forward all documentation relevant to the dispute, including NRCS Utah's State Conservationist's proposed resolution, to the NRCS FPO and Senior Policy Official (SPO Deputy Chief for Science and Technology) and the ACHP. The ACHP shall provide the FPO, SPO, and the State Conservationist with its advice on the resolution of the objection within thirty (30) days of receiving adequate documentation. Prior to reaching a final decision on the dispute, NRCS Utah shall prepare a written response that takes into account any timely advice or comments regarding the dispute from the ACHP and any signatory or consulting parties, and provide them with a copy of this written response. NRCS Utah will then proceed according to its final decision.

   2. If the ACHP does not provide its advice regarding the dispute within the thirty (30) day time period, NRCS Utah may make a final decision on the dispute and proceed. Prior to reaching such a final decision, NRCS Utah shall prepare a written response that takes into account any timely comments regarding the dispute from the signatories and consulting parties and provide them and the ACHP with a copy of the written response.

b. The responsibility of the NRCS Utah State office to carry out all other actions subject to the terms of this agreement that are not the subject of the dispute remains unchanged.

c. Any consulting party to State-based Prototype Agreement may request the ACHP provide its advisory opinion regarding the substance of any finding, determination, or decision regarding compliance with its terms.

d. At any time during the implementation of the State-base Prototype Agreement, a member of the public may submit an objection pertaining to this agreement to NRCS Utah's State Conservationist, in writing. Upon receiving such an objection, the State Conservationist shall notify the NRCS SPO and FPO, and Utah SHPO; take the objection into account; and consult with other consulting parties as appropriate to resolve the objection. The NRCS State Conservationist shall notify the SPO, FPO, and Utah SHPO the outcome of this process.

IX. Public Involvement.

NRCS Utah's State Conservationist will ensure the public is involved in the development of this State-based Prototype Agreement and participates in Section 106 review as set forth above in Section V (reference to other parties).

X. Annual Reporting and Monitoring.

a. Every year following the execution of this agreement, the NRCS Utah State Conservationist shall provide all consulting parties (including those parties who participate in the consultation but do not sign the agreement) and the FPO a summary report detailing work undertaken pursuant to its terms, including a list of undertakings falling under Appendix [A] as well as undertakings that required further review; a summary of the nature and content of meetings held with SHPO/Indian tribes/NHOs; and an assessment of the overall effectiveness of the State-based Prototype Agreement. Such report shall include any scheduling changes proposed, any problems encountered, and any disputes and objections received in NRCS' efforts to carry out the terms of this agreement.

    1. The NRCS FPO shall use the state reports to provide, through the NRCS SPO, an annual report to the ACHP.

    2. The State Conservationist shall use the state report to assess the need for annual meetings with the SHPO/Indian tribes/NHO each fiscal year.

b. NRCS Utah's State Conservationist will participate in an annual review with the NRCS Regional Conservationist regarding the effectiveness of the prototype agreement and submit a written (email) report following this review to the SPO (Deputy Chief for Science and Technology).

c. NRCS Utah's State Conservationist or Utah SHPO may request that the ACHP participate in any annual meeting or agreement review.

XI. Compliance With Applicable State Law and Tribal Law (When on Tribal Lands).

NRCS Utah shall comply with relevant and applicable state law, including permit requirements on state land, and with relevant and applicable tribal law, when on tribal lands.

XII. Duration of Prototype Agreement.

This State-based Prototype Agreement for NRCS Utah will be in effect for 10 years from the date of execution unless amended or terminated pursuant to Stipulation XIII below.

XIII. Amendment and Termination.

a. This State-based Prototype Agreement may be amended if agreed to in writing by all signatories. The amendment will be effective on the date a copy, signed by all of the signatories, is filed with the NRCS FPO, SPO, and the ACHP.

b. If any signatory to this State-based Prototype Agreement, or the ACHP, determines that its provisions will not or cannot be carried out, that party shall immediately consult with the other parties to attempt to develop an amendment per Stipulation XII.A. If within 30 calendar days, or other time period agreed upon by the signatories, an amendment cannot be agreed upon, any signatory or the ACHP may terminate the agreement upon written notification to the other signatories.

c. If this State-based Prototype Agreement is terminated or expires without being extended via the amendment process described above, and prior to continuing work on any undertaking, NRCS shall comply with 36 CFR Part 800 for all individual undertakings in Utah.

XIV. NRCS Utah will consider requests from other USDA agencies to become a signatory to the State-based Prototype Agreement following formal written requests and appropriate discussion with and approval by the NRCS, FPO, and SPO; and joint USDA Agency-NRCS State Office consultation with the ACHP, NCSHPO, and other consulting parties, as appropriate. Such inclusion of the USDA agency may require amendment to this State-based Prototype Agreement.

XV. Approval.

Execution of this State-based Prototype Agreement by NRCS Utah and Utah SHPO and implementation of its terms evidence that NRCS has taken into account the effects of its undertakings in Utah on historic properties and afforded the ACHP a reasonable opportunity to comment.

APPENDIX A

NRCS Utah Activities, Enhancements, and Practices With No Potential to Affect Historic Properties

Pursuant to Stipulation V.a of the NRCS Utah SPPA, and in accordance with 36 CFR Part 800. 3(a)(1), NRCS Utah has determined that the following conservation activities, enhancements, and practices constitute undertakings with no potential to affect historic properties. These determinations have been made in consultation with the NRCS Utah State Conservationist, NRCS Conservation Specialists, and the Utah SHPO. NRCS Utah is not required to conduct further consultation under Section 106 for the general activities and conservation measures included in this Appendix.

I. General Activities with No Potential to Affect Archaeological Resources:

In accordance with 36 CFR Part 800.3(a)(1), NRCS Utah has determined that the following general activities have no potential to affect historic properties, and thus require no further consultation under Section 106.

a) Conservation Planning or Technical Assistance (I.a). NRCS Utah has determined that providing general conservation planning and technical assistance has no potential to affect historic properties. This assistance is primarily focused on management and is completed in the office or in the field. Planning and technical assistance involves no ground disturbance activities that would necessitate a cultural resources inventory.

b) CPAs, DIAs, and CEMAs (I.b). NRCS Utah has determined that Conservation Planning Activities (CPAs), Design and Implementation Activities (DIAs), and Conservation Evaluation and Monitoring Activities (CEMAs) have no effect on Archaeological resources. CPAs produce conservation plans that document participant objectives, existing resource concerns, participant decisions regarding conservation practices, and activities that will be used to address identified resource concerns. DIAs produce designs, prescriptions, or other instructions for implementing a single conservation practice or a system of conservation practices derived from the participant's conservation plan. Lastly, CEMAs produce results of an evaluation, monitoring, test, or assessment. As with general conservation planning, these activities do not result in ground disturbance that would necessitate Section 106 compliance and an Archaeological resources field review.

c) Highly Erodible Land and Wetland Determinations (I.c). NRCS Utah has determined that the determination of Highly Erodible Lands (HEL) and Wetlands has no potential to affect historic properties when completed in the office and involving no ground disturbing activities. Wetlands determinations are occasionally completed in the field utilizing a hand-dug test pit to identify reduxomorphic features (color patterns in soils). Under such circumstances, Conservation Planners will shift the location of test pits to avoid impacts to Archaeological resources and coordinate with NRCS Utah APS.

d) NRCS Snow Survey and Climate Monitoring Data Collection (I.d). NRCS Utah has determined that standard survey data collection at Snow Courses, Snow Telemetry (SNOTEL) locations, and Soil Climate Analysis Network (SCAN) locations has no potential to affect historic properties. Data collection at these locations occurs electronically or is collected by hand with the use of probes and shovels to measure existing snowpacks. No surface disturbance is associated with any of these data collection methods. Establishment of new SNOTEL, Snow Course, and/or SCAN locations has the potential to affect historic properties. Should the establishment of new locations become necessary, NRCS Utah will complete a pedestrian Archaeological resources inventory and Section 106 consultation prior to construction.

e) NRCS Utah Soil Survey and Geotechnical Testing (I.e). NRCS Utah has determined that limited soil survey testing utilizing hand-dug test pits, hand probes, and/or augers has no potential to affect historic properties, provided that such testing is shifted to avoid impacts to Archaeological resources, and provided that the testing is located on privately-owned land. Similarly, NRCS Utah has determined that limited geotechnical auger testing of sediment fill and earthen fill structures associated with dam rehabilitation work has no potential to affect historic properties, provided that such geotechnical testing is shifted to avoid impacts to Archaeological resources, and provided that the geotechnical testing is located on privately-owned land. If either activity is located on Federal, State, or Tribal-Administered lands, or if heavy equipment (i.e., backhoes, tractors, excavators, etc.) will be used, then the activities are considered to have potential to affect historic properties. Under such circumstances, a pedestrian Archaeological resources inventory and Section 106 consultation will be required.

f) Acquisition of Lands and Easements (I.f). NRCS Utah has determined that the acquisition of lands and conservation easements has no effect on Archaeological resources. These are considered administrative actions that do not authorize ground disturbance.

g) Leases, Easements, Rights-of-Way, and Permits (I.g). NRCS Utah has determined that the issuing of leases, easements, rights-of-way, and/or permits (not including grazing permits) has no effect on Archaeological resources. These are considered administrative actions that do not authorize ground disturbance.

h) Renewal, Transfer, and/or Administration of Grazing Leases (I.h). NRCS Utah has determined that the renewal or transfer of grazing leases/permits, and other permit administrative actions where types of animals do not change, numbers of animal unit months (AUMs) do not increase, or seasons of use do not change has no effect on Archaeological resources. These are considered administrative actions that do not authorize ground disturbance.

i) Issuing or Renewal of Existing Rights-of-Way (I.i). NRCS Utah has determined that issuing rights-of-way for existing developments or renewal of existing rights-of-way has no effect on Archaeological resources. These are considered administrative actions that do not authorize ground disturbance.

II. Conservation Measures with No Potential to Affect Archaeological Resources:

In accordance with 36 CFR Part 800. 3(a)(1), NRCS Utah has determined that the following categories of conservation measures have no potential to affect Archaeological resources, and no further consultation under Section 106 is required for their implementation. As such, conservation measures within these categories are exempted from Archaeological resources field reviews. Common examples for each category are listed in Table 1. The examples in Table 1 are not intended to be all-inclusive, and there may be unique situations that require additional coordination with NRCS Utah's APS personnel. If any of the conservation practices described in Table 1 are associated with undertakings occurring on public or Tribal lands, or involve extenuating circumstances as defined in Appendix B of the NRCS Utah SPPA, then consideration of the effects of the undertaking is necessary and coordination with NRCS APS personnel is required.

a) Management Conservation Measures Without Ground Disturbance (II.a). NRCS has determined that management conservation measures have no effect on Archaeological resources when applied without ground disturbance.

b) Herbicidal or Biological Vegetation Treatments (II.b). NRCS has determined that vegetation treatments using herbicidal or biological applications have no effect on Archaeological resources. No ground disturbance is associated with conservation measures applied in this manner. If known or suspected Indigenous gathering areas are located near the proposed practice, coordination with NRCS APS personnel is required.

c) Conservation Measures in Croplands or Areas of Existing Disturbance (II.c). NRCS has determined that conservation measures have no effect on Archaeological resources when applied to croplands and areas that have been previously and completely disturbed by agricultural or mechanical means and depth of proposed practices will not exceed the depth of previous disturbance, and where no Archaeological resources exist and there are no indirect effects to extant Archaeological resources.

d) Fencing Construction/Maintenance with Minimal Disturbance (II.d). NRCS has determined that fence construction and/or modifications of existing fence lines has no effect on Archaeological resources when construction/maintenance does not require ground disturbance beyond placement of posts; where construction or maintenance will not result in concentrations of animals; where construction/maintenance does not require creation of two-track trails from vehicles; and where the potential for significant Archaeological resources is low. Similarly, placement of wildlife markers and structures on fencing has no effect on Archaeological resources.

e) Minor Operations and Maintenance Activities (II.e). NRCS has determined that conservation measures related to minor, routine, or preventive operations and maintenance activities associated with existing facilities and infrastructure have no effect on Archaeological resources provided that the structures are less than 50 years old. Such actions generally do not require new construction or ground disturbance.

f) Temporary or Ground Surface Conservation Measures (II.f). NRCS has determined that conservation measures have no effect on Archaeological resources when applied as temporary structures, or when the conservation measures are limited to hand tools and/or surface activities that will not involve ground disturbance.

Table 1. Common Examples of Conservation Measures with No Potential to Affect Archaeological Resources

Category	Common Examples
a. Management Conservation Measures Without Ground Disturbance (II.a)	Drainage Water Management; Dust Management; Feed Management; Forage Harvest Management; Integrated Pest Management; Irrigation Water Management; Nutrient Management; Prescribed Grazing; Residue & Tillage Management; Saline and Sodic Soil Management; Upland Wildlife Habitat Management; Wetland Wildlife Habitat Management
b. Herbicidal or Biological Vegetation Treatments (II.b)	Brush Management Utilizing Herbicidal or Biological Control Measures; Herbaceous Weed Treatment Utilizing Herbicidal or Biological Control Measures
c. Conservation Measures in Croplands or Areas of Existing Disturbance (II.c)	Alley Cropping; Conservation Cover; Contour Farming; Cover Crops; Crop Rotation; Cross Wind Trap Strips; Field Borders; Filter Strips; Firebreaks; Forest Stand Improvement; Fuel Breaks; Grassed Waterway; High Tunnels; Hedgerow Plantings; Irrigation Pivots (excluding towers, subsurface pipelines); Land Clearing and Smoothing; No Tillage/Reduced Tillage Farming; Pasture and Hay Planting; Range Planting; Riparian Herbaceous Cover; Riparian Forest Buffer; Soil Amendments; Strip-Cropping; Surface Roughening; Tree/Shrub/Vegetation Plantings; Wheel Line Irrigation Sprinklers (excluding subsurface pipelines, risers); Windbreaks/Shelterbelts/Herbaceous Wind Barriers; Wildlife Habitat Planting; Woody Residue Treatment
d. Fencing Construction/Maintenance With Minimal Disturbance (II.d)	Access Control; Electric Fencing; Fence Markers; Fence Removal/Replacement Along Existing Corridors; Fence Construction/Replacement Without Corridor Preparation/Blading; Temporary Fencing; T-Post Fencing
e. Minor Operations and Maintenance Activities (Less Than 50 Years Old) (II.e)	Air Filtration and Scrubbing; Combustion System Improvement; Energy-Efficient Agricultural Operation; Energy-Efficient Lighting Systems; Energy-Efficient Building Envelopes; Fan Installation/Replacement; Field Operations Emissions Reduction; Groundwater Testing; Irrigation Headgate Replacement; Light Replacements; Obstruction Removal; Pumping Plant Installation/Replacement; Roof Runoff Systems; Solar Power Conversion; Sprinkler Nozzle Replacement; Storage Tank Replacement; Structures for Wildlife; Tree/Shrub Pruning; Watering Facility Replacement
f. Temporary or Ground Surface Conservation Measures (II.f)	Surface/Temporary Animal Mortality Facilities; Chipping/Mulching Vegetation Treatment; Lop and Scatter Woody Residue Treatments; Portable Livestock Shelters; Surface Irrigation/Watering Systems; Surface/Temporary Compost Facilities; Vegetation Treatment Utilizing Hand Tools

III. Activities with No Potential to Affect Historic Irrigation Systems

In accordance with 36 CFR Part 800. 3(a)(1), NRCS Utah has determined that the following activities have no potential to affect historic irrigation systems, and thus require no further consultation under Section 106. These activities are limited to privately-owned irrigation systems and are not applicable to systems operated, managed, or administered by the U.S. Bureau of Reclamation or the U.S. Bureau of Indian Affairs.

a. Routine maintenance of irrigation systems and other associated structures where there is no change to the exterior of the structure or exterior features thereof (III.a).

b. Maintenance or replacement of non-historic irrigation features such as pumping stations, relift stations, head gates, flumes, manholes, culverts, fish-screens, diversions, and other constructed irrigation system features (III.b).

c. Short-term (less than one year) disturbance of an irrigation feature for boring or open-cut crossings when the feature will be restored to its original condition (III.c).

d. Mowing and brushing within previously disturbed areas, and general maintenance of existing landscaping along access roads, trails, levees, canals, laterals, and ditches (III.d).

e. Terrestrial and aquatic weed removal from within earthen or lined canals or laterals (III.e).

f. Draining, cleaning, or grading within an existing prism without changing the profile; and dredging where dredged materials are deposited in previously disturbed areas (III.f).

g. Clearing of sediment or debris from stilling basins, forebays, canals, laterals, ditches, conduits, siphons, drains, and other constructed features where the clearing occurs in previously disturbed areas, and the sediment or debris is placed in previously disturbed areas (III.g).

h. Placement of scientific equipment within the existing channel of streams or rivers where access and placement of the equipment and accessing the work site involves no new ground disturbance (III.h).

i. Restoration of existing rip rap, or placement of additional rip rap on top of existing rip rap, when using the same type of materials and maintaining original design criteria, and when the undertaking does not occur on a structure or a prehistoric site (III.i).

j. Setting a stationary or cleaning screen at an existing head gate (III.j).

k. Placement of a crossing for a pivot or wheel line irrigation system (III.k).

IV. Coordination with Archaeological Program Specialists to Determine Effects

Conservation Planners and Partners will coordinate with NRCS Utah's APS if there is uncertainty as to whether certain activities or conservation measures have the potential to affect

Archaeological resources. This coordination must occur prior to implementation.

V. Annual Updates to this Appendix

NRCS Utah recognizes that the standards and definitions for the conservation activities, enhancements, and practices are subject to changes on an annual basis. Similarly, NRCS Utah also recognizes that additional conservation activities, enhancements, and practices are added on an annual basis as the focus of conservation changes over time. To address these changes, NRCS Utah will submit an updated version Table 1 of this Appendix to the Utah SHPO and other consulting parties, as appropriate and as needed. As specified in Stipulation V.b of the NRCS Utah SPPA, the list of undertakings provided in this Appendix may be modified through consultation and written agreement between the NRCS Utah State Conservationist and the Utah SHPO without requiring an amendment to the NRCS Utah SPPA.

APPENDIX B

Procedures for NRCS Practices that occur on State or Federal Lands, or that involve external funding or permitting

UDAF, TLA, DNR, BOR, and USFS have elected to be signatories on this SPPA and the terms of this SPPA are applicable to these projects. However, coordination with Archaeological Resources Specialists from these Federal and State agencies is still required, thus necessitating a greater level of involvement of NRCS APS. For projects that involve Public (Federal and State-managed) Lands, lands administered by BIA or BOR, permitting from another federal agency, or that involve non-NRCS external funding (UDAF, BOR, DWR/WRI funding), completion and submission of a Archaeological Resources Review Form to NRCS Archaeological Resources Specialist is required, even when all practices would be considered to have no potential to affect Archaeological resources under the terms of this SPPA.

For such contracts, the following procedures will be followed:

I. An Archaeological Resources review form and accompanying shapefiles will be submitted to NRCS Utah APS for review.

II. NRCS Utah APS will complete any needed coordination with other agency Archaeological resources specialists.

III. NRCS Utah APS will complete a literature review, including review of SEGO, BLM GLO survey plats and patents, archival maps and photographs, and other sources as appropriate.

IV. In the event that a field visit or Archaeological resources inventory is needed, this inventory will be completed by a DOI SOI qualified archaeologist.

V. Following completion of a full literature review by APS, a completed, signed, and approved Archaeological Resources Review Form will generally be sent back to the Conservation Planner provided all proposed activities are included within Appendix B of this SPPA.

VI. An approved Archaeological Resources Review form will generally be sufficient for cooperating agency records, and consultation and reporting requirements for these projects will be met through submission of an annual report including summary statistics on these projects to the Utah SHPO, Tribes, and signatories to this SPPA.

APPENDIX C

NRCS Utah Summary Annual Reporting Requirements

I. When cumulative conservation activities, enhancements, and practices encompass an area of 10 acres or less in size or less that three linear miles, and where no historic properties would be adversely affected by the proposed undertaking, projects will be summarized in an annual report that is submitted to the Utah SHPO and Tribes rather than subjected to individual reporting.

II. When cumulative conservation activities, enhancements, and practices encompass an area of 100 acres or less in size and have been inventoried by trained NRCS Utah Field Office Staff with no findings, projects will be summarized in an annual report that is submitted to the Utah SHPO and Tribes rather than subjected to individual reporting.

III. Projects not meeting the above criteria will be subject to individual reporting and consultation requirements.

USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE

NRCS Utah Archaeological Resources Procedures

Appendix D



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I. INTRODUCTION

The NRCS General Manual 420, Part 401 **(GM 420 Part 401)** formally establishes NRCS policy regarding responsibilities to historic and archaeological properties under the National Historic Preservation Act **(NHPA)** of 1966, it's implementing regulations, 36 CFR Part 800, and other related authorities. Among other things, GM 420 Part 401 defines general and lead Federal Agency responsibilities, NRCS personnel responsibilities, consulting party responsibilities, and how the NRCS considers archaeological resources in NRCS programs and activities. In addition, GM 420 Part 401 discusses the use and training of NRCS personnel and conservation partners for limited archaeological resources identification efforts.

The *NRCS National Archaeological Resources Procedures Handbook* **(H 190 Part 601)** was developed by the NRCS in addition to GM 420 Part 401 in order to provide a procedural reference and guidance on processes the NRCS, it's conservation partners, and it's consultants use to identify, evaluate and protect archaeological resources, including historic properties, in compliance with the NHPA, 36 CFR Part 800, and other related authorities. This document provides additional guidance on responsibilities of the NRCS in the archaeological resources compliance process, and provides additional procedures in the identification, avoidance, and determination of effects on archaeological resources that may be impacted by NRCS undertakings.

Both GM 420 Part 401 and H190 Part 601 serve as the primary guidance documents for compliance with the NHPA by the NRCS in Utah. In accordance with GM 420 Part 401.34, and following the guidance issued in GM 420 Part 401.43, NRCS Utah has developed the following guidance document for use by NRCS Utah personnel, its conservation partners, and subcontractors for undertakings implemented by the NRCS within the State of Utah. These procedures, when applied in accordance with the NRCS Utah SPPA, serve as alternative procedures to Advisory Council on Historic Preservation **(ACHP)** regulations (i.e., substitutes for all or part of Subpart B of the regulations) pursuant to 800.14(a) and Section 110(a)(2)(E) of the NHPA. These procedures provide a streamlined Section 106 compliance process appropriate for conservation technical and financial assistance, and other activities carried out by NRCS Utah.

II. RESPONSIBILITIES FOR SECTION 106 COMPLIANCE FOR NRCS UTAH

Responsibilities for compliance with Section 106 for NRCS Utah undertakings are as follows:

a) **The NRCS Utah State Conservationist.** The NRCS Utah State Conservationist is the responsible Federal Official for archaeological resources compliance for NRCS undertakings within the State of Utah. The NRCS Utah State Conservationist has approval authority for all NRCS undertakings and is responsible for committing NRCS Utah to take the appropriate actions in order to comply with Section 106. Importantly, the NRCS Utah State Conservationist is responsible for conducting archaeological resources consultation with the Utah State Historic Preservation Office **(SHPO)**, Federal and State Agencies, Tribal Historic Preservation Offices **(THPOs)**, Tribes, and other interested parties.

b) **District Conservationists.** NRCS Utah District Conservationists are responsible for ensuring that the provisions for compliance with Section 106 and with NRCS Utah archaeological resources policies are implemented in their areas and offices.

c) **State Archaeologist and Area Archaeological Program Specialists (APS).** The NRCS Utah State Archaeologist oversees the Archaeological program and the implementation of archaeological resources compliance policies for all NRCS undertakings in Utah. The work of the State Archaeologist is supplemented by Area APS staff. State and Area APS personnel provide oversight and quality assurance reviews during conservation planning and provide training to NRCS Utah personnel and partnering conservation planners who help identify archaeological resources during the planning process. The APS personnel are also responsible for providing direct assistance to NRCS Area and Field Office staff to complete archaeological resources inventories and evaluations when needed.

d) **NRCS Utah Personnel and Conservation Partners (Conservation Planners).** In situations where conservation planning authority occurs at the field office level, NRCS Utah personnel are responsible for assisting in the identification of archaeological resources that may be impacted as a result of NRCS undertakings. NRCS personnel are further assisted in these efforts by conservation partners such as the Utah Association of Conservation Districts **(UACD)** and the Utah Department of Agriculture and Food **(UDAF)**, among others. The archaeological resources identification process often involves completion of a pedestrian archaeological resources inventory of those areas within a conservation plan that will be subjected to physical disturbance, and submitting the pertinent review forms and paperwork to the APS for review and approval.

e) **Agricultural Producers, Applicants for Assistance, and Project Sponsors (Cooperators).** Each year, agricultural producers, applicants for assistance, and project sponsors seek technical and financial assistance from NRCS Utah to implement conservation undertakings throughout the state. Because the financial assistance is comprised of Federal funding delivered through a variety of NRCS conservation programs, the undertaking is subject to review under Section 106 of the NHPA and its implementing regulations. Cooperator responsibilities in the Section 106 compliance process include working with Conservation Planners to help identify archaeological resources on their property, project implementation when authorized to do so, and making all necessary efforts to avoid and minimize impacts to archaeological resources that are identified during the conservation planning process. As the property owners and the project applicants, all Cooperators are fully entitled and are encouraged to participate in the Section 106 process as a consulting party.

III. NRCS UTAH TRAINING REQUIREMENTS FOR PARTICIPATION IN ARCHAEOLOGICAL RESOURCES INVENTORIES

The NRCS GM 420 Part 401.24 states that all NRCS personnel and conservation partners responsible for planning or implementing NRCS undertakings will receive training for consideration of archaeological resources in conservation planning. To facilitate this process the NRCS developed a National Archaeological Resources Training Series available on AgLearn. Part 1 is an online course designed to familiarize personnel with laws and

regulations underlying the archaeological resources compliance process. The course also provides basic information on how to consider archaeological resource issues in conservation planning, how to conduct archaeological resource inventories during the conservation planning process, and how to identify archaeological resources in the field.

The Archaeological Resources Part II training consists of a two-day formal training session provided by the NRCS Utah APS. Day one of the training is typically classroom based and covers the specific requirements for archaeological resource compliance in Utah. Day two of the training is generally a field day and personnel visit archaeological sites and learn basic field techniques and inventory methods. The goals of the program are to:

a.) Provide a basic understanding of laws that govern historic preservation;
b.) Raise awareness of archaeological resources in a variety of contexts; and
c.) Incorporate archaeological resources and issues into conservation planning.

As stipulated in the NRCS Utah Planner Certification requirements, all NRCS Utah personnel and conservation partners wishing to qualify as certified planners must complete the National Archaeological Resources Training Series within one year of being hired. In addition, NRCS Utah requires that Conservation Planners receive supplemental archaeological resources training every five years as part of the Conservation Planner re-certification process. This supplemental training will require Conservation Planners to take the Archaeological Resources Part II training.

Conservation Planners who successfully complete the National Archaeological Resources Training Series and the supplemental training every five years are authorized to conduct basic, limited archaeological resources investigations in accordance with the guidelines discussed later in this fieldwork procedures manual. The National Archaeological Resources Training Series is **NOT** designed to train individuals as professional or even *'paraprofessional'* archaeologists. Rather, these programs and policies have been implemented to promote awareness, identification and protection of archaeological resources in NRCS Utah conservation planning. The training program is part of a broad effort to streamline the compliance process while ensuring maximum consideration of historic properties. In all instances, NRCS Utah APS personnel serve as the technical specialists and are ultimately responsible for quality control and assurance related to archaeological resources compliance on NRCS Utah undertakings.

IV. DEFINING ARCHAEOLOGICAL RESOURCES

Archaeological resources are defined by the NRCS through the National Archaeological Resources Training Series as "…the physical evidence of past activities and accomplishments of people." Broadly, archaeological resources may include both tangible traces (i.e., buildings, structures, objects, sites, districts, etc.) and less tangible traces (landscapes, vistas, locations of archaeological value, etc.) of archaeological activity and significance. Although many different elements of human activity may be defined as archaeological resources, the NRCS focuses primarily on three main categories: archaeological sites, isolated occurrences, and Traditional Cultural Properties.

a) **Archaeological Sites.** Traces of past activity that are tangible are usually classified as archaeological sites based on considerations of the age of archaeological remains, the density and diversity of artifacts and features, and the spatial arrangements of remains

within the area under consideration. For NRCS Utah undertakings, the minimum criteria for defining archaeological resources as archaeological sites are displayed below in Table 1.

Table 1. NRCS Utah Criteria for Defining Archaeological Sites

The location contains remains of past human activity that are at least 50 years old and meets one of the following criteria:

A. Contains at least 10 artifacts of a single class (e.g., 10 sherds) within a 10-meter (50-foot) diameter area, except when all pieces appear to originate from a single source (e.g., one ceramic pot, one glass bottle); or

B. Contains at least 15 artifacts which include at least 2 classes of artifact types (e.g., sherds, nails, glass, lithic debris) within a 10-meter diameter area; or

C. Contains one or more archaeological features in temporal association with any number of artifacts; or

D. Possesses two or more temporally associated archaeological features without artifacts.

Federal law and NRCS policy stipulate that all archaeological resources meeting the criteria for archaeological site definition be evaluated for eligibility for the NRHP. All NRHP eligibility determinations are the responsibility of NRCS Utah APS personnel and are developed in consultation with the Utah SHPO and other required or interested participants in the archaeological resources review process. The criteria used to determine eligibility for the NRHP are shown below in Table 2.

Table 2. NRHP Eligibility Criteria (Per 36 CFR Part 60.4)

The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:

A. That are associated with events that have made a significant contribution to the broad patterns of our history; or

B. That are associated with the lives of persons significant in our past; or

C. That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

D. That have yielded, or may be likely to yield, information important in prehistory or history.

An archaeological site that possesses sufficient integrity and meets one or more of the Criteria listed in Table 2 is eligible for the NRHP and is considered a *Historic Property*. This is a very specific term for archaeological resources that are either "… included in or eligible for inclusion in the National Register." It is important to note that historic properties can include both prehistoric and historical archaeological sites, and that the term is not used for sites determined to be not eligible for the NRHP. Those archaeological sites determined to be historic properties are afforded special protection under Federal law and NRCS policy. Conservation planning must take into account potential impacts to these archaeological resources in particular, and take appropriate steps to avoid, minimize, or mitigate any adverse effects that may result from NRCS Utah activities.

b) **Traditional Cultural Properties.** A Traditional Cultural Property **(TCP)** is a place that is significant for its association with cultural practices or beliefs of a living community. Such locations are rooted in that community's history and are important in maintaining the continuing cultural identity of the community. The significance of a TCP is derived from the role the location plays in a community's historical beliefs, customs, and practices.

   Some TCPs may not contain any material remains. They must still be taken into account during archaeological resources planning. Such places will normally become known to the Conservation Planner during the archaeological resources review as the result of questioning participants, informants, local residents, or through consultation with Federally Recognized Indian Tribes. Treatment of TCPs during the conservation planning process will require the assistance of the informant and should also involve NRCS Utah APS personnel.

c) **Isolated Occurrences.** An isolated occurrence **(IO)** may be sub-categorized as "isolated artifacts" in instances where a single artifact or a small group of artifacts (flakes, pot sherds, cans, etc.) are identified and do not constitute a site, as defined above. An "isolated feature" is defined as a archaeological feature (ditches, fence lines, power line, roads, depressions, etc.) that does not have any other features or artifacts present that would further qualify it as a site.

V. NRCS UTAH PROCEDURES FOR COMPLETING ARCHAEOLOGICAL RESOURCES INVESTIGATIONS

The number of steps that may be necessary to fully consider archaeological resources in any given situation may vary depending on whether such resources are found in the work area, whether they are significant, and other circumstances. The following discussion details the steps that Conservation Planners must follow to complete the archaeological resources compliance process. It is always wise (and legally mandated) to begin the archaeological resources review process as early as possible in conservation planning.

a) **Obtain Consent from the Cooperator.** Prior to the initiation of the archaeological resources investigation process, Conservation Planners are required to meet with the prospective Cooperator and complete the *Authorization for NRCS Release of Conservation Plan File Information* form. This form is utilized by NRCS Utah to inform Cooperators of the consultation process that is required as part of the conservation planning process.

Completion of the form by the Cooperator provides consent for the NRCS to enter into the consultation process with the appropriate consulting parties, and to disclose information related to resources that are located on the property controlled by the Cooperator.

b) Review the SPPA to determine if all Practices are Included in Appendix A.

1. Conservation Planners who have successfully completed NRCS Utah's Archaeological Resources training series will review each practice to determine if they have no potential to effect historic properties, as described in Appendix A.
2. The respective District Conservationist will also review the project and confirm that all practices are included in Appendix A, and that no extenuating circumstances exist.
3. If all practices are included in Appendix A and no extenuating circumstances exist as described in Appendix B (Project does not involve Tribal, Public Lands or other State, Federal, or Tribal agencies, USACE or other Federal permitting, or non-NRCS Funding), then the project does not require further Archaeological Resources Review, and this is noted on the NRCS-CPA-52 Environmental Worksheet.
4. If there is any uncertainty on whether practices are included in Appendix A, APS will be contacted for further coordination.

c) Prepare an Archaeological Resources Review Form. For projects that involve practices that are subject to archaeological resources review, Conservation Planners will begin preparation of the *NRCS Utah Archaeological Resources Review Form*. This form is utilized by NRCS Utah to guide Conservation Planners through the archaeological resources review process.

1. Provide Administrative Information for the Undertaking. Conservation Planners will provide basic administrative information about the conservation plan that is being considered by completing Part A of the Form. The Administrative Information will identify the respective Cooperator, the NRCS Utah contract number that is associated with the undertaking, and the funding source that is being used to implement the undertaking,

2. Describe the Proposed Undertaking. Conservation Planners will provide a basic description of the undertaking by completing Part B of the Form. Conservation Planners will provide a written description of the undertaking, and will list the conservation activities, enhancements, and/or practices that will be involved in the implementation. Conservation planners will review Appendix A of the NRCS Utah SPPA to determine whether a planned conservation activity, enhancement, or practice for a given undertaking is subject to further archaeological resources investigation.

   Each conservation activity, enhancement, and practice involved in a conservation plan will be considered individually for its potential to affect archaeological resources. If a planned conservation activity, enhancement, and practice is not covered in Appendix A of the NRCS Utah SPPA, it will be assumed that it has the potential to affect archaeological resources and will treated as an undertaking that is subject to review.

3. Describe the Area of Potential Effects **(APE)**. Conservation Planners will provide a basic description of the APE for the undertaking in Part C of the Form. This will include a description of the conditions, history of land use, and disturbance activities that have occurred within the APE; and will include a legal description of the APE. Land ownership must also be included in the description of the APE to determine if the undertaking will involve coordination with another state or Federal agency.

4. Complete a Pre-field Information Review**.** Conservation Planners will summarize the results of the pre-field information review by completing Part D of the Form. If it is determined that a conservation plan involves conservation activities, enhancements, and/or practices that have potential to affect archaeological resources, Conservation Planners will proceed with the archaeological resources review process. Conservation Planners will complete a pre-field information review, and this information will be used to determine whether or not NRCS APS personnel need to be involved in the investigation. If the undertaking involves Federal, State, or Tribal land; Non-NRCS funding, Federal permitting, if NRCS Utah is a cooperating Federal agency; if planning authority for an undertaking is above the field office level; or if any extenuating circumstances exist (e.g. 100+ acres of physical disturbance of undeveloped ground; archaeological resources are present; undertaking involves 4 or more cooperators, etc.); Conservation Planners are required to request direct assistance from NRCS APS personnel before proceeding with the archaeological resources investigation.

d) Complete an Archaeological Resources Inventory. If the criteria for involving NRCS APS personnel do not apply to an undertaking (i.e., only private lands are involved in the contract) and the total cumulative APE of the contract is under 100 acres, Conservation Planners that have successfully completed the NRCS Archaeological Resources Training Part I and II Series will proceed with a pedestrian archaeological resources inventory of the undertaking. This pedestrian inventory will focus on those conservation activities, enhancements, and/or practices that are subject to review for archaeological resources investigation, and the goal of the inventory shall be the identification of any visible archaeological resources that could potentially be impacted by implementation of the undertaking.

When completing a pedestrian archaeological resources inventory of the undertaking, it is important for Conservation Planners to begin by interviewing the property owner or land manager to see if they have any knowledge of any archaeological resources on the property. Under most circumstances, these individuals have extensive knowledge of the property and can provide Conservation Planners with an idea of what to expect during an inventory. During the pedestrian inventory, Conservation Planners will inventory the affected areas in parallel transects spaced no more than 50 feet (15 meters) apart. Conservation Planners will inspect the areas for environmental indicators (water, landforms, etc.) that may provide clues to the presence of archaeological resources. Conservation Planners are encouraged to use a variety of methods to track their progress and record their findings (GPS data, photography, drawings, written descriptions, etc.), but Conservation Planners should also be aware that collection of artifacts or materials during the inventory is strictly prohibited.

e) **Report the Results of the Review to the NRCS Utah APS .** Once Parts A, B, C, and D of the *NRCS Utah Archaeological Resources Review Form* have been completed, Conservation Planners will complete Part E of the Form, which provides information about the archaeological resources inventory. If a pedestrian archaeological resources inventory is completed as described above, then Conservation Planners will provide a description of the inventory methods that were used, and the conditions that were encountered during the inventory. Conservation Planners shall complete the process by reporting the results of the inventory and summarizing the investigation, and they will submit an electronic copy of the review form to the NRCS APS for further review and final approval.

At a minimum, Conservation Planners will submit Shapefiles of practices subject to Archaeological Resources review or a 1:24,000 topographic location map showing the proposed undertaking and the areas that were inventoried for archaeological resources. This map shall be submitted with *NRCS Utah Archaeological Resources Review Form* to the NRCS APS, and the map or shapefiles should display the location of any archaeological resources that were identified during the pedestrian inventory. Additional maps such as aerial photography, planning maps, and engineering designs are welcome and encouraged, but they are supplemental to the topographic location map.

f) **Complete the NRCS APS Review and Implement the Undertaking.** Once the review form and topographic map have been submitted to the NRCS Utah APS, the APS will review the materials and complete a literature review for the undertaking with the Utah SHPO to determine if any previous inventories or archaeological resources have occurred within the APE. The NRCS APS will provide management recommendations and a formal determination of project effects for the proposed undertakings. These will be provided to Conservation Planners with completed and signed archaeological resources review form. If further information is needed, or if NRCS Utah APS personnel are needed to provide further assistance for an undertaking, Conservation Planners will be notified of such needs. Under no circumstances will Cooperators be allowed to implement an undertaking until given authorization to proceed from the NRCS APS.

NRCS Utah field offices will retain a copy of all archaeological resources review forms, site documentation, associated materials, and correspondence as part of the conservation planning materials for a proposed undertaking. A central filing of all archaeological resources review forms, reports, archaeological site documentation, and consultation will be maintained by APS staff.

If the design, nature, or the extent of the proposed undertaking should change after the archaeological resources review process has been completed, Conservation Planners will initiate the Section 106 review process again for the new/revised undertaking. Conservation Planners will be required to submit an updated review form and project map to the NRCS Utah APS for review, and the NRCS Utah APS will review the revised undertaking as described above.

VI. GENERAL PLANNING GUIDANCE

At the conclusion of the archaeological resources investigation, and prior to the implementation of an undertaking, Conservation Planners shall meet with Cooperators and

equipment operators to hold a preconstruction meeting to address any questions or concerns. Conservation Planners are encouraged to invite NRCS APS personnel to such meetings, particularly if any archaeological resources avoidance areas have been identified that could be impacted during implementation. Conservation Planners shall inform the Cooperators and equipment operators of the boundaries and extent of the proposed undertaking and will provide them with the appropriate data (maps, GIS data, GPS points, etc.) to help identify the boundaries of the undertaking and any avoidance areas. If any changes in the design or configuration of the undertaking result from the preconstruction meeting, Conservation Planners should notify the District Conservationist and take the appropriate steps to modify the undertaking. The NRCS APS should also be notified of any such changes, so that further consideration of archaeological resources can be undertaken.

If archaeological resources are present within the APE, Conservation Planners shall inform Cooperators of their responsibility towards archaeological resources prior to project implementation. Conservation Planners and NRCS Utah APS Personnel shall take the appropriate measures to ensure that the archaeological resources avoidance areas are clearly identified before the undertaking can be implemented. Archaeological resources, and any buffer areas deemed appropriate, shall be clearly marked for avoidance with lathe, flagging tape, paint, etc. prior to the implementation of the project. All markings for archaeological resources shall be removed after implementation has been completed. Conservation Planners shall inform the Cooperators and equipment operators of the presence of the archaeological resources, and will provide them with the appropriate data (maps, GIS data, GPS points, etc.) to help identify their location. The Cooperator and the equipment operator shall be briefed about their responsibilities for the protection and preservation of archaeological resources during implementation of the undertaking, and they will be provided with instructions for the treatment of archaeological resources in the event of a discovery or unintentional impact.

Once an undertaking has been implemented and completed, Conservation Planners shall complete a follow-up inspection of the affected area to ensure that the undertaking was completed according to the design specified in the conservation plan. The Conservation Planner will also review the archaeological resources to ensure that they were appropriately avoided during implementation. If any changes in the design or configuration of the undertaking are observed during the follow-up inspection, or if damage to historic properties is observed, Conservation Planners should notify the District Conservationist and take the appropriate steps to modify the undertaking. The NRCS APS should also be notified of any such changes, so that further consideration of archaeological resources can be undertaken.

VII. CATEGORIZING ARCHAEOLOGICAL RESOURCES COMPLIANCE FOR NRCS UTAH UNDERTAKINGS

The policies and procedures established by the NRCS in GM 420 Part 401, H190 Part 601, the NRCS Utah SPPA, and this document have been designed to streamline the Section 106 compliance process for the efficient delivery of technical and financial conservation assistance. As discussed below, NRCS Utah has developed a simplified three-category archaeological resources compliance system that can be used to classify each undertaking according to the specific set of circumstances that are involved. These classifications are primarily used for annual reporting purposes. To be classified within a given category,

Conservation Planners shall submit a completed *NRCS Utah Archaeological Resources Review Form* to the NRCS APS for each undertaking. The form shall provide the administrative information, legal description, and pre-field information for the undertaking, and it shall list all of the conservation activities, enhancements, and practices that are proposed. Information provided on the *NRCS Utah Archaeological Resources Review Form* will be used to classify the undertaking according to the three categories discussed in the following sections. In turn, the classification will allow the NRCS APS personnel and Conservation Planners to identify the level of planning, consultation processes, and timing for implementation that is appropriate for each undertaking.

a) Category I. Category I undertakings are defined by NRCS Utah as those undertakings comprised entirely of conservation activities, enhancements, and practices with little or no potential to affect historic properties as defined in Appendix A of the NRCS Utah SPPA. Category I undertakings also include those where the total cumulative APE of all practices subject to archaeological resources review is under ten acres or less than three linear miles and no historic properties will be affected by the undertaking.

b) Category II. Category II undertakings are defined by NRCS Utah as small-scale undertakings that are limited in size and scope. Generally, Category II undertakings involve contracts in which the cumulative APE of all practices subject to archaeological resources review is between 10- 100 acres and can be inventoried by Conservation Planners who have successfully completed the NRCS Archaeological Resources Part I and II training. Category II status is limited to undertakings where NRCS Utah has been determined to be the lead Federal agency for the purposes of Section 106, and where the undertakings occur exclusively on privately-owned lands.

c) Category III. Category III undertakings are defined by NRCS Utah as undertakings that involve **Extenuating Circumstances** that warrant further consideration of archaeological resources and typically require the direct involvement of APS staff. Category III status is limited to those undertakings that meet the criteria discussed below and are limited to undertakings where NRCS Utah has been determined to be the lead Federal agency for the purposes of Section 106. Extenuating circumstances, as defined by NRCS Utah, include the following:

1. Undertaking Involves other Federal, Tribal, or State Agencies. Undertakings that involve Public (Federal and State-managed) lands, lands administered by BIA or BOR, permitting from another federal agency, or that involve non-NRCS external funding (UDAF, BOR, DWR/WRI funding) require direct involvement of APS staff, even when all practices would be considered to have no potential to affect archaeological resources under the terms of the SPPA. These undertakings generally require coordination between NRCS Utah APS and external APS staff associated with the cooperating Federal, Tribal, or State agency.

2. Undertaking Involves More Than 100 Acres of Physical Disturbance of Undeveloped Ground. Undertakings that involve more than 100 acres of physical disturbance of undeveloped ground require additional consideration for archaeological resources. Undertakings of such size require a systematic, intensive pedestrian archaeological resources inventory, and such inventories must be designed and directly supervised by a qualified professional archaeologist.

3. Undertaking has Archaeological Resources Present. Additional consideration must be given to those undertakings where archaeological sites or TCPs are identified during the pre-field information review, or when archaeological sites or TCPs are identified during the pedestrian archaeological resources inventory. This policy does not apply to isolated occurrences. Once identified, Conservation Planners must notify the NRCS Utah State or Area APS and schedule a field visit. The NRCS Utah APS will formally document the archaeological resource and determine its eligibility for the NRHP.

   To be considered as a Category III undertaking, the NRCS Utah APS will coordinate with Conservation Planners to ensure that the proposed conservation activities, practices, or enhancements can be designed to avoid the archaeological resource by at least 50 feet to reduce or eliminate impacts to the archaeological resource. Additional consultation is required for archaeological resources that cannot be avoided by 50 feet during implementation.

4. Undertaking Involves 4 or More Cooperators. In accordance with GM 420 Part 401 and H190 Part 601, additional consideration is given to those undertakings that involve 4 or more cooperators. Such undertakings involve cooperation among multiple property owners, require a variety of permits and notifications, and have a higher public profile. Under such circumstances, assistance may be necessary to complete any required fieldwork authorizations or permits, and to complete public outreach, reporting, and consultation processes as outlined in Section 106.
5. General Concern. If Conservation Planners feel that there is general concern for archaeological resources at any point, they are encouraged to seek the direct assistance of NRCS Utah APS personnel. NRCS Utah APS personnel can assist the Conservation Planner with the review process and can assist with the field inventory. NRCS Utah APS personnel can also meet with the respective Cooperator to address any issues or concerns that the Cooperator may have with the archaeological resources investigation.

6. NRCS Utah is a Cooperating Federal Agency for the Undertaking. Implementation in accordance with Section 106 and its implanting regulations is required for undertakings where NRCS Utah functions as a cooperating agency for the purposes of Section 106. Such undertakings are often the focus of large-scale studies such as Environmental Assessments **(EAs)** or Environmental Impact Statements **(EISs)** that require interagency cooperation, consultation, and public outreach. As stated above, full compliance is necessary to establish lead and cooperating Federal agencies; to complete any required fieldwork authorizations or permits; and to complete the reporting and consultation process.

7. Planning Authority for an Undertaking is Higher than the NRCS Utah Field Office. Implementation in accordance with Section 106 and its implanting regulations is required for undertakings where conservation planning authority is at a level higher than the NRCS Utah Field offices. These undertakings are often related to watershed planning, emergency watershed protection, fire rehabilitation, or dam rehabilitation, among other categories. As stated above, full compliance is necessary to establish lead and cooperating Federal agencies; to complete any required fieldwork

authorizations or permits; and to complete the reporting and consultation processes outlined in Section 106.

8. Undertaking has Archaeological Resources Present That **Cannot** be Avoided by at Least 50 Feet. Implementation in accordance with Section 106 and its implanting regulations is required for undertakings where archaeological resources are identified during the pre-field information review or pedestrian archaeological resources inventory that cannot be avoided by 50 feet during implementation. Conservation Planners must notify the NRCS Utah APS and schedule a field visit when archaeological resources are identified within the planning area. The NRCS Utah APS will formally document the archaeological resource, determine its eligibility for the NRHP, and assess the effects of the undertaking on the archaeological resource. NRCS Utah will complete the reporting and consultation process as outlined in Section 106 to determine eligibility for the NRHP and to determine project effects.

9. Category III undertakings that will involve adverse effects to historic properties as defined in 36 CFR Part 800.5.a.1. For such undertakings, NRCS Utah will resolve the adverse effects through the development of a treatment plan detailing the measures that will be used to minimize and mitigate the effects to the historic properties in accordance with 36 CFR Part 800.6. This treatment plan will be developed through consultation among the NRCS, the Utah SHPO, and other consulting parties, as appropriate. The ACHP will be invited to participate in the consultation process as well. Once the treatment plan and measures to minimize and mitigate the adverse effects are agreed upon by the consulting parties, a Memorandum of Agreement **(MOA)** will be executed and implemented pursuant to compliance with Section 106.

VIII. CRITERIA FOR ASSISTANCE FROM NRCS UTAH APS PERSONNEL

Participation in the National Archaeological Resources Training Series and the recertification every five years authorizes NRCS Utah to utilize its personnel and conservation partners in completing basic archaeological resources identification. In accordance with the SPPA, the use of trained personnel for completing archaeological resources investigations is limited to those undertakings where NRCS Utah has been determined to be the lead Federal agency for the purposes of Section 106, where no extenuating circumstances exist, and where the undertakings occur exclusively on privately-owned lands. Utilizing the three-category archaeological resources compliance system, Table 3 presents the criteria that are used to determine if an undertaking requires further assistance from NRCS Utah APS personnel.

Table 3. Criteria for Assistance from NRCS Utah APS Personnel

Category	APS Required?	Description
Category I	**NO**	**Category I undertakings have little or no potential to affect historic properties. A review of such undertakings can be completed by Conservation Planners and submitted to the NRCS APS for approval without direct APS assistance.**

Category II	**NO**	**Category II undertakings are limited in size and scope and lack extenuating circumstances that would otherwise involve additional consideration for archaeological resources. Pedestrian inventories for Category II undertakings can be completed by Conservation Planners and submitted to the NRCS APS for approval without direct assistance.**
Category III	**YES**	**Category III undertakings warrant further consideration of archaeological resources due to the extenuating circumstances that are involved. Direct assistance from NRCS APS personnel is therefore necessary.**

IX. IMPLEMENTATION TIMING

Because of the critical importance of timing for its Cooperators, NRCS Utah has developed specific guidance for the timing of implementation on its undertakings from the standpoint of archaeological resources compliance. Timing for implementation can vary according to the specific circumstances of an undertaking, but timing can generally be determined according to the three- category archaeological resources compliance system. The timing of implementation for each category is discussed in the following sections.

a) **Category I.** For Category I undertakings, implementation shall proceed with a determination of 'no potential to cause effects' in accordance with 36 CFR Part 800.3(a)1. Implementation shall proceed once the NRCS APS has returned a signed copy of the *NRCS Utah Archaeological Resources Review Form* to the Conservation Planner. Conservation Planners will maintain a signed copy of the form with the conservation plan for the undertaking.

b) **Category II.** For Category II undertakings, implementation shall proceed with a determination of 'no historic properties affected' in accordance with 36 CFR Part 800.4(d)(1). Implementation shall proceed once the NRCS APS has returned a signed copy of the *NRCS Utah Archaeological Resources Review Form* to the Conservation Planner. Conservation Planners will maintain a signed copy of the form with the conservation plan for the undertaking, and implementation shall occur as stated in the design specifications stated in the conservation plan.

c) **Category III.** For Category III undertakings, implementation shall proceed at the discretion of the NRCS APS upon the completion of fieldwork with a determination of 'no historic properties affected' in accordance with 36 CFR Part 800.4(d)(1). Implementation shall proceed through communication between the NRCS APS and the Conservation Planner. If archaeological sites or TCPs are present within the APE, and the proposed conservation activities, enhancements, and/or practices can be modified to avoid the resource with a buffer zone of no less than 50 feet (15 meters), then implementation can proceed in accordance with the design specifications stated in the conservation plan. NRCS Utah APS personnel will meet with the Conservation Planner to document the archaeological resources and evaluate them for eligibility for the NRHP. Once the Section 106 consultation process has been completed, the NRCS APS will return a signed copy of the *NRCS Utah Archaeological Resources Review Form* to the Conservation Planner. Conservation Planners will maintain a signed copy of the form and any associated archaeological resources reports and consultation letters with the conservation plan for the undertaking.

If, after the consultation process, an avoided archaeological resource has been determined eligible for the NRHP, then Cooperators must ensure that the archaeological resources remain avoided and unaffected to the extent that the eligibility of the archaeological resource for the NRHP is not adversely affected. Avoidance shall last for the lifespan of the conservation activity, enhancement, and/or practice that is being planned. However, if an avoided archaeological resource is determined not eligible for the NRHP through the consultation process, further avoidance measures are unnecessary and can be maintained at the discretion of the property owner.

For Category III undertakings involving adverse effects to historic properties, NRCS Utah will implement undertakings in accordance with Section 106 of the NHPA and its implementing regulations found in 36 CFR Part 800. NRCS Utah will resolve the adverse effects through the development of a treatment plan detailing the measures that will be used to minimize and mitigate the effects to the historic properties in accordance with 36 CFR Part 800.6. This treatment plan will be developed through consultation among the NRCS, the Utah SHPO, and other consulting parties, as appropriate. The ACHP will be invited to participate in the consultation process as well. Once the treatment plan and measures to minimize and mitigate the adverse effects are agreed upon by the consulting parties, an MOA will be executed and implemented pursuant to compliance with Section 106.

Once the mitigation work and the Section 106 consultation process has been completed, the NRCS APS will authorize implementation and will return a signed copy of the *NRCS Utah Archaeological Resources Review Form* to the Conservation Planner. Conservation Planners will maintain a signed copy of the form and any associated archaeological resources reports and consultation letters with the conservation plan for the undertaking.

X. REPORTING ARCHAEOLOGICAL RESOURCES INVESTIGATIONS

As specified in stipulation V of the NRCS Utah SPPA, NRCS Utah will report the findings of all of its archaeological resources investigations to the Utah SHPO, Native American Tribes, consulting parties, NRCS National Headquarters, and the ACHP. The timing and nature of such reporting shall vary according to the specific circumstances for each undertaking. Generally, reporting will be completed in accordance with the three-category archaeological resources compliance system. Specific timing for reporting is shown in Table 4 and is discussed in the following sections.

a) **Category I.** NRCS Utah will synthesize information for all Category I undertakings and shall include the information within the annual summary report that is to be provided to all consulting parties and the NRCS Federal Preservation Officer **(FPO)** in accordance with Stipulation X of the NRCS Utah SPPA.

b) **Category II**. For Category II undertakings, NRCS Utah will also summarize these in a section of the annual summary report that is to be provided to all consulting parties and the NRCS Federal Preservation Officer **(FPO)** in accordance with Stipulation X of the NRCS Utah SPPA.

c) **Category III Undertakings.** For Category III undertaking, NRCS Utah shall consult with the Utah SHPO, Native American Tribes, and other consulting parties, as appropriate, on a case-by-case basis. NRCS Utah shall consult with the Utah SHPO, Native American Tribes, and other consulting parties, as appropriate, to define the APE, identify and evaluate historic properties that may be affected by the undertaking, determine project effects, and identify strategies for resolving adverse effects. NRCS Utah will provide GIS shapefiles for these undertakings to the Utah SHPO, and to other consulting parties as deemed necessary. Information on these undertakings shall be included within the annual summary report that is to be provided to all consulting parties, the general public, and the NRCS FPO in accordance with Stipulation X of the NRCS Utah SPPA.

It is important to note that reporting the results of archaeological resources investigations by NRCS Utah does not authorize access to those archaeological resources that are identified during the review process. Most of these archaeological resources are located on privately-owned lands, and they cannot be accessed without landowner consent. Reporting the archaeological resources investigations also does not provide authorization to collect artifacts and materials associated with the archaeological site or TCP. These materials are considered the property of the landowner, and collection of such materials is prohibited.

Table 4. Summary of Implementation, Reporting, and Consultation Timing for NRCS Utah Undertakings

Category	APS Required?	Implementation Timing	Reporting & Consultation Timing
Category I	NO	Implementation shall proceed with a determination of 'no potential to affect historic properties' after a completed archaeological resource review form is received from the NRCS Utah APS.	Combined Annual report to SHPO, NHQ, Consulting parties
Category II	NO	Implementation shall proceed with a determination of 'no historic properties affected' after completed archaeological resources review form is received from the NRCS Utah APS.	Combined Annual report to SHPO, NHQ, Consulting parties
Category III	YES	A determination of project effects is required prior to implementation, and work CANNOT proceed until the review process is completed and completed archaeological resources review form is received from NRCS Utah APS.	Case-by-case basis with SHPO, consulting parties; also summarized in Annual report to SHPO, NHQ, Consulting parties

XI. UNANTICIPATED DISCOVERIES AND TREATMENT OF HUMAN REMAINS

a) **Unanticipated Discoveries.** NRCS Utah will treat the unanticipated discovery of archaeological resources in accordance with Stipulation VII.b of the NRCS Utah SPPA, with GM 420 Part 401.24, with H 190 Part 601.29, and with 36 CFR 800.13 of the ACHP regulations.

b) Human Remains. NRCS Utah will treat the unanticipated discovery of archaeological resources in accordance with Stipulation VII.c of the NRCS Utah SPPA, with H 190 Part 601.29(6), and with 36 CFR Part 800.13 of the ACHP regulations. If human remains are identified during conservation planning or during the implementation of a conservation activity, enhancement, or practice, all activities deemed likely to impact the remains will cease and the following steps shall be taken.

1. Contact the Appropriate Authorities. NRCS Utah personnel will contact the respective County Sheriff where the discovery is made. NRCS Utah personnel will also contact NRCS APS personnel. The Utah SHPO shall also be notified.

2. If the remains are determined to be Native American in origin and are not considered to be part of a crime scene by the Sheriff, NRCS Utah will follow the procedures outlined in U.C.A. 9-9-401 on private land. On Federal or Tribal land, NRCS Utah will follow procedures established in Section 3 of the Native American Graves Protection and Repatriation Act **(NAGPRA)**.

3. If the remains are determined not to be part of a crime scene and are not Native American in origin, NRCS Utah will consult with the Utah SHPO and other consulting parties, as appropriate, to develop a mitigation plan for treating the remains.

4. NRCS Utah personnel and Cooperators will take all appropriate measures (barriers, fencing, temporary coverings, etc.) to protect the remains in place until the plan for treating the remains has been properly implemented.

XII. AVOIDANCE OF ARCHAEOLOGICAL RESOURCES, ANTICIPATORY DEMOLITION, AND WITHDRAWAL OF ASSISTANCE.

a) Avoidance of Archaeological Resources. In accordance with Subpart C of H 190 Part 601.22(C), and in accordance with Section 110 of the NHPA, Cooperators receiving technical and financial assistance from NRCS Utah shall make all necessary efforts to avoid and minimize impacts to archaeological resources that are identified during the conservation planning process. This is of particular importance for those archaeological resources determined eligible for the NRHP. The policy of avoidance of archaeological resources shall remain in place for the duration of the lifespan of the conservation activity, enhancement, and practice that is being implemented, in accordance with NRCS Farm Bill Programs rules. Failure to avoid historic properties could potentially result in a determination of adverse effects, mitigation where appropriate, contract termination, and withdrawal of technical and financial assistance.

In accordance with the criteria for identifying Category III undertakings outlined above, conservation activities, enhancements, and practices can be redesigned to avoid archaeological resources by a 50-foot buffer during the implementation process in an effort to streamline the delivery of conservation assistance in a timely manner. If, after the consultation process, an avoided archaeological resource has been determined eligible for the NRHP, then Cooperators must ensure that the archaeological resources remain avoided as described above. However, if an avoided archaeological resource is determined not eligible for the NRHP through the consultation process, further avoidance measures are unnecessary.

b) Anticipatory Demolition. As stated in H 190 Part 601.27.A(2), NRCS Utah will not

provide technical or financial assistance to Cooperators who intentionally destroy, remove, or otherwise adversely affect historic properties within a conservation planning area in an effort to evade compliance with Section 106 of the NHPA. If such damages occur, NRCS Utah shall insure that Federal assistance is not used to cause or further an adverse impact to a archaeological resource. Under these circumstances, NRCS will follow its Procedures for the Withdrawal of Assistance found in GM 420 Part 401.23 and H 190 Part 601.27.

c) **Withdrawal of Technical and Financial Assistance.** Both GM 420 Part 401.23 and H 190 Part 601.27 outline the process for the withdrawal of assistance that NRCS Utah shall follow in situations where an adverse effect has occurred or is likely to occur through a Cooperator's refusal to implement feasible mitigation measures. NRCS Utah will take the appropriate measures to document and assess the impacts and will document the actions and events leading to the withdrawal of assistance. The extent and duration of the withdrawal shall vary according to the conservation activity, enhancement, or practice under which the impact might have occurred, and may also vary at the discretion of the NRCS Utah State Conservationist.

SIGNATORY PAGE

STATE-BASED PROTOTYPE PROGAMMATIC AGREEMENT
BETWEEN THE
US DEPARTMENT OF AGRICULTURE,
NATURAL RESOURCES CONSERVATION SERVICE, UTAH STATE OFFICE
AND THE
UTAH STATE HISTORIC PRESERVATION OFFICE
REGARDING CONSERVATION ASSISTANCE

EMILY FIFE

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_____ Date:

Emily Fife, State Conservationist
Natural Resources Conservation Service
Salt Lake City, Utah

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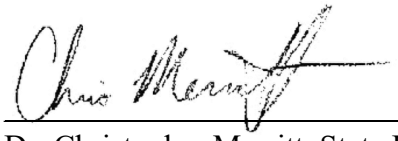

Date: 3/12/2025

Dr. Christopher Merritt, State Historic Preservation Officer Utah
State Historic Preservation Office
Salt Lake City, Utah

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Kelly Pehrson (Mar 25, 2025 16:10 MDT)

Date: 03/25/2025

Kelly Pehrson, Deputy Commissioner
Utah Department of Agriculture and Food
Salt Lake City, Utah

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Michelle McConkie Date: March 11, 2025

Michelle McConkie, Director,
School and Institutional Trust Lands Administration
Salt Lake City, Utah

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Michael Canning
Michael Canning (Mar 27, 2025 07:41 MDT)

Date: 03/27/2025

Mike Canning, Deputy Director
Utah Department of Natural Resources
Utah Division of Wildlife Resources

Sarah Scott (Mar 25, 2025 10:58 MDT)

03/25/2025

Financial Manager II
DWR

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Date:

Rick Baxter, Provo Area Manager
Utah Bureau of Reclamation
Provo, Utah

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Date:

Christopher Carlton,
Regional Forester, Forest Service
Intermountain Region Ogden, Utah